

PHYSICS

PAPER 1 2017 — 2023

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1 - (9702/11_Summer_2017_Q1) - *Physical Quantities & Units*

A student creates a table to show reasonable estimates of some physical quantities.

Which row is **not** a reasonable estimate?

	quantity	value
A	current in a fan heater	12 A
B	mass of an adult person	70 kg
C	speed of an Olympic sprint runner	10 m s^{-1}
D	water pressure at the bottom of a garden pond	10^6 Pa

2 - (9702/12_Summer_2017_Q1) - *Physical Quantities & Units*

What is the approximate average speed of a winning female Olympic athlete running a 100 m race?

- A** 6 m s^{-1} **B** 9 m s^{-1} **C** 12 m s^{-1} **D** 15 m s^{-1}

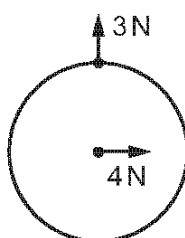
3 - (9702/13_Summer_2017_Q1) - *Physical Quantities & Units*

What is the best estimate of the kinetic energy of a family car travelling at 50 km h^{-1} ?

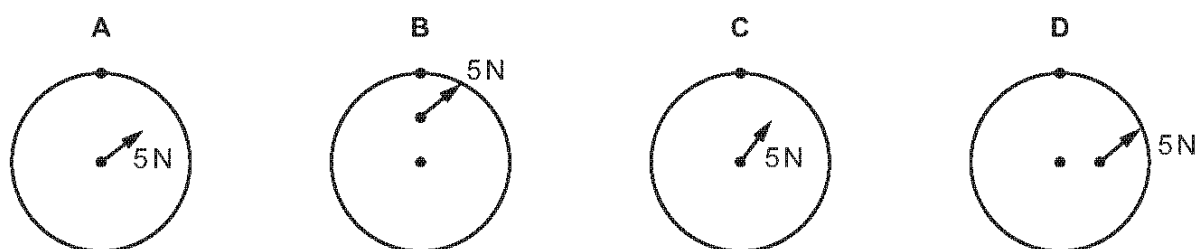
- A** $1.5 \times 10^3 \text{ J}$ **B** $1.5 \times 10^5 \text{ J}$ **C** $1.5 \times 10^7 \text{ J}$ **D** $1.5 \times 10^9 \text{ J}$

4 - (9702/12_Summer_2017_Q2) - *Physical Quantities & Units*

Two forces act on a circular disc as shown.

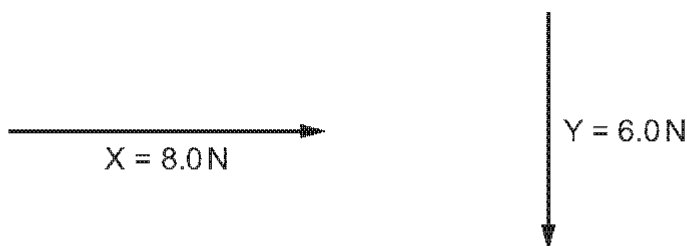


Which diagram shows the line of action of the resultant force?



5 - (9702/13_Summer_2017_Q2) - Physical Quantities & Units

The diagram shows two vectors X and Y. The vectors are perpendicular to one another.



What is the magnitude and direction of vector $(X - Y)$?

- A** 10.0 N at an angle of 37° downwards from the direction of X
- B** 10.0 N at an angle of 37° upwards from the direction of X
- C** 14.0 N at an angle of 53° downwards from the direction of X
- D** 14.0 N at an angle of 53° upwards from the direction of X

6 - (9702/11_Summer_2017_Q3) - Physical Quantities & Units

The speed v of a liquid leaving a tube depends on the change in pressure ΔP and the density ρ of the liquid. The speed is given by the equation

$$v = k \left(\frac{\Delta P}{\rho} \right)^n$$

where k is a constant that has no units.

What is the value of n ?

- A** $\frac{1}{2}$
- B** 1
- C** $\frac{3}{2}$
- D** 2

7 - (9702/12_Summer_2017_Q3) - Physical Quantities & Units

What correctly expresses the volt in terms of SI base units?

- A** $A \Omega$
- B** $W A^{-1}$
- C** $kg m^2 s^{-1} A^{-1}$
- D** $kg m^2 s^{-3} A^{-1}$



8 - (9702/13_Summer_2017_Q3) - *Physical Quantities & Units*

Which expression using SI base units is equivalent to the volt?

- A** $\text{kg m}^2 \text{s}^{-1} \text{A}^{-1}$
- B** $\text{kg m s}^{-2} \text{A}$
- C** $\text{kg m}^2 \text{s}^{-1} \text{A}$
- D** $\text{kg m}^2 \text{s}^{-3} \text{A}^{-1}$

9 - (9702/12_Summer_2017_Q13) - *Physical Quantities & Units, Forces, Density & Pressure*What are the SI base units of the quantity $\frac{\text{pressure}}{\text{density}}$?

- A** s^{-2} **B** $\text{kg}^2 \text{s}^{-2}$ **C** $\text{kg}^2 \text{m}^2 \text{s}^{-2}$ **D** $\text{m}^2 \text{s}^{-2}$

10 - (9702/12_Summer_2017_Q20) - *Physical Quantities & Units, Deformation Of Solids*

What are the units of stress, strain and the Young modulus?

	stress	strain	Young modulus
A	newton	metre	pascal
B	newton	no unit	newton
C	pascal	metre	newton
D	pascal	no unit	pascal

11 - (9702/11_Winter_2017_Q1) - *Physical Quantities & Units*Which SI unit, expressed in base units, is **not** correct?

- A** unit of force, kg m s^{-2}
- B** unit of momentum, kg m s^{-1}
- C** unit of pressure, $\text{kg m}^{-2} \text{s}^{-2}$
- D** unit of work, $\text{kg m}^2 \text{s}^{-2}$



12 - (9702/12_Winter_2017_Q1) - *Physical Quantities & Units*

Which pair of units are **not** the same when expressed in SI base units?

- A ms^{-2} and Nkg^{-1}
- B Ns and kg m s^{-1}
- C Pa and Nm^{-2}
- D Vm^{-2} and NC^{-1}

13 - (9702/13_Winter_2017_Q1) - *Physical Quantities & Units*

How many cubic nanometres, nm^3 , are in a cubic micrometre, μm^3 ?

- A 10^3
- B 10^6
- C 10^9
- D 10^{12}

14 - (9702/11_Summer_2018_Q1) - *Physical Quantities & Units, Deformation Of Solids*

What is a unit for stress?

- A $\text{kg m}^{-1} \text{s}^{-2}$
- B $\text{kg m}^{-2} \text{s}^{-2}$
- C Nm^{-1}
- D Nm

15 - (9702/12_Summer_2018_Q1) - *Physical Quantities & Units*

A sheet of gold leaf has a thickness of $0.125 \mu\text{m}$. A gold atom has a radius of 174 pm .

Approximately how many layers of atoms are there in the sheet?

- A 4
- B 7
- C 400
- D 700

16 - (9702/13_Summer_2018_Q1) - *Physical Quantities & Units*

What is the best way of describing a physical quantity?

- A a quantity with a magnitude and a direction but no unit
- B a quantity with a magnitude and a unit
- C a quantity with a magnitude but no direction
- D a quantity with a unit but no magnitude

17 - (9702/11_Summer_2018_Q2) - *Physical Quantities & Units*

Physical quantities can be classed as vectors or as scalars.

Which pair of quantities consists of two vectors?

- A kinetic energy and force
- B momentum and time
- C velocity and electric field strength
- D weight and temperature



18 - (9702/12_Summer_2018_Q2) - *Physical Quantities & Units*

The drag coefficient C_d is a number with no units. It is used to compare the drag on different cars at different speeds. C_d is given by the equation

$$C_d = \frac{2F}{v^n \rho A}$$

where F is the drag force on the car, ρ is the density of the air, A is the cross-sectional area of the car and v is the speed of the car.

What is the value of n ?

- A** 1 **B** 2 **C** 3 **D** 4

19 - (9702/13_Summer_2018_Q2) - *Physical Quantities & Units*

Which pair includes a vector quantity and a scalar quantity?

- A** displacement and acceleration
B force and kinetic energy
C power and speed
D work and potential energy

20 - (9702/12_Winter_2018_Q1) - *Physical Quantities & Units, Measurement Techniques*

A car is travelling at a speed of 20 m s^{-1} . The table contains values for the kinetic energy and the momentum of the car.

Which values are reasonable estimates?

	kinetic energy / J	momentum / kg m s^{-1}
A	3×10^5	3×10^4
B	3×10^5	5×10^6
C	2×10^7	3×10^4
D	2×10^7	5×10^6

21 - (9702/11_Winter_2018_Q2) - *Physical Quantities & Units*

When a beam of light is incident on a surface, it delivers energy to the surface. The intensity of the beam is defined as the energy delivered per unit area per unit time.

What is the unit of intensity, expressed in SI base units?

- A** $\text{kg m}^{-2} \text{s}^{-1}$ **B** $\text{kg m}^2 \text{s}^{-3}$ **C** kg s^{-2} **D** kg s^{-3}



22 - (9702/12_Winter_2018_Q2) - *Physical Quantities & Units*

What is the unit of resistance when expressed in SI base units?

- A $\text{kg m}^2 \text{s}^{-2} \text{A}^{-1}$
- B $\text{kg m}^2 \text{s}^{-3} \text{A}^{-2}$
- C $\text{kg m s}^{-2} \text{A}^{-1}$
- D $\text{kg m s}^{-3} \text{A}^{-1}$

23 - (9702/13_Winter_2018_Q2) - *Physical Quantities & Units*

Three of these quantities have the same unit.

Which quantity has a different unit?

- A $\frac{\text{energy}}{\text{distance}}$
- B force
- C power $\times$ time
- D rate of change of momentum

24 - (9702/12_Winter_2018_Q3) - *Physical Quantities & Units*

Which list contains both scalar and vector quantities?

- A acceleration, momentum, velocity, weight
- B area, current, force, work
- C distance, kinetic energy, power, pressure
- D mass, temperature, time, speed

25 - (9702/13_Winter_2018_Q3) - *Physical Quantities & Units*

Which group of quantities contains only vectors?

- A acceleration, displacement, speed
- B acceleration, work, electric field strength
- C displacement, force, velocity
- D power, electric field strength, force

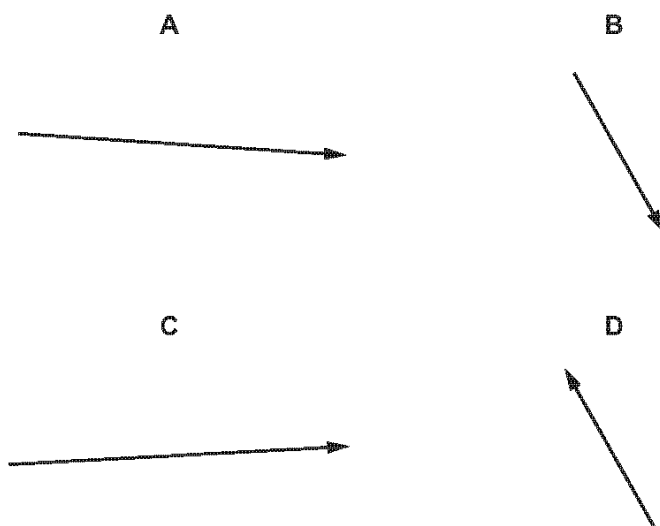


26 - (9702/12_Winter_2018_Q4) - *Physical Quantities & Units, Measurement Techniques*

Vectors P and Q are drawn to scale.



Which diagram represents the vector $(P + Q)$?



27 - (9702/11_Summer_2019_Q1) - *Physical Quantities & Units*

Which unit can be expressed in base units as $\text{kg m}^2 \text{s}^{-2}$?

- A joule
- B newton
- C pascal
- D watt

28 - (9702/12_Summer_2019_Q1) - *Physical Quantities & Units*

What is equivalent to 2000 microvolts?

- A $2 \mu\text{JC}^{-1}$
- B 2 mV
- C 2 pV
- D 2000 mV

29 - (9702/13_Summer_2019_Q1) - *Physical Quantities & Units*

Which is an SI base unit?

- A current
- B gram
- C kelvin
- D volt



30 - (9702/11_Summer_2019_Q2) - Physical Quantities & Units

The luminosity L of a star is given by

$$L = 4\pi r^2 \sigma T^4$$

where

r is the radius of the star,

T is the temperature of the star and

σ is a constant with units $\text{W m}^{-2} \text{K}^{-4}$.

What are the SI base units of L ?

- A** $\text{kg m}^2 \text{s}^{-1}$ **B** $\text{kg m}^2 \text{s}^{-2}$ **C** $\text{kg m}^2 \text{s}^{-3}$ **D** $\text{kg m}^2 \text{s}^{-4}$

31 - (9702/12_Summer_2019_Q2) - Physical Quantities & Units

What is the number of SI base units required to express electric field strength and power?

	electric field strength	power
A	3	3
B	3	2
C	4	2
D	4	3

32 - (9702/13_Summer_2019_Q2) - Physical Quantities & Units

Osmium, a naturally occurring element, has a density of $23\,000 \text{ kg m}^{-3}$.

What is also a value of the density of osmium?

- A** $2.3 \times 10^4 \mu\text{g cm}^{-3}$
B $2.3 \times 10^4 \text{ g cm}^{-3}$
C 2.3 kg cm^{-3}
D $2.3 \times 10^{-2} \text{ kg cm}^{-3}$



33 - (9702/12_Summer_2019_Q3) - *Physical Quantities & Units*

The Planck constant h has SI units Js.

Which equation could be used to calculate the Planck constant?

A $h = \frac{DE}{v}$ where D is distance, E is energy and v is velocity

B $h = \frac{v}{D}$ where v is velocity and D is distance

C $h = \frac{1}{4\pi E}$ where E is electric field strength

D $h = \frac{Fr^2}{m}$ where F is force, r is radius and m is mass

34 - (9702/11_Winter_2019_Q1) - *Physical Quantities & Units*

For which quantity is the magnitude a reasonable estimate?

A frequency of a radio wave 500 pHz

B mass of an atom 500 μg

C the Young modulus of a metal 500 kPa

D wavelength of green light 500 nm

35 - (9702/12_Winter_2019_Q1) - *Physical Quantities & Units*

A cyclist has a speed of 5 m s^{-1} and a small car has a speed of 12 m s^{-1} .

Which statement does **not** give a reasonable estimate?

A The kinetic energy of the cyclist is $1 \times 10^3 \text{ J}$.

B The kinetic energy of the car is $7 \times 10^4 \text{ J}$.

C The momentum of the cyclist is $4 \times 10^2 \text{ kg m s}^{-1}$.

D The momentum of the car is $2 \times 10^5 \text{ kg m s}^{-1}$.

36 - (9702/13_Winter_2019_Q1) - *Physical Quantities & Units*

Which quantity with its unit is correct?

A acceleration of a bicycle = 1.4 m s^{-1}

B electric current in a lamp = 0.25 A s^{-1}

C electric potential difference across a battery = 8.0 J C^{-1}

D kinetic energy of a car = 4500 N m^{-1}



37 - (9702/12_Winter_2019_Q2) - *Physical Quantities & Units*

Which expression gives an SI base quantity?

- A charge per unit time
- B force per unit area
- C mass per unit volume
- D work done per unit distance

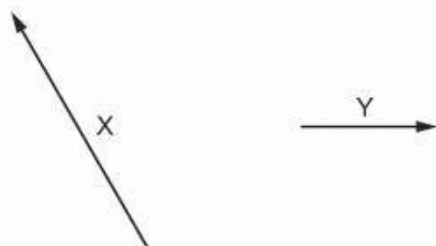
38 - (9702/13_Winter_2019_Q2) - *Physical Quantities & Units*

Which two units are **not** equivalent to each other?

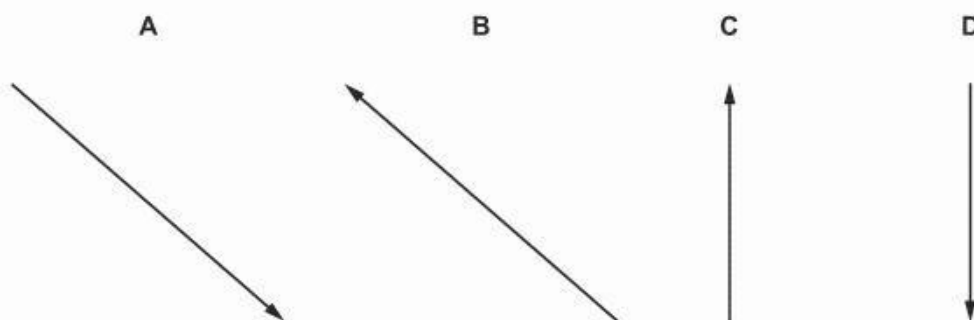
- A Nm and $\text{kg m}^2 \text{s}^{-2}$
- B Ns and kg m s^{-1}
- C Js^{-1} and $\text{kg m}^2 \text{s}^{-3}$
- D Pa and kg m s^{-2}

39 - (9702/11_Winter_2019_Q3) - *Physical Quantities & Units*

The diagram shows two vectors X and Y, drawn to scale.



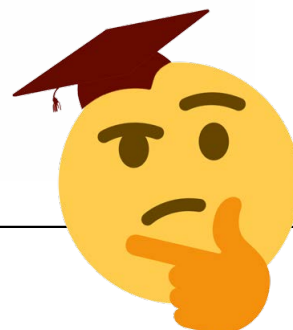
If $X = Y - Z$, which diagram best represents the vector Z?



40 - (9702/12_Winter_2019_Q3) - *Physical Quantities & Units*

Which list contains only scalar quantities?

- A area, length, displacement
- B kinetic energy, speed, power
- C potential energy, momentum, time
- D velocity, distance, temperature

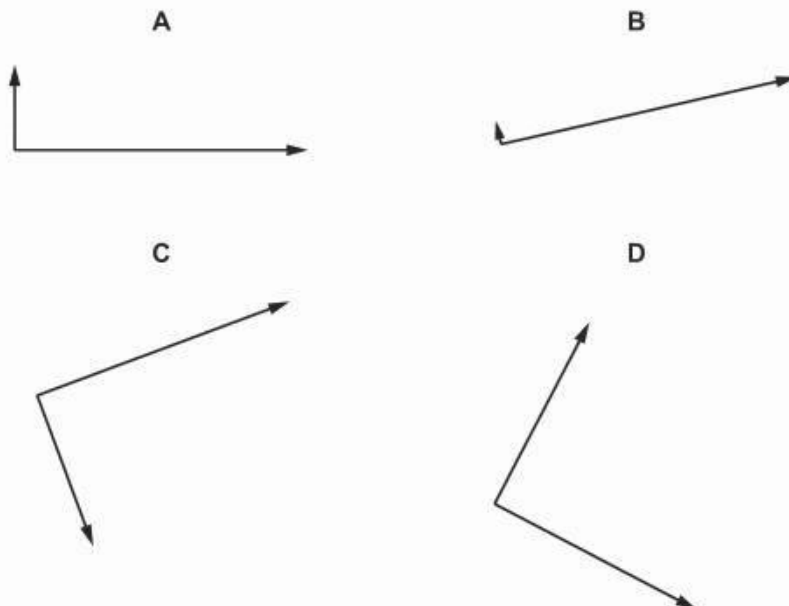


41 - (9702/13_Winter_2019_Q3) - *Physical Quantities & Units*

The arrow represents a vector R .



Which diagram does **not** represent R as two perpendicular components?



42 - (9702/11_Summer_2020_Q1) - *Physical Quantities & Units*

What is a reasonable estimate of the kinetic energy of a car travelling at a speed of 30 m s^{-1} ?

- A 10^2 J B 10^4 J C 10^6 J D 10^8 J

43 - (9702/12_Summer_2020_Q1) - *Physical Quantities & Units*

What is a reasonable estimate of the mass of a raindrop?

- A 10^1 kg B 10^{-1} kg C 10^{-3} kg D 10^{-5} kg

44 - (9702/13_Summer_2020_Q1) - *Physical Quantities & Units*

A man is running a race in a straight line.

What is an approximate value of his kinetic energy?

- A 10 J B 100 J C 1000 J D 10000 J



45 - (9702/11_Summer_2020_Q2) - Physical Quantities & Units

The frequency f of vibration of a mass m supported by a spring with spring constant k is given by the equation

$$f = Cm^p k^q$$

where C is a constant with no units.

What are the values of p and q ?

	p	q
A	$-\frac{1}{2}$	$-\frac{1}{2}$
B	$-\frac{1}{2}$	$\frac{1}{2}$
C	$\frac{1}{2}$	$-\frac{1}{2}$
D	$\frac{1}{2}$	$\frac{1}{2}$

46 - (9702/11_Summer_2020_Q3) - Physical Quantities & Units

The power produced by a force moving an object is given by the equation shown.

$$\text{power} = \frac{\text{work}}{\text{time}} = \frac{\text{force} \times \text{displacement}}{\text{time}}$$

Which quantities are scalars and which are vectors?

	scalars	vectors
A	displacement, time	force, power
B	power, work	displacement, force
C	power, force	displacement, work
D	work, time	power, displacement

47 - (9702/13_Summer_2020_Q3) - Physical Quantities & Units

Which characteristics are possessed by a vector quantity but **not** by a scalar quantity?

- A direction only
- B magnitude and direction
- C magnitude and unit
- D unit only



48 - (9702/11_Winter_2020_Q1) - *Physical Quantities & Units*

Which quantity is a physical quantity?

- A atomic number
- B efficiency
- C number density of charge carriers
- D strain

49 - (9702/12_Winter_2020_Q1) - *Physical Quantities & Units*

A student uses the volume of a metal coin in order to determine the density of the metal.

What is **not** needed in order to determine an estimate of the volume of the coin?

- A estimate of the diameter
- B estimate of the mass
- C estimate of the thickness
- D use of the formula for the volume of a cylinder

50 - (9702/13_Winter_2020_Q1) - *Physical Quantities & Units*

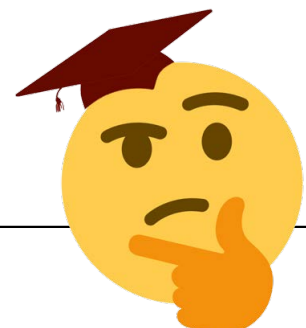
What is a reasonable estimate of the volume of a fully inflated standard football?

- A 600 cm^3
- B 6000 cm^3
- C $60\,000 \text{ cm}^3$
- D $600\,000 \text{ cm}^3$

51 - (9702/11_Winter_2020_Q2) - *Physical Quantities & Units*

Which time interval is the shortest?

- A 0.05 ms
- B 50 ns
- C $500\,000 \text{ ps}$
- D $0.5 \mu\text{s}$



52 - (9702/12_Winter_2020_Q2) - Physical Quantities & Units

The speed v of waves on a stretched wire is given by the equation

$$v = T^p \mu^q$$

where T is the tension in the wire and μ is the mass per unit length of the wire.

What are the values of p and q ?

	p	q
A	$-\frac{1}{2}$	$-\frac{1}{2}$
B	$-\frac{1}{2}$	$\frac{1}{2}$
C	$\frac{1}{2}$	$-\frac{1}{2}$
D	$\frac{1}{2}$	$\frac{1}{2}$

53 - (9702/13_Winter_2020_Q2) - Physical Quantities & Units

What is **not** an SI base unit?

- A coulomb
- B kelvin
- C kilogram
- D second

54 - (9702/12_Summer_2021_Q1) - Physical Quantities & Units

What is **not** a reasonable estimate of the physical property indicated?

- A $2 \times 10^3 \text{ W}$ for the power dissipated by the heating element of an electric kettle
- B $4 \times 10^2 \text{ m}^3$ for the volume of water in a swimming pool
- C $5 \times 10^5 \text{ N s}$ for the momentum of a lorry moving along a road
- D $6 \times 10^2 \text{ N}$ for the weight of a fully grown racehorse

55 - (9702/13_Summer_2021_Q2) - Physical Quantities & Units

What is a unit of momentum?

- A kg m s^{-2}
- B N s^{-1}
- C N s
- D kg m s^{-1}



56 - (9702/11_Winter_2021_Q1) - *Physical Quantities & Units*

What is essential when recording a measurement of a physical quantity?

- A the measurement has an SI unit
- B the measurement has a unit and a number
- C the measurement has a unit given as a base unit
- D the measurement is from an analogue scale

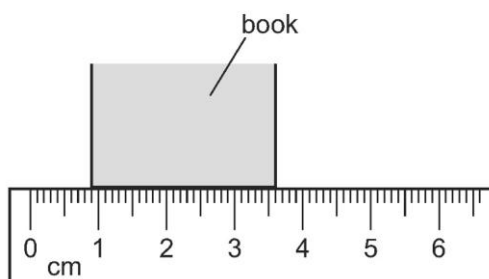
57 - (9702/12_Winter_2021_Q1) - *Physical Quantities & Units*

Which row shows what all physical quantities must have?

	magnitude	direction	unit
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✗	✓

58 - (9702/13_Winter_2021_Q1) - *Physical Quantities & Units*

A paperback book contains 210 sheets of paper (pages). Its thickness is measured with a ruler, as shown.



What is the average thickness of one sheet of the paper in the book?

- A 0.013 mm B 0.017 mm C 0.13 mm D 0.17 mm



59 - (9702/11_Winter_2021_Q2) - Physical Quantities & Units

The mobility μ of electrons travelling through a metal conductor can be calculated using the equation

$$\mu = \left(\frac{e}{m} \right) \tau$$

where e is the charge on an electron and m is its mass. The average time between the collisions of an electron with the atoms in the metal is τ .

What are the SI base units of μ ?

- A A kg^{-1} B $\text{A s}^2 \text{kg}^{-1}$ C A s kg^{-1} D $\text{A s}^{-2} \text{kg}^{-1}$

60 - (9702/12_Winter_2021_Q2) - Physical Quantities & Units

What is an alternative way of expressing an energy of 43 dJ?

- A $4.3 \times 10^3 \text{ mJ}$
B $4.3 \times 10^3 \text{ MJ}$
C $4.3 \times 10^{-3} \text{ mJ}$
D $4.3 \times 10^{-3} \text{ MJ}$

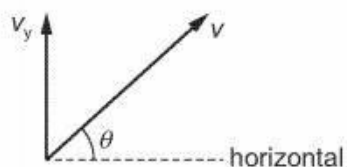
61 - (9702/13_Winter_2021_Q2) - Physical Quantities & Units

What is the unit of resistance when expressed in SI base units?

- A $\text{kg}^{-1} \text{m}^{-2} \text{s A}^2$
B $\text{kg}^{-1} \text{m}^{-2} \text{s}^3 \text{A}^2$
C $\text{kg m}^2 \text{s}^{-1} \text{A}^{-2}$
D $\text{kg m}^2 \text{s}^{-3} \text{A}^{-2}$

62 - (9702/12_Winter_2021_Q3) - Physical Quantities & Units

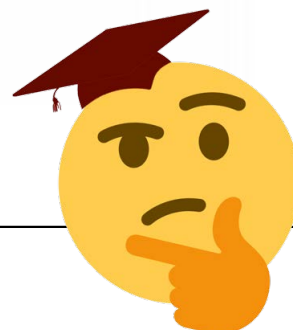
A tennis ball is hit so that it leaves the racket with velocity v at an angle θ to the horizontal.



The vertical component of the velocity is v_y .

What is the magnitude of the horizontal component of v ?

- A $v \sin \theta$ B $v_y \cos \theta$ C $v_y \sin \theta$ D $(v^2 - v_y^2)^{\frac{1}{2}}$



63 - (9702/13_Winter_2021_Q3) - *Physical Quantities & Units*

Which list consists only of scalar quantities?

- A acceleration, displacement, force, weight
- B density, energy, frequency, velocity
- C distance, pressure, temperature, time
- D momentum, power, volume, wavelength

64 - (9702/11_Summer_2022_Q1) - *Physical Quantities & Units*

Which term represents a physical quantity?

- A metre
- B percentage uncertainty
- C quark flavour
- D spring constant

65 - (9702/12_Summer_2022_Q1) - *Physical Quantities & Units*

Which estimate is reasonable?

- A 1×10^{-3} kg for the mass of a grain of sand
- B 1×10^{-2} m³ for the volume of a tennis ball
- C 1×10^0 J for the work done lifting an apple from waist height to head height
- D 1×10^4 W for the power of a light bulb in a house

66 - (9702/13_Summer_2022_Q1) - *Physical Quantities & Units*

Which pair of quantities are physical quantities?

- A charge and ampere
- B efficiency and kilogram
- C pascal and strain
- D period and potential difference

67 - (9702/11_Summer_2022_Q2) - *Physical Quantities & Units*

Which two units are identical when expressed in terms of SI base units?

- A J C⁻¹ and kg m² A⁻¹ s⁻²
- B J s and kg m² s⁻¹
- C N m and kg m³ s⁻²
- D N s and kg m s⁻³



68 - (9702/12_Summer_2022_Q2) - *Physical Quantities & Units*

What is the symbol for the SI base unit of temperature?

- A C B K C °C D °K

69 - (9702/13_Summer_2022_Q2) - *Physical Quantities & Units*

Which list of unit prefixes decreases in magnitude from left to right?

- A centi, deci, milli
B deci, milli, centi
C pico, kilo, milli
D kilo, milli, pico

70 - (9702/11_Winter_2022_Q1) - *Physical Quantities & Units*

What is needed to accurately represent all physical quantities?

- A a base unit and a number
B a unit and a number expressed in standard form (scientific notation)
C a unit and a numerical magnitude
D an SI unit and a numerical magnitude

71 - (9702/12_Winter_2022_Q1) - *Physical Quantities & Units*

Which quantity is a physical quantity?

- A flavour
B kelvin
C minute
D potential difference

72 - (9702/13_Winter_2022_Q1) - *Physical Quantities & Units*

A train of mass 600 000 kg moves with a speed of 100 km h^{-1} .

What is the order of magnitude of the kinetic energy of the train?

- A 10^6 J B 10^8 J C 10^{10} J D 10^{12} J



73 - (9702/11_Winter_2022_Q2) - Physical Quantities & Units

A voltmeter connected across a resistor in a circuit reads 3.6 V.

What could be the current in the resistor and the resistance of the resistor?

	current	resistance
A	150 mA	0.24 k Ω
B	15 mA	2.4 k Ω
C	1.5 mA	0.24 M Ω
D	15 μ A	240 k Ω

74 - (9702/12_Winter_2022_Q2) - Physical Quantities & Units

What is a power of 3.7 MW when expressed in kilowatts?

- A 3.7×10^{-3} kW
- B 3.7×10^{-3} KW
- C 3.7×10^3 kW
- D 3.7×10^3 KW

75 - (9702/13_Winter_2022_Q2) - Physical Quantities & Units

What are the SI base units of electromotive force (e.m.f.)?

- A kg m² s⁻¹ A⁻¹
- B kg m² s⁻³ A⁻¹
- C kg m² s⁻¹ A
- D kg m s⁻³ A⁻¹

76 - (9702/11_Summer_2023_Q1) - Physical Quantities & Units

Which unit is **not** an SI base unit?

- A A
- B kg
- C C
- D s

77 - (9702/12_Summer_2023_Q1) - Physical Quantities & Units

A stone sinks in water.

What is a possible value for the density of the stone?

- A 8×10^2 kg m⁻³
- B 2×10^3 kg m⁻³
- C 8×10^3 N m⁻³
- D 2×10^4 N m⁻³



78 - (9702/12_Summer_2023_Q2) - *Physical Quantities & Units*

Gm, Tm, μm and pm are all units of length.

Which unit is the largest and which unit is the smallest?

	largest unit	smallest unit
A	Gm	μm
B	Gm	pm
C	Tm	μm
D	Tm	pm

79 - (9702/13_Summer_2023_Q1) - *Physical Quantities & Units*

What **must** be included in a record of a physical quantity?

- A an integer value for the quantity
- B an SI unit
- C a numerical value for the quantity
- D a unit expressed in base units

80 - (9702/13_Summer_2023_Q2) - *Physical Quantities & Units*

What is the ohm expressed in SI base units?

- A $\text{kg m}^2 \text{s}^{-3} \text{A}^{-2}$ B $\text{kg}^{-1} \text{m}^{-2} \text{s}^3 \text{A}^2$ C $\text{J C}^{-1} \text{A}^{-1}$ D W A^{-2}

81 - (9702/11_Winter_2023_Q1) - *Physical Quantities & Units*

What is a reasonable estimate of the cross-sectional area of the wire in a paper clip?

- A $1 \times 10^{-3} \text{m}^2$ B $8 \times 10^{-5} \text{m}^2$ C $8 \times 10^{-7} \text{m}^2$ D $1 \times 10^{-9} \text{m}^2$

82 - (9702/11_Winter_2023_Q2) - *Physical Quantities & Units*

Which quantity is **not** an SI base quantity?

- A charge
- B mass
- C temperature
- D time



83 - (9702/12_Winter_2023_Q1) - *Physical Quantities & Units*

A student estimates the maximum speed of some different moving objects.

Which maximum speed is **not** a reasonable estimate?

- A container ship: 10 m s^{-1}
- B Olympic sprinter: 0.1 km s^{-1}
- C racing car: 9000 cm s^{-1}
- D snail: 0.01 km h^{-1}

84 - (9702/12_Winter_2023_Q2) - *Physical Quantities & Units*

Which quantity is an SI base quantity?

- A force
- B newton
- C second
- D time

85 - (9702/13_Winter_2023_Q1) - *Physical Quantities & Units*

What is the best estimate of the wavelength of green light?

- A 260 nm
- B 540 nm
- C 780 nm
- D 920 nm

86 - (9702/13_Winter_2023_Q2) - *Physical Quantities & Units*

In an electric circuit, an ammeter reads $2 \mu\text{A}$.

In a second circuit, the ammeter reads 1 mA.

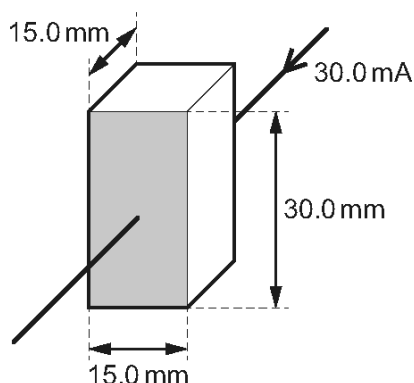
How many times larger is the current in the second circuit compared with the current in the first circuit?

- A 500
- B 5000
- C 500 000
- D 5 000 000



1 - (9702/12_Summer_2017_Q4) - *Measurement Techniques*

The current in a block of semiconductor is 30.0 mA when there is a potential difference (p.d.) of 10.0 V across it. The dimensions of the block and the direction of the current in it are as shown.



The electrical meters used are accurate to ± 0.1 mA and ± 0.1 V. The dimensions of the block are accurate to ± 0.2 mm.

What is the resistivity of the semiconductor?

- A** $10.0 \pm 0.2 \Omega \text{ m}$
- B** $10.0 \pm 0.3 \Omega \text{ m}$
- C** $10.0 \pm 0.5 \Omega \text{ m}$
- D** $10.0 \pm 0.8 \Omega \text{ m}$

2 - (9702/13_Summer_2017_Q4) - *Measurement Techniques*

A voltage is carefully measured with a high-quality instrument and found to be 2.321 V.

Two students, using two different methods, conclude that the voltage is 2.33 V and 2.344 V respectively.

Which statement is correct?

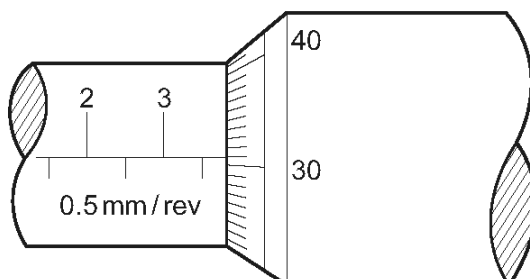
- A** 2.33 V is less accurate and less precise than 2.344 V.
- B** 2.33 V is less accurate and more precise than 2.344 V.
- C** 2.33 V is more accurate and less precise than 2.344 V.
- D** 2.33 V is more accurate and more precise than 2.344 V.



3 - (9702/12_Summer_2017_Q5) - Measurement Techniques

The diameter of a cylindrical metal rod is measured using a micrometer screw gauge.

The diagram below shows an enlargement of the scale on the micrometer screw gauge when taking the measurement.



What is the cross-sectional area of the rod?

- A** 3.81 mm^2 **B** 11.4 mm^2 **C** 22.8 mm^2 **D** 45.6 mm^2

4 - (9702/11_Summer_2017_Q9) - Measurement Techniques

A student attempts to find the density ρ of aluminium by taking measurements of a rectangular sheet.

$$\text{mass } m = 51.6 \pm 0.1 \text{ g}$$

$$\text{length } l = 100.0 \pm 0.1 \text{ cm}$$

$$\text{width } w = 10.0 \pm 0.1 \text{ cm}$$

$$\text{thickness } t = 0.20 \pm 0.01 \text{ mm}$$

He uses the equation $\rho = \frac{m}{wlt}$ to calculate the density.

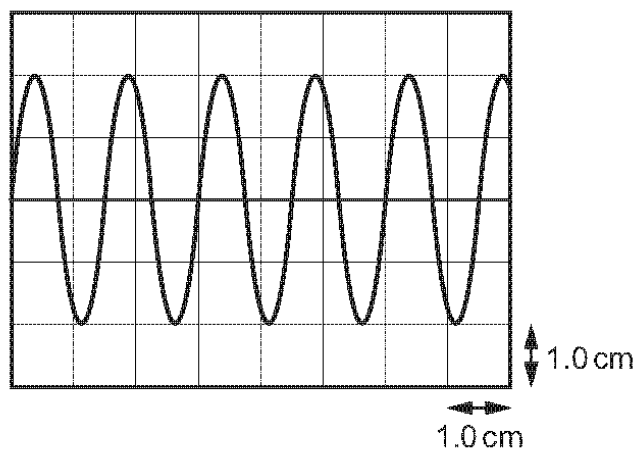
What is the calculated value of density with its uncertainty?

- A** $0.26 \pm 0.01 \text{ g cm}^{-3}$
B $0.26 \pm 0.02 \text{ g cm}^{-3}$
C $2.6 \pm 0.1 \text{ g cm}^{-3}$
D $2.6 \pm 0.2 \text{ g cm}^{-3}$



5 - (9702/13_Summer_2017_Q23) - *Measurement Techniques, Waves*

A trace is shown on the screen of a cathode-ray oscilloscope (c.r.o.).



The time-base setting is 2.5 ms cm^{-1} and the Y-gain is 2.0 V cm^{-1} .

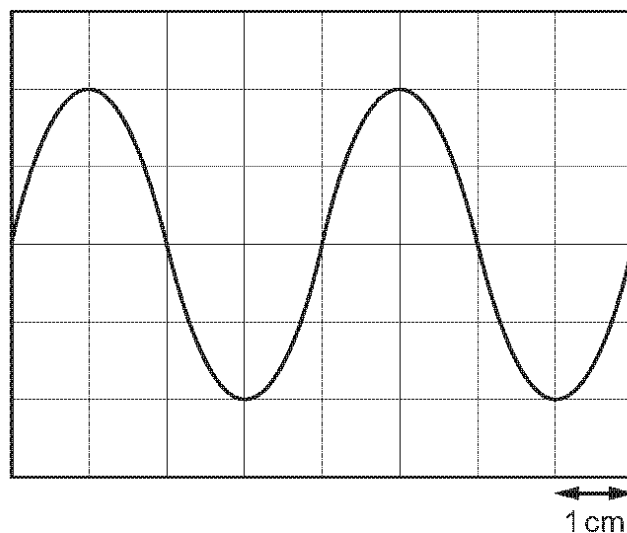
What is the frequency and the amplitude of the waveform displayed by the c.r.o.?

	frequency /Hz	amplitude /V
A	0.00375	4.0
B	0.00375	8.0
C	267	4.0
D	267	8.0



6 - (9702/11_Summer_2017_Q24) - *Measurement Techniques, Waves*

A sound wave is displayed on the screen of a cathode-ray oscilloscope (c.r.o.) as shown.



The time-base of the c.r.o. is set at 2.5 ms cm^{-1} .

What is the frequency of the sound wave?

- A** 50 Hz **B** 100 Hz **C** 200 Hz **D** 400 Hz

7 - (9702/12_Winter_2017_Q4) - *Measurement Techniques*

A quantity y is to be determined from the equation shown.

$$y = \frac{px}{q^2}$$

The percentage uncertainties in p , x and q are shown.

	percentage uncertainty
p	6%
x	2%
q	4%

What is the percentage uncertainty in y ?

- A** 0.5% **B** 0.75% **C** 12% **D** 16%



8 - (9702/13_Winter_2017_Q4) - *Measurement Techniques*

A school has a piece of aluminium that it uses for radioactivity experiments. Its thickness is marked as 3.2 mm. A student decides to check this value. He has vernier calipers which give measurements to 0.1 mm and a micrometer which gives measurements to 0.01 mm.

Which statement **must** be correct?

- A** The micrometer gives a more accurate measurement.
- B** The micrometer gives a more precise measurement.
- C** The vernier calipers give a more accurate measurement.
- D** The vernier calipers give a more precise measurement.

9 - (9702/11_Winter_2017_Q5) - *Measurement Techniques, Superposition*

A double-slit interference experiment is used to determine the wavelength of light from a monochromatic source.

The following measurements are used.

slit separation $a = 0.50 \pm 0.02$ mm

fringe separation $x = 1.7 \pm 0.1$ mm

distance between slits and screen $D = 2.000 \pm 0.002$ m

What is the percentage uncertainty in the calculated wavelength?

- A** 0.1% **B** 1% **C** 6% **D** 10%

10 - (9702/13_Winter_2017_Q5) - *Measurement Techniques*

Four possible sources of error in a series of measurements are listed.

- 1 an analogue meter whose scale is read from different angles
- 2 a meter which always measures 5% too high
- 3 a meter with a needle that is not frictionless, so the needle sometimes sticks slightly
- 4 a meter with a zero error

Which errors are random and which are systematic?

	random error	systematic error
A	1 and 2	3 and 4
B	1 and 3	2 and 4
C	2 and 4	1 and 3
D	3 and 4	1 and 2



11 - (9702/12_Summer_2018_Q3) - Measurement Techniques

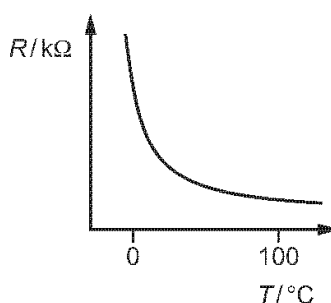
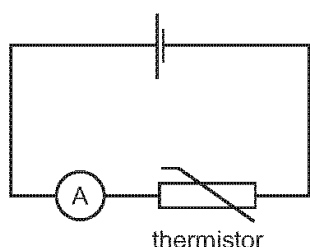
A student measures the current through a resistor and the potential difference (p.d.) across it. There is a 4% uncertainty in the current reading and a 1% uncertainty in the p.d. reading. The student calculates the resistance of the resistor.

What is the percentage uncertainty in the calculated resistance?

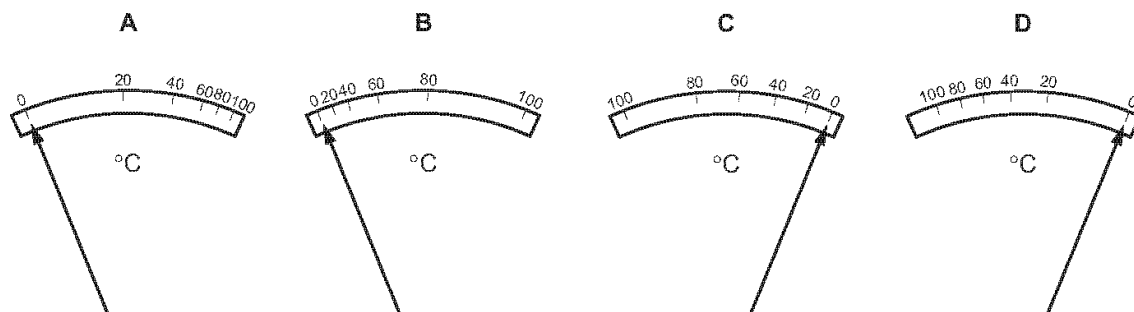
- A 0.25% B 3% C 4% D 5%

12 - (9702/11_Summer_2018_Q4) - Measurement Techniques

In the circuit shown, an analogue ammeter is to be recalibrated as a thermometer. The ammeter is connected in series with a thermistor. The thermistor is a component with a resistance that varies with temperature. The graph shows how the resistance R of the thermistor changes with temperature T .



Which diagram could represent the temperature scale on the ammeter?



13 - (9702/12_Summer_2018_Q4) - Measurement Techniques

A student applies a potential difference V of $(4.0 \pm 0.1)V$ across a resistor of resistance R of $(10.0 \pm 0.3)\Omega$ for a time t of $(50 \pm 1)s$.

The student calculates the energy E dissipated using the equation below.

$$E = \frac{V^2 t}{R} = \frac{4.0^2 \times 50}{10.0} = 80 \text{ J}$$

What is the absolute uncertainty in the calculated energy value?

- A 1.5 J B 3 J C 6 J D 8 J



14 - (9702/13_Summer_2018_Q4) - *Measurement Techniques*

What will reduce the systematic errors when taking a measurement?

- A adjusting the needle on a voltmeter so that it reads zero when there is no potential difference across it
- B measuring the diameter of a wire at different points and taking the average
- C reducing the parallax effects by using a marker and a mirror when measuring the amplitude of oscillation of a pendulum
- D timing 20 oscillations, rather than a single oscillation, when finding the period of a pendulum

15 - (9702/11_Summer_2018_Q5) - *Measurement Techniques*

The sides of a cube are measured with calipers.

The measured length of each side is (30.0 ± 0.1) mm.

The measurements are used to calculate the volume of the cube.

What is the percentage uncertainty in the calculated value of the volume?

- A 0.01% B 0.3% C 1% D 3%

16 - (9702/13_Summer_2018_Q5) - *Measurement Techniques*

In an experiment to determine the Young modulus E of the material of a wire, the measurements taken are shown.

mass hung on end of wire $m = 2.300 \pm 0.002$ kg

original length of wire $l = 2.864 \pm 0.005$ m

diameter of wire $d = 0.82 \pm 0.01$ mm

extension of wire $e = 7.6 \pm 0.2$ mm

The Young modulus is calculated using

$$E = \frac{4mgl}{\pi d^2 e}$$

where g is the acceleration of free fall.

The calculated value of E is $1.61 \times 10^{10} \text{ N m}^{-2}$.

How should the calculated value of E and its uncertainty be expressed?

- A $(1.61 \pm 0.04) \times 10^{10} \text{ N m}^{-2}$
- B $(1.61 \pm 0.05) \times 10^{10} \text{ N m}^{-2}$
- C $(1.61 \pm 0.07) \times 10^{10} \text{ N m}^{-2}$
- D $(1.61 \pm 0.09) \times 10^{10} \text{ N m}^{-2}$



17 - (9702/11_Winter_2018_Q1) - *Measurement Techniques*

The radius of the Earth is approximately 6.4×10^6 m, and the radius of the Moon is approximately 1.7×10^6 m. A student wishes to build a scale model of the Solar System in the classroom, using a football of radius 0.12 m to represent the Earth.

Which object would best represent the Moon?

- A basketball
- B cherry
- C golf ball
- D tennis ball

18 - (9702/12_Winter_2018_Q1) - *Physical Quantities & Units, Measurement Techniques*

A car is travelling at a speed of 20 m s^{-1} . The table contains values for the kinetic energy and the momentum of the car.

Which values are reasonable estimates?

	kinetic energy / J	momentum / kg m s^{-1}
A	3×10^5	3×10^4
B	3×10^5	5×10^6
C	2×10^7	3×10^4
D	2×10^7	5×10^6

19 - (9702/13_Winter_2018_Q1) - *Measurement Techniques*

Which statement is **not** a reasonable estimate?

- A Atmospheric pressure at sea level is about 1×10^5 Pa.
- B Light takes 5×10^2 s to reach us from the Sun.
- C The frequency of ultraviolet light is 3×10^{12} Hz.
- D The lifespan of a man is about 2×10^9 s.



20 - (9702/11_Winter_2018_Q4) - Measurement Techniques

A micrometer screw gauge is used to measure the diameter of a copper wire.

The reading with the wire in position is shown in diagram 1. The wire is removed and the jaws of the micrometer are closed. The new reading is shown in diagram 2.

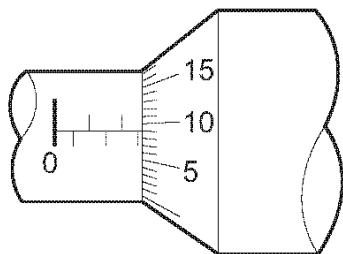


diagram 1

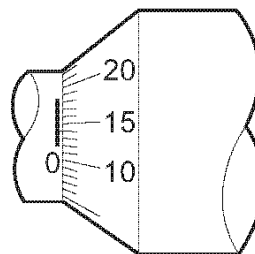


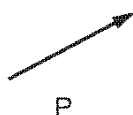
diagram 2

What is the diameter of the wire?

- A 1.90 mm B 2.45 mm C 2.59 mm D 2.73 mm

21 - (9702/12_Winter_2018_Q4) - Physical Quantities & Units, Measurement Techniques

Vectors P and Q are drawn to scale.



Which diagram represents the vector $(P + Q)$?

A



B



C



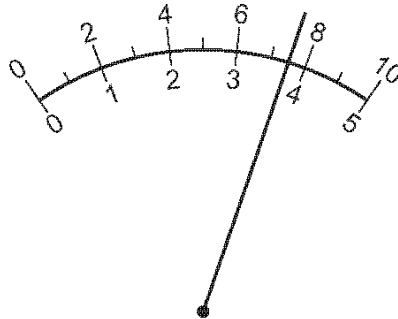
D



22 - (9702/13_Winter_2018_Q4) - *Measurement Techniques*

An ammeter is calibrated so that it shows a full-scale deflection when it measures a current of 2.0 A.

The diagram shows the display of this ammeter when it is measuring a current.



Which current is the ammeter measuring?

- A 0.75 A B 1.5 A C 3.8 A D 7.5 A

23 - (9702/11_Winter_2018_Q5) - *Measurement Techniques*

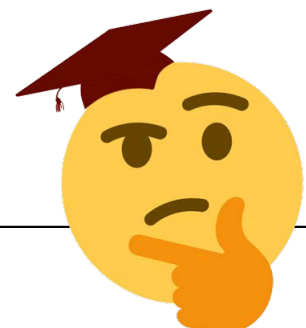
A digital meter has an accuracy of $\pm 1\%$.

The meter is used to measure the current in an electrical circuit.

The reading on the meter varies between 3.04 A and 3.08 A.

What is the value of the current, with its uncertainty?

- A $(3.06 \pm 0.02) \text{ A}$
B $(3.06 \pm 0.04) \text{ A}$
C $(3.06 \pm 0.05) \text{ A}$
D $(3.06 \pm 0.07) \text{ A}$

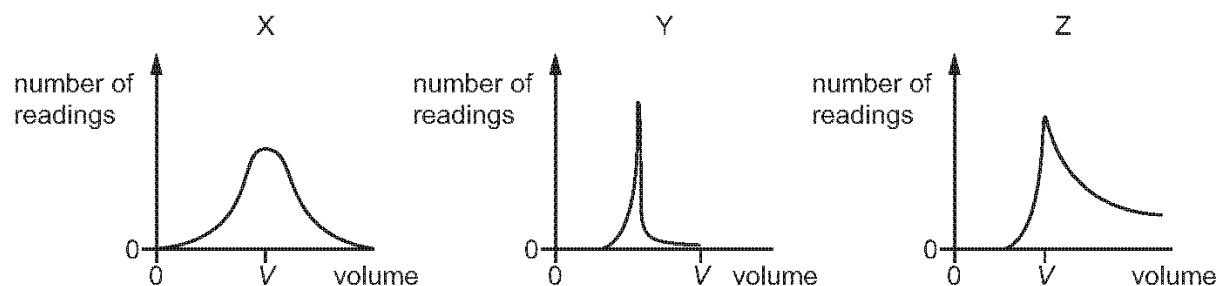


24 - (9702/12_Winter_2018_Q5) - *Measurement Techniques*

Students take readings of the volume of a liquid using three different pieces of measuring equipment X, Y and Z.

The true value of the volume of the liquid is V .

The students' results are shown.



How many pieces of equipment are precise and how many are accurate?

	number of precise pieces of equipment	number of accurate pieces of equipment
A	1	1
B	1	2
C	2	1
D	2	2

25 - (9702/13_Winter_2018_Q5) - *Measurement Techniques*

The width of a table is measured as (50.3 ± 0.1) cm. Its length is measured as (1.40 ± 0.01) m.

What is the area of the table and its absolute uncertainty?

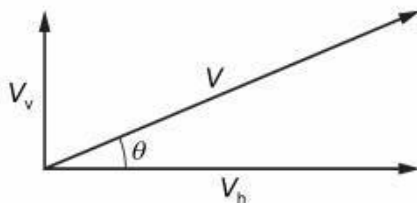
- A** $(0.7 \pm 0.1) \text{ m}^2$
- B** $(0.704 \pm 0.006) \text{ m}^2$
- C** $(0.704 \pm 0.011) \text{ m}^2$
- D** $(70.4 \pm 0.6) \text{ m}^2$



26 - (9702/11_Summer_2019_Q3) - Measurement Techniques

A particle has velocity V at an angle θ to the horizontal.

The components of the particle's velocity are V_v upwards in the vertical direction and V_h to the right in the horizontal direction, as shown.



What are expressions for the magnitude of V and for the angle θ ?

	magnitude of V	θ
A	$\sqrt{(V_v^2 + V_h^2)}$	$\tan^{-1} \left(\frac{V_h}{V_v} \right)$
B	$\sqrt{(V_v^2 + V_h^2)}$	$\tan^{-1} \left(\frac{V_v}{V_h} \right)$
C	$\sqrt{(V_v^2 - V_h^2)}$	$\tan^{-1} \left(\frac{V_h}{V_v} \right)$
D	$\sqrt{(V_v^2 - V_h^2)}$	$\tan^{-1} \left(\frac{V_v}{V_h} \right)$

27 - (9702/13_Summer_2019_Q4) - Measurement Techniques, Work, Energy & Power

What is the approximate kinetic energy of an Olympic athlete when running at maximum speed during a 100 m race?

- A** 400 J **B** 4000 J **C** 40 000 J **D** 400 000 J



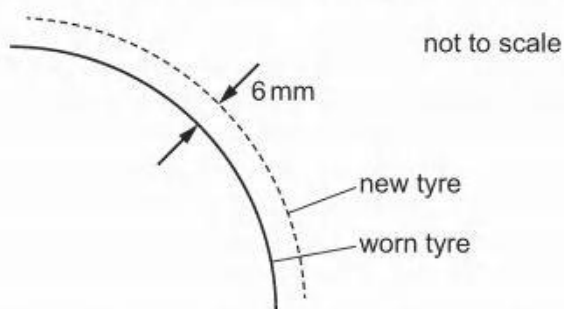
28 - (9702/11_Summer_2019_Q5) - Measurement Techniques

The speed shown on a car's speedometer is proportional to the rate of rotation of the tyres.

The variation of the diameter of a tyre as it wears introduces an error in the speed shown on the speedometer.

A car has new tyres of diameter 600 mm. The speedometer is accurately calibrated for this diameter.

The tyres wear as shown, with 6 mm of material being removed from the outer surface.



What is the error in the speed shown on the speedometer after this wear has taken place?

- A The speed shown is too high by 1%.
- B The speed shown is too high by 2%.
- C The speed shown is too low by 1%.
- D The speed shown is too low by 2%.

29 - (9702/12_Summer_2019_Q5) - Measurement Techniques

A student wishes to determine the density ρ of lead. She measures the mass and diameter of a small sphere of lead:

$$\text{mass} = (0.506 \pm 0.005) \text{ g}$$

$$\text{diameter} = (2.20 \pm 0.02) \text{ mm.}$$

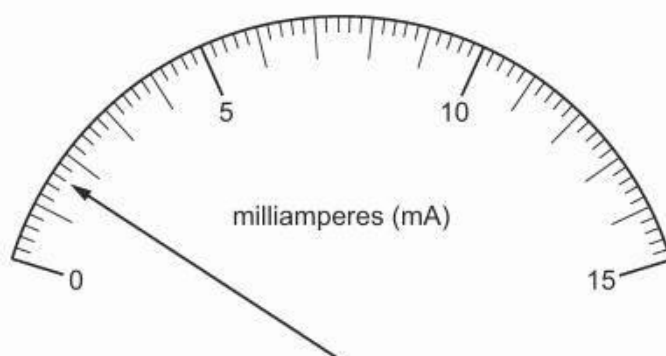
What is the best estimate of the percentage uncertainty in her calculated value of ρ ?

- A 1.7%
- B 1.9%
- C 2.8%
- D 3.7%



30 - (9702/13_Summer_2019_Q5) - Measurement Techniques

The diagram shows the reading on an analogue ammeter.



Which digital ammeter reading is the same as the reading on the analogue ammeter?

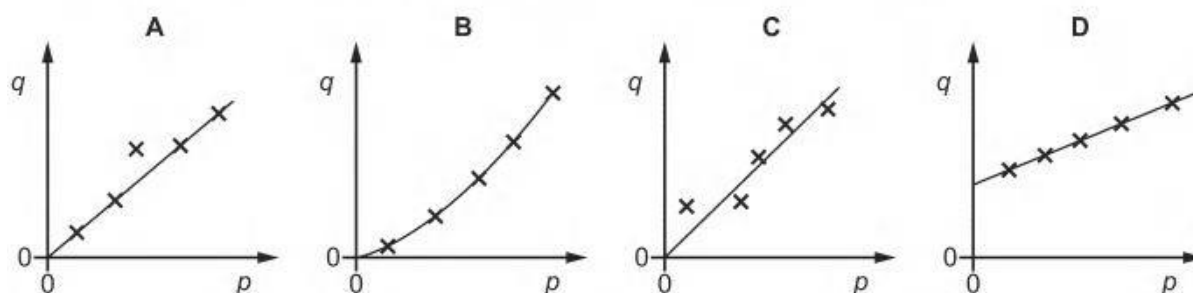
	display units	display reading
A	μA	1600
B	μA	160
C	mA	16.0
D	A	1.60

31 - (9702/12_Summer_2019_Q6) - Measurement Techniques

Two quantities p and q are directly proportional to each other.

Experimental results are taken and plotted in a graph of q against p .

Which graph shows there were random errors in the measurements of p and q ?



32 - (9702/13_Summer_2019_Q6) - Measurement Techniques

A micrometer screw gauge is used to measure the diameter of a small uniform steel sphere. The micrometer reading is $5.00 \text{ mm} \pm 0.01 \text{ mm}$.

What will be the percentage uncertainty in a calculation of the volume of the sphere, using these values?

- A 0.2% B 0.4% C 0.6% D 1.2%



33 - (9702/12_Summer_2019_Q7) - Measurement Techniques

A man of mass 75.2 kg uses a set of weighing scales to measure his mass three times. He obtains the following readings.

	mass / kg
reading 1	80.2
reading 2	80.1
reading 3	80.2

Which statement best describes the precision and accuracy of the weighing scales?

- A not precise to ± 0.1 kg and accurate to ± 0.1 kg
- B not precise to ± 0.1 kg and not accurate to ± 0.1 kg
- C precise to ± 0.1 kg and accurate to ± 0.1 kg
- D precise to ± 0.1 kg and not accurate to ± 0.1 kg

34 - (9702/11_Winter_2019_Q4) - Measurement Techniques

A student intends to measure accurately the diameter of a wire (known to be approximately 1 mm) and the internal diameter of a pipe (known to be approximately 2 cm).

What are the most appropriate instruments for the student to use to make these measurements?

	wire	pipe
A	calipers	calipers
B	calipers	micrometer
C	micrometer	calipers
D	micrometer	micrometer

35 - (9702/12_Winter_2019_Q4) - Measurement Techniques

A micrometer is used to measure the 28.50 mm width of a plastic ruler. The micrometer reads to the nearest 0.01 mm.

What is the correct way to record this reading?

- A 0.02850 ± 0.01 m
- B 0.0285 ± 0.001 m
- C $(2.850 \pm 0.001) \times 10^{-2}$ m
- D $(2.850 \pm 0.001) \times 10^{-3}$ m



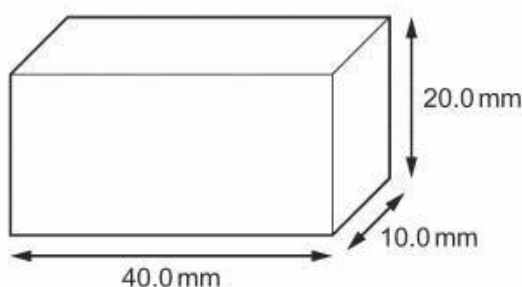
36 - (9702/13_Winter_2019_Q4) - *Measurement Techniques*

What could reduce systematic errors?

- A averaging a large number of measurements
- B careful calibration of measuring instruments
- C reducing the sample size
- D repeating measurements

37 - (9702/12_Winter_2019_Q5) - *Measurement Techniques*

The sides of a wooden block are measured with calipers. The lengths of the sides are measured as 20.0 mm, 40.0 mm and 10.0 mm.



The calipers can measure with an absolute uncertainty of ± 0.1 mm.

What is the percentage uncertainty in the calculated volume of the block?

- A 0.3%
- B 1.8%
- C 3.8%
- D 30%

38 - (9702/13_Winter_2019_Q5) - *Measurement Techniques*

The power loss P in a resistor is calculated using the formula $P = \frac{V^2}{R}$.

The percentage uncertainty in the potential difference V is 3% and the percentage uncertainty in the resistance R is 2%.

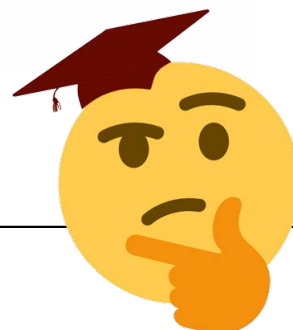
What is the percentage uncertainty in P ?

- A 4%
- B 7%
- C 8%
- D 11%

39 - (9702/12_Summer_2020_Q2) - *Measurement Techniques*

Which quantity is a scalar?

- A acceleration
- B force
- C kinetic energy
- D momentum



40 - (9702/12_Summer_2020_Q3) - Measurement Techniques

A galvanometer of resistance $5\ \Omega$ is to be used in a null method.

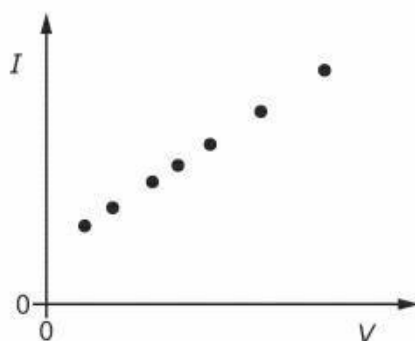
In order to protect the galvanometer from damage due to an excessive initial current, resistors of resistance $0.5\ \Omega$ and $1\ \text{k}\Omega$ are available.

Which arrangement would provide this protection?

- A the $0.5\ \Omega$ resistor in series with the galvanometer
- B the $0.5\ \Omega$ resistor in parallel with the galvanometer and this combination placed in series with the $1\ \text{k}\Omega$ resistor
- C the $1\ \text{k}\Omega$ resistor in parallel with the galvanometer
- D the $1\ \text{k}\Omega$ resistor in parallel with the galvanometer and this combination placed in series with the $0.5\ \Omega$ resistor

41 - (9702/12_Summer_2020_Q4) - Measurement Techniques

Readings are made of the current I for different voltages V across a fixed resistor. The results are plotted on a graph to show the variation of I with V .



What is the best description of the errors in the readings?

- A both systematic and random
- B neither systematic nor random
- C random only
- D systematic only



42 - (9702/13_Summer_2020_Q4) - Measurement Techniques

A circuit is set up in order to determine the resistance of a 12V, 1.2W lamp when operating normally. An analogue ammeter and an analogue voltmeter are used.

Which ranges for the meters would be most suitable?

	ammeter range /A	voltmeter range /V
A	0–0.5	0–20
B	0–0.5	0–100
C	0–10	0–20
D	0–10	0–100

43 - (9702/11_Summer_2020_Q5) - Measurement Techniques

A measurement is taken correctly but with a ruler at a significantly higher temperature than that at which the ruler was calibrated. The higher temperature causes the ruler to expand.

What describes the effect on the measurement caused by the higher temperature and how the measurement may be improved?

- A** The measurement will be subject to a random error. The measurement can be made more accurate by taking the average of several repeated measurements.
- B** The measurement will be subject to a random error. The measurement can be made more precise by taking the average of several repeated measurements.
- C** The measurement will be subject to a systematic error. The measurement can be made more accurate by taking the average of several repeated measurements.
- D** The measurement will be subject to a systematic error. The measurement can be made more precise by taking the average of several repeated measurements.

44 - (9702/13_Summer_2020_Q5) - Measurement Techniques

Two liquid-in-glass thermometers in a well-mixed liquid are individually observed by 10 different students. All agree that one thermometer reads 21 °C and the other thermometer reads 23 °C.

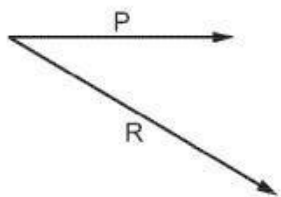
What is a possible explanation for the difference?

- A** The liquid is not all at the same temperature.
- B** The readings are not precise.
- C** There is a random error affecting the readings.
- D** There is a systematic error affecting the readings.

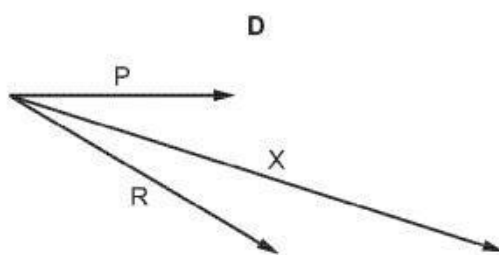
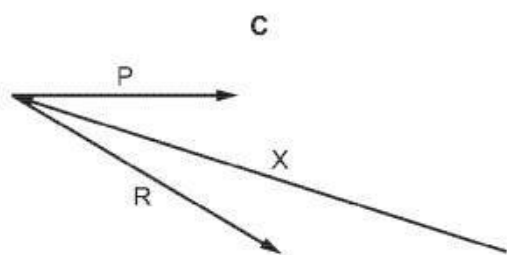
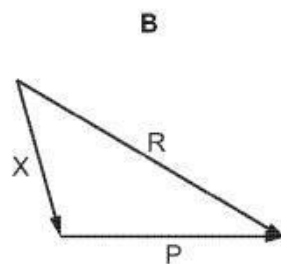
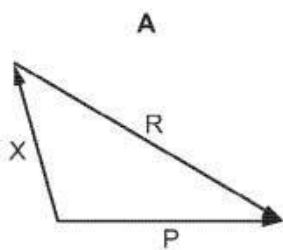


45 - (9702/11_Winter_2020_Q3) - Measurement Techniques

P and R are coplanar vectors.

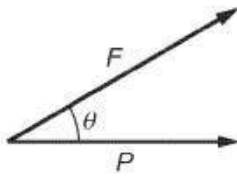


If $X = P - R$, which diagram best represents vector X?

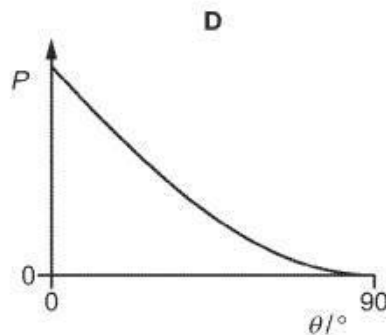
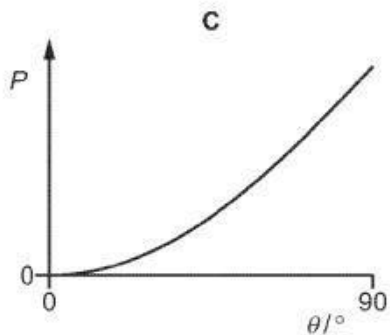
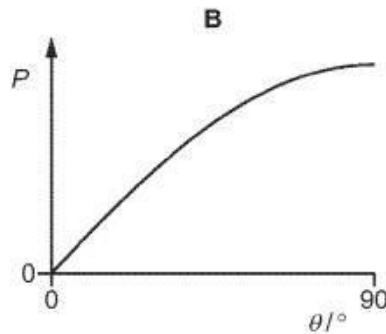
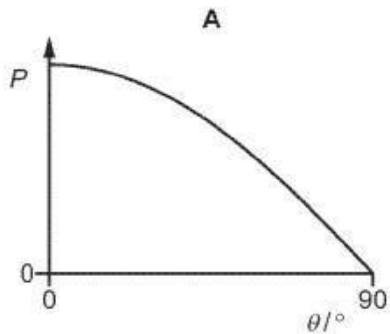


46 - (9702/12_Winter_2020_Q3) - Measurement Techniques

The diagram shows a force F . P is the horizontal component of F , at an angle θ to F .



Which graph best shows the variation with θ of the magnitude of P ?



47 - (9702/13_Winter_2020_Q3) - Measurement Techniques

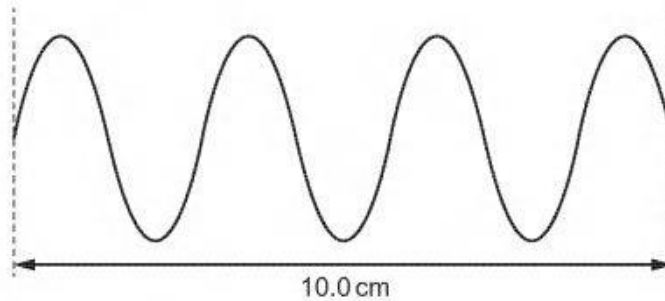
Which two quantities are both vector quantities?

- A displacement and distance
- B force and momentum
- C torque and time
- D weight and pressure



48 - (9702/11_Winter_2020_Q4) - *Measurement Techniques*

A student uses a cathode-ray oscilloscope (CRO) to measure the period of a signal. She sets the time-base of the CRO to 5 ms cm^{-1} and observes the trace illustrated below. The trace has a length of 10.0 cm.



What is the period of the signal?

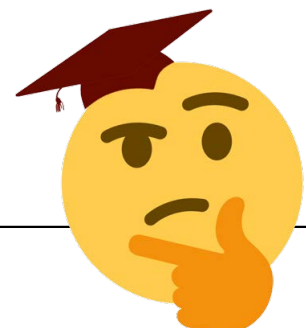
- A $7.1 \times 10^{-6}\text{ s}$ B $1.4 \times 10^{-5}\text{ s}$ C $7.1 \times 10^{-3}\text{ s}$ D $1.4 \times 10^{-2}\text{ s}$

49 - (9702/12_Winter_2020_Q4) - *Measurement Techniques*

A student wishes to measure a distance of about 10 cm to a precision of 0.01 cm.

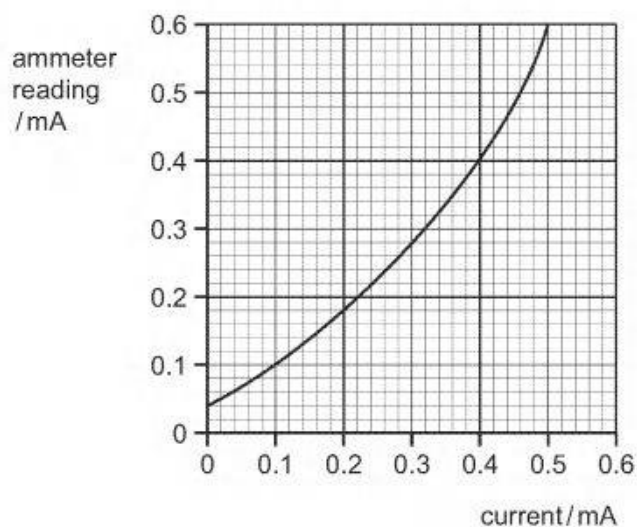
Which measuring instrument should be used?

- A metre rule
B micrometer
C tape measure
D vernier calipers



50 - (9702/13_Winter_2020_Q4) - *Measurement Techniques*

A calibration curve is shown for an ammeter whose scale is inaccurate.



Two readings taken on the meter at different times during an experiment are 0.13 mA and 0.47 mA.

By how much did the current really increase between taking the two readings?

- A 0.30 mA B 0.34 mA C 0.40 mA D 0.44 mA

51 - (9702/11_Winter_2020_Q5) - *Measurement Techniques*

The diameter of a spherical golf ball is measured with calipers and found to be (4.11 ± 0.01) cm.

The volume of a sphere is $V = \frac{1}{6}\pi d^3$, where d is the diameter of the sphere.

What is the volume of the golf ball?

- A $(36.35 \pm 0.01) \text{ cm}^3$
B $(36.35 \pm 0.03) \text{ cm}^3$
C $(36.35 \pm 0.09) \text{ cm}^3$
D $(36.4 \pm 0.3) \text{ cm}^3$



52 - (9702/12_Winter_2020_Q5) - Measurement Techniques

A steel ball is dropped and falls through a vertical height h . The time t taken to fall is measured using light gates.

The results are given in the table.

h	$(4.05 \pm 0.01) \text{ m}$
t	$(0.91 \pm 0.02) \text{ s}$

The acceleration of free fall g is calculated using the equation shown.

$$h = \frac{1}{2}gt^2$$

What is the percentage uncertainty in the value of g ?

- A 2.4% B 4.6% C 5.1% D 9.3%

53 - (9702/13_Winter_2020_Q5) - Measurement Techniques

A student measures the length l and the period T of oscillation of a simple pendulum. He then uses the equation shown to calculate the acceleration of free fall g .

$$T = 2\pi\sqrt{\frac{l}{g}}$$

His measurements are shown.

l	$(87.3 \pm 0.2) \text{ cm}$
T	$(1.9 \pm 0.05) \text{ s}$

What is the percentage uncertainty in his calculated value of g ?

- A 2.4% B 2.9% C 5.5% D 7.2%

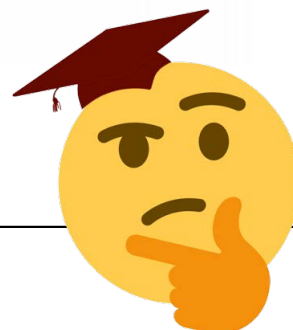
54 - (9702/12_Summer_2021_Q4) - Measurement Techniques

An analogue ammeter with a range of 0–250 mA is connected into an electrical circuit. The diagram shows the ammeter's display.



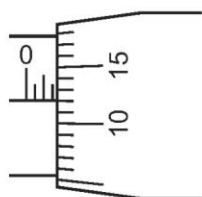
What is the reading on the ammeter?

- A 76 mA B 165 mA C 183 mA D 190 mA

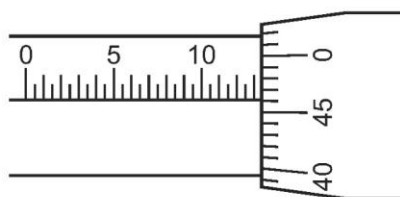


55 - (9702/13_Summer_2021_Q4) - *Measurement Techniques*

The diagram shows two readings on a micrometer.



reading 1



reading 2

What is the difference between the two readings?

- A 10.34 mm B 11.84 mm C 12.34 mm D 12.84 mm

56 - (9702/11_Summer_2021_Q5) - *Measurement Techniques*

A micrometer screw gauge is used to measure the diameter of a wire.

The reading on the micrometer with the jaws closed is (-0.05 ± 0.02) mm.

The reading with the wire in position between the two jaws is $(+1.03 \pm 0.02)$ mm.

What is the diameter of the wire?

- A (0.98 ± 0.02) mm
B (1.08 ± 0.02) mm
C (0.98 ± 0.04) mm
D (1.08 ± 0.04) mm

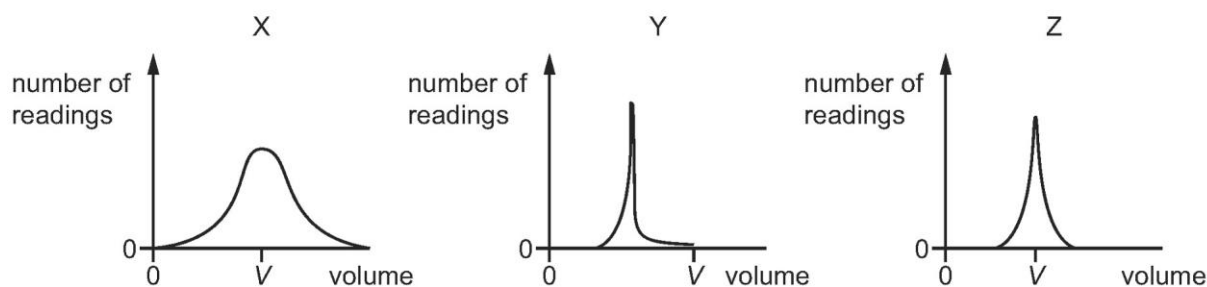


57 - (9702/12_Summer_2021_Q5) - Measurement Techniques

Students take readings of the volume of a liquid using three different pieces of measuring equipment X, Y and Z.

The true value of the volume of the liquid is V .

The students' results are shown.



How many pieces of equipment are precise and how many are accurate?

	number of precise pieces of equipment	number of accurate pieces of equipment
A	1	1
B	1	2
C	2	1
D	2	2

58 - (9702/13_Summer_2021_Q5) - Measurement Techniques

The diameter of a circular disc is measured as (7.0 ± 0.1) mm.

What is the area of the disc and the absolute uncertainty in the area?

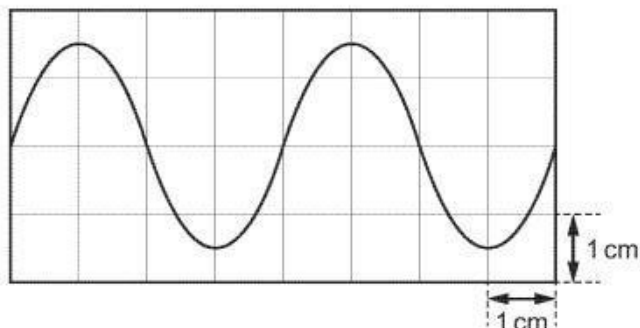
	area of disc / mm^2	absolute uncertainty / mm^2
A	38.5	± 0.5
B	38	± 1
C	154	± 2
D	154	± 4



59 - (9702/11_Winter_2021_Q4) - Measurement Techniques

A cathode-ray oscilloscope (CRO) is used to display a sound wave of frequency 2000 Hz.

The display of the CRO is shown.

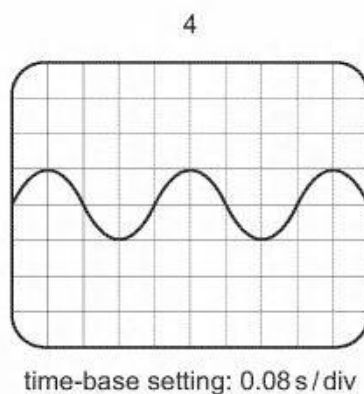
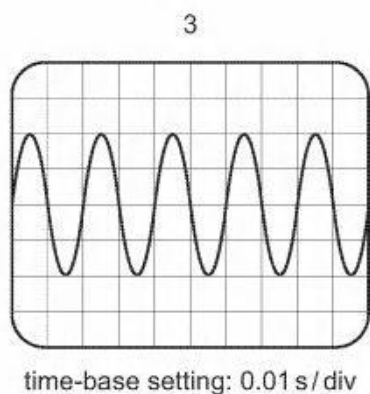
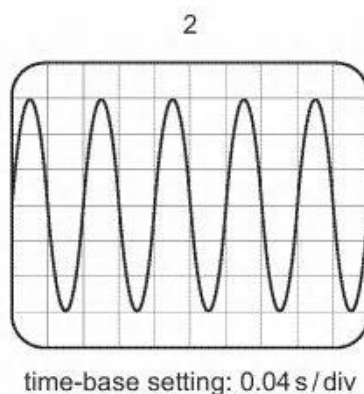
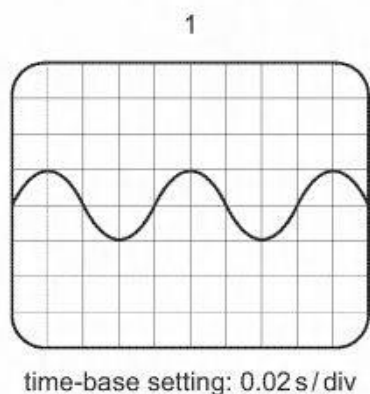


What is the time-base setting on the CRO?

- A $125 \mu\text{s cm}^{-1}$ B $250 \mu\text{s cm}^{-1}$ C $500 \mu\text{s cm}^{-1}$ D $1000 \mu\text{s cm}^{-1}$

60 - (9702/12_Winter_2021_Q4) - Measurement Techniques

Four cathode-ray oscilloscope (CRO) screens each display a waveform. The screen and the time-base setting of each CRO is shown.



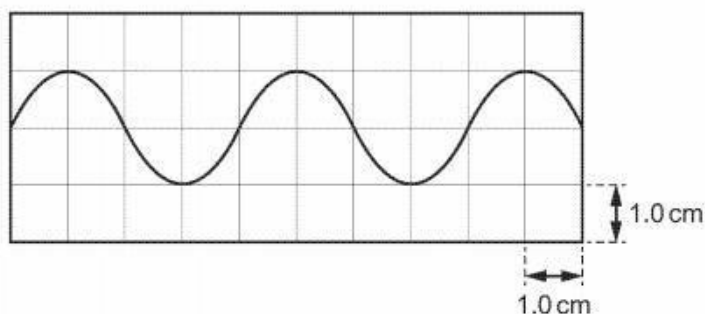
Which screens show waveforms of the same frequency?

- A 1 and 2 B 1 and 3 C 1 and 4 D 2 and 3



61 - (9702/13_Winter_2021_Q4) - Measurement Techniques

The output of a signal generator is connected to a cathode-ray oscilloscope (CRO). A trace is shown on the screen.



The time-base of the CRO is set at 2.00 ms cm^{-1} .

What is the frequency of the signal?

- A 50 Hz B 125 Hz C 250 Hz D 500 Hz

62 - (9702/11_Winter_2021_Q5) - Measurement Techniques

Four possible sources of error in a series of measurements are listed.

- 1 an analogue meter whose scale is read from different angles
- 2 a meter which always measures 5% too high
- 3 a meter with a needle that is not frictionless, so the needle sometimes sticks slightly
- 4 a meter with a zero error

Which errors are random and which are systematic?

	random error	systematic error
A	1 and 2	3 and 4
B	1 and 3	2 and 4
C	2 and 4	1 and 3
D	3 and 4	1 and 2



63 - (9702/12_Winter_2021_Q5) - *Measurement Techniques*

A student measures the time T for one complete oscillation of a pendulum of length l .

Her results are shown in the table.

l/m	T/s
0.420 ± 0.001	1.3 ± 0.1

She uses the formula

$$T = 2\pi \sqrt{\frac{l}{g}}$$

to calculate the acceleration of free fall g .

What is the best estimate of the percentage uncertainty in the value of g ?

- A 0.02% B 4% C 8% D 16%

64 - (9702/13_Winter_2021_Q5) - *Measurement Techniques*

After measuring the width of a shelf to be 305 mm, it is found that the graduations on the ruler used are 1.0% further apart than they should be.

Which type of measurement error is this and what is the true width of the shelf?

	type of error	true width / mm
A	random	302
B	random	308
C	systematic	302
D	systematic	308

65 - (9702/11_Summer_2022_Q3) - *Measurement Techniques*

A value for the acceleration of free fall on Earth is given as $(10 \pm 2) \text{ m s}^{-2}$.

Which statement is correct?

- A The value is accurate but not precise.
B The value is both precise and accurate.
C The value is neither precise nor accurate.
D The value is precise but not accurate.



66 - (9702/12_Summer_2022_Q3) - *Measurement Techniques*

Which statement about systematic errors is **not** correct?

- A A systematic error can be caused by using an incorrectly calibrated instrument.
- B One particular type of systematic error can affect all the measurements by the same amount.
- C The effect of a systematic error can be reduced by repeating and averaging the measurements.
- D Zero error is a type of systematic error.

67 - (9702/13_Summer_2022_Q3) - *Measurement Techniques*

The drag coefficient C_d is a number with no units. It is used to compare the drag on different cars at different speeds. C_d is given by the equation

$$C_d = \frac{2F}{v^n \rho A}$$

where F is the drag force on the car, ρ is the density of the air, A is the cross-sectional area of the car and v is the speed of the car.

What is the value of n ?

- A 1 B 2 C 3 D 4

68 - (9702/13_Summer_2022_Q4) - *Measurement Techniques*

A micrometer screw gauge is used to measure the diameter of a small uniform steel sphere. The measurement of the diameter is $5.00 \text{ mm} \pm 0.01 \text{ mm}$.

What is the percentage uncertainty in the calculated volume of the sphere, using these values?

- A 0.2% B 0.4% C 0.6% D 1.2%

69 - (9702/11_Winter_2022_Q3) - *Measurement Techniques*

In an experiment to determine the acceleration of free fall g , the time t taken for a ball to fall through distance s is measured. The percentage uncertainty in the measurement of s is 2%. The percentage uncertainty in the measurement of t is 3%.

The value of g is determined using the equation shown.

$$g = \frac{2s}{t^2}$$

What is the percentage uncertainty in the calculated value of g ?

- A 1% B 5% C 8% D 11%



70 - (9702/12_Winter_2022_Q3) - *Measurement Techniques*

A spring is suspended from a fixed point and a force is applied. The position of a pointer attached to the bottom of the spring against a vertical ruler is recorded.

Before the force is applied, the position of the pointer is (225 ± 2) mm.

After the force is applied, the position of the pointer is (250 ± 2) mm.

The extension of the spring is determined.

What is the percentage uncertainty in the extension?

- A 1.6% B 1.8% C 8.0% D 16%

71 - (9702/13_Winter_2022_Q3) - *Measurement Techniques*

A digital meter is used to measure the current in an electric circuit.

The reading on the meter fluctuates (varies) between 3.04 A and 3.08 A. The readings on the meter have an accuracy of $\pm 1\%$.

What is the true value of the current, with its uncertainty?

- A (3.06 ± 0.02) A
B (3.06 ± 0.04) A
C (3.06 ± 0.05) A
D (3.06 ± 0.07) A

72 - (9702/11_Winter_2022_Q4) - *Measurement Techniques*

Which quantity is a vector?

- A momentum
B speed
C temperature
D Young modulus

73 - (9702/12_Winter_2022_Q4) - *Measurement Techniques*

What is the difference between a scalar quantity and a vector quantity?

- A A scalar quantity has direction but a vector quantity does not.
B A scalar quantity has magnitude but a vector quantity does not.
C A vector quantity has direction but a scalar quantity does not.
D A vector quantity has magnitude but a scalar quantity does not.



74 - (9702/13_Winter_2022_Q4) - *Measurement Techniques*

Which quantity is a vector quantity?

- A density
- B mass
- C volume
- D weight

75 - (9702/11_Summer_2023_Q2) - *Measurement Techniques*

What is the best estimate of the number of atoms in a piece of metal of volume 50 cm^3 ?

- A 5×10^{15} B 5×10^{25} C 5×10^{29} D 5×10^{31}

76 - (9702/11_Summer_2023_Q3) - *Measurement Techniques*

A copper pipe has a true diameter of 42.03 mm.

A builder measures the diameter of the pipe five times using digital calipers. The measurements are shown.

diameter / mm
48.01
47.99
48.01
48.00
47.99

What describes the builder's measurements?

- A accurate and precise
- B accurate but not precise
- C not precise and not accurate
- D precise but not accurate



77 - (9702/12_Summer_2023_Q3) - *Measurement Techniques*

Two measurements for a solid sphere are shown.

$$\text{mass} = (32.5 \pm 0.1) \text{ g}$$

$$\text{diameter} = (1.87 \pm 0.04) \text{ cm}$$

These values are used to determine the density of the sphere.

What is the percentage uncertainty in the density?

- A 2.4% B 4.6% C 6.1% D 6.7%

78 - (9702/13_Summer_2023_Q3) - *Measurement Techniques*

A desk has a true width of 50.0 cm.

Two students, X and Y, measure the width of the desk.

Student X uses a tape measure and records a width of $(49.5 \pm 0.5) \text{ cm}$.

Student Y uses a metre rule and records a width of $(51.4 \pm 0.1) \text{ cm}$.

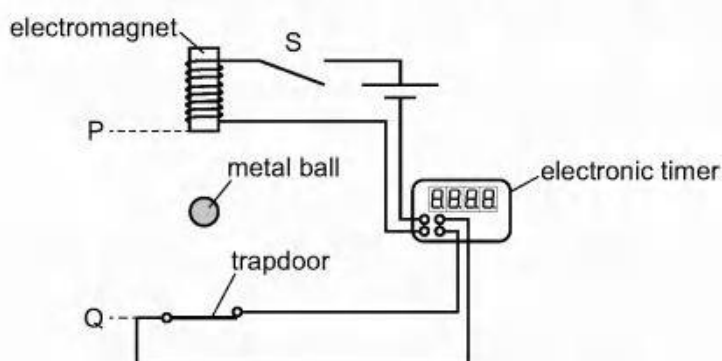
Which statement about the measurement of student X is correct?

- A It is less accurate and less precise than the measurement of student Y.
B It is less accurate but more precise than the measurement of student Y.
C It is more accurate and more precise than the measurement of student Y.
D It is more accurate but less precise than the measurement of student Y.



79 - (9702/11_Winter_2023_Q3) - Measurement Techniques

A student determines the acceleration of free fall by using a small metal ball, as shown.



When switch S is opened, the ball is released from an electromagnet and an electronic timer is started. The ball then falls vertically downwards. The timer stops when the ball hits a trapdoor. The student measures the distance PQ between the electromagnet and the trapdoor. This distance and the reading on the timer are then used to calculate the acceleration of free fall.

Which statement about errors in the experiment is correct?

- A The random error can be reduced by adding the diameter of the ball to the distance PQ.
- B The random error can be reduced by subtracting the diameter of the ball from the distance PQ.
- C The systematic error can be reduced by adding the diameter of the ball to the distance PQ.
- D The systematic error can be reduced by subtracting the diameter of the ball from the distance PQ.

80 - (9702/12_Winter_2023_Q3) - Measurement Techniques

A student takes measurements to determine the constant acceleration of a model car moving from rest in a straight line. The measured values with their absolute uncertainties are shown.

quantity	measured value	uncertainty
displacement	16.5 m	± 0.1 m
time	15.0 s	± 1.0 s

The student uses the equation $s = \frac{1}{2}at^2$ to calculate the acceleration of the car.

What is the acceleration and its absolute uncertainty?

- A $(0.11 \pm 0.01) \text{ m s}^{-2}$
- B $(0.11 \pm 0.02) \text{ m s}^{-2}$
- C $(0.15 \pm 0.01) \text{ m s}^{-2}$
- D $(0.15 \pm 0.02) \text{ m s}^{-2}$



81 - (9702/13_Winter_2023_Q3) - *Measurement Techniques*

A set of repeated measurements is made of a fixed quantity. An average of these measurements is calculated.

What is the effect of averaging on the random error and the systematic error in the measurements?

- A Random error and systematic error are both reduced.
- B Random error and systematic error are both unaffected.
- C Random error is reduced but systematic error is unaffected.
- D Random error is unaffected but systematic error is reduced.



1 - (9702/11_Summer_2017_Q2) - Kinematics

A particle travels in a straight line with speed v .

The particle slows down and changes direction. The new speed of the particle is $\frac{v}{2}$.

The new velocity has a component of $\frac{v}{4}$ in the same direction as the initial path of the particle.

Through which angle has the particle turned?

- A 27° B 30° C 45° D 60°

2 - (9702/11_Summer_2017_Q4) - Kinematics

The values of displacement, velocity and acceleration of a vehicle can be deduced from graphs representing its motion. Often the areas under these graphs, or the gradients of the graphs, are used.

What would **not** give a value for a displacement, a velocity or an acceleration?

- A area under a velocity-time graph
B gradient of a displacement-time graph
C gradient of a velocity-time graph
D gradient of an acceleration-time graph

3 - (9702/13_Summer_2017_Q5) - Kinematics

On a planet, a vertically-launched projectile takes 12.5s to return to its starting position. The projectile gains a maximum height of 170 m. The planet does not have an atmosphere.

What is the acceleration of free fall on this planet?

- A 2.2 ms^{-2} B 8.7 ms^{-2} C 27 ms^{-2} D 54 ms^{-2}

4 - (9702/11_Summer_2017_Q6) - Kinematics

A ball is kicked upwards at an angle of 45° to horizontal ground. After a short flight, the ball returns to the ground.

It may be assumed that air resistance is negligible.

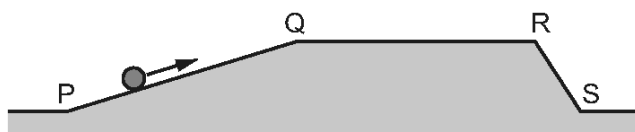
What is **never** zero during the flight of the ball?

- A the horizontal component of the ball's acceleration
B the horizontal component of the ball's velocity
C the vertical component of the ball's momentum
D the vertical component of the ball's velocity

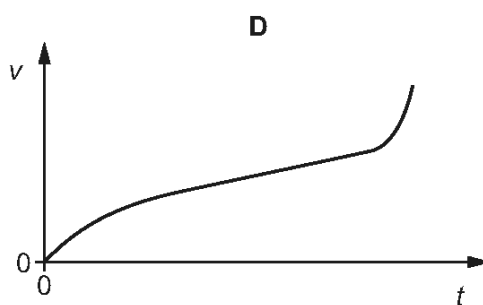
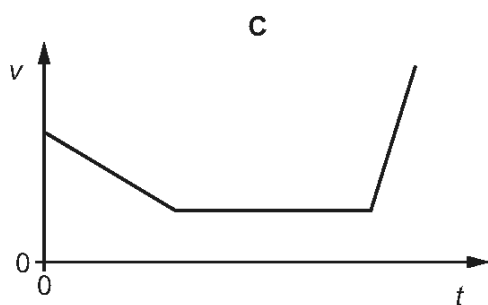
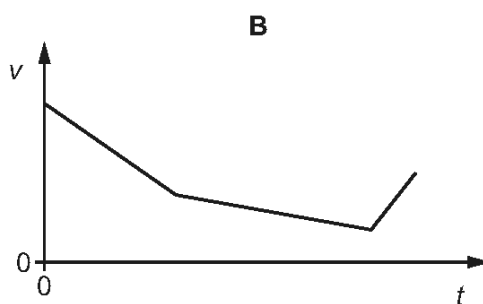
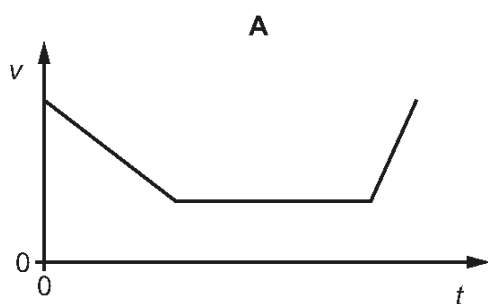


5 - (9702/12_Summer_2017_Q6) - Kinematics

A ball is set in motion at P on a frictionless surface. It moves up slope PQ, along the horizontal surface QR and finally descends slope RS.

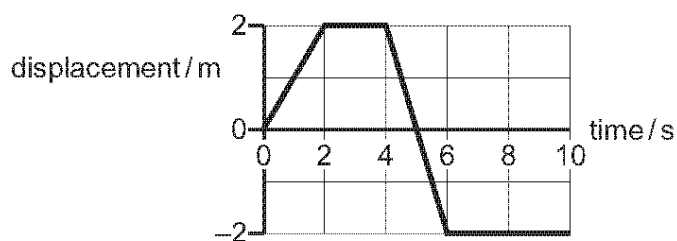


Which graph could represent the variation with time t of the ball's speed v as the ball moves from P to S?



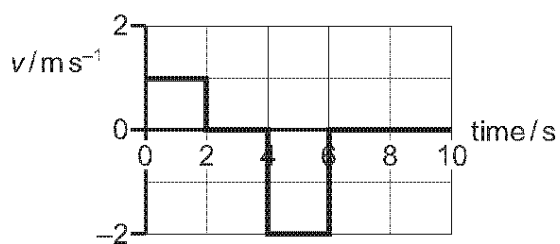
6 - (9702/13_Summer_2017_Q6) - Kinematics

A displacement-time graph for a toy car is shown.

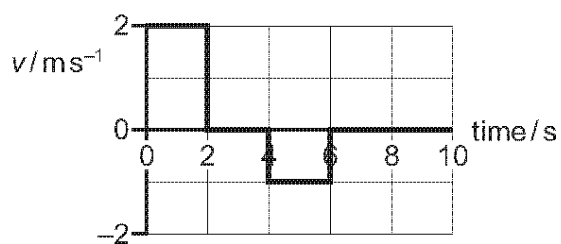


Which graph shows the variation with time of the velocity v of the car?

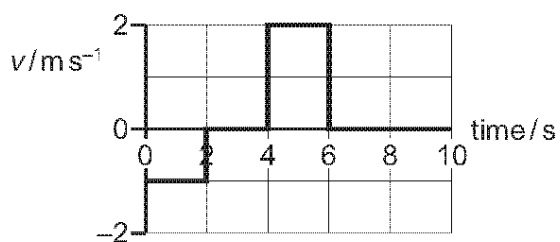
A



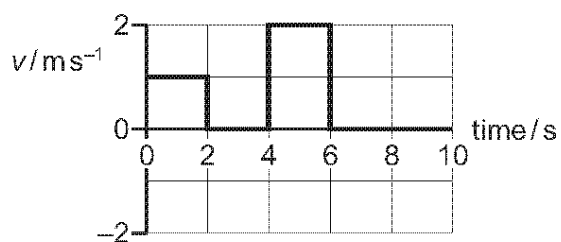
B



C

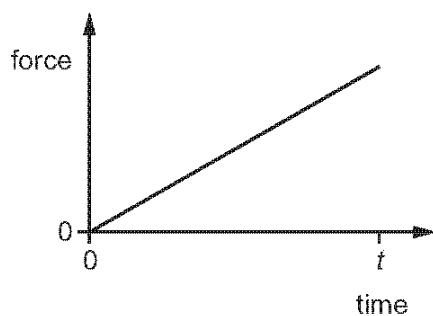


D

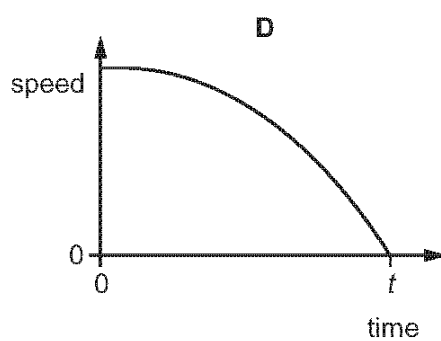
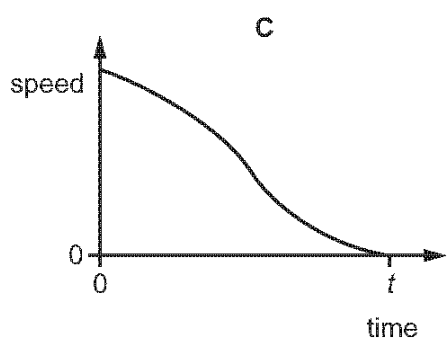
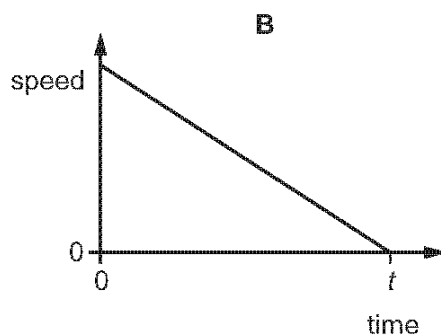
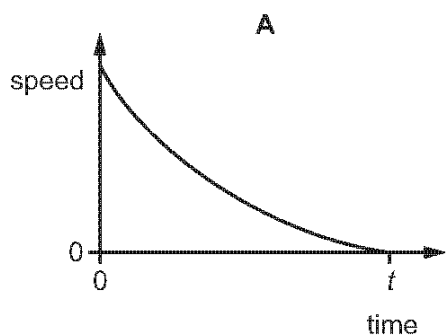


7 - (9702/13_Summer_2017_Q7) - Kinematics

A driver stops his car in time t by gradually increasing the total braking force on the car. The graph shows the resultant force on the car.



Which graph shows how the speed of the car will vary during this time?

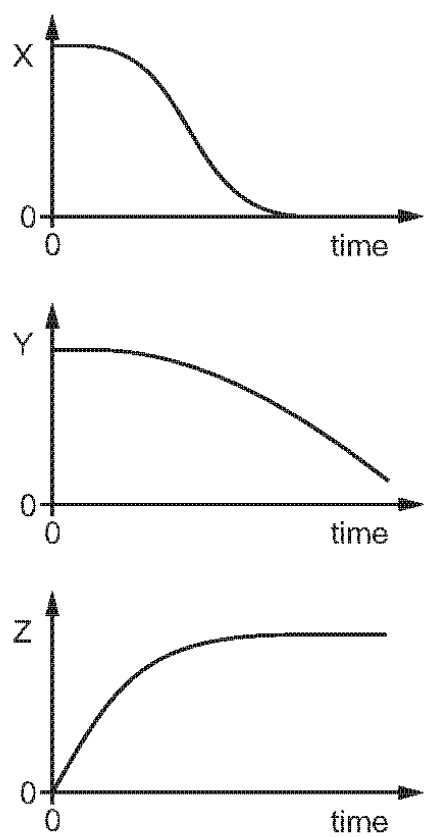


8 - (9702/11_Summer_2017_Q8) - Kinematics, Dynamics

An object is dropped at time $t = 0$ from a high building. Air resistance is significant.

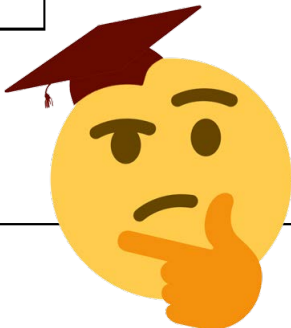
Three graphs are plotted against time.

- the height of the object above the ground
- the speed of the object
- the magnitude of the resultant force on the object



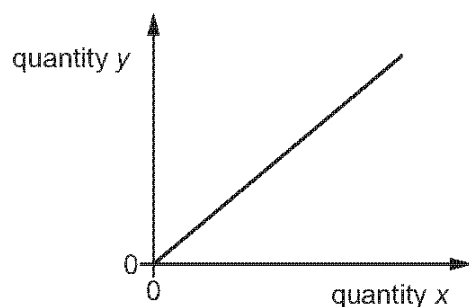
What are the quantities X, Y and Z?

	height of the object above the ground	speed of the object	magnitude of the resultant force on the object
A	X	Y	Z
B	X	Z	Y
C	Y	Z	X
D	Z	Y	X



9 - (9702/13_Summer_2017_Q8) - Kinematics, Dynamics

The graph shows the variation of a quantity y with a quantity x for a body that is falling in air at constant (terminal) velocity in a uniform gravitational field.

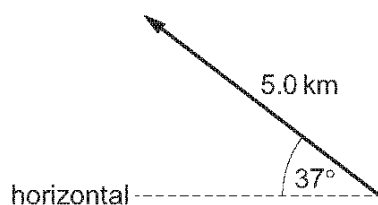


Which quantities could x and y represent?

	x	y
A	air resistance	acceleration
B	loss of height	gain in kinetic energy
C	loss of potential energy	work done against air resistance
D	time	velocity

10 - (9702/12_Winter_2017_Q2) - Kinematics, Forces, Density & Pressure

What is the vertical component of this displacement vector?



- A** 3.0 km **B** 3.8 km **C** 4.0 km **D** 5.0 km

11 - (9702/11_Winter_2017_Q6) - Kinematics

In still air, a bird can fly at a speed of 10 m s^{-1} . The wind is blowing from the east at 8.0 m s^{-1} .

In which direction must the bird fly in order to travel to a destination that is due north of the bird's current location?

- A** 37° east of north
B 37° west of north
C 53° east of north
D 53° west of north



12 - (9702/12_Winter_2017_Q6) - Kinematics

A hot-air balloon is moving vertically upwards with a constant speed of 3.00 m s^{-1} . A sandbag is dropped from the balloon. It takes 5.00 s for the sandbag to fall to the ground.

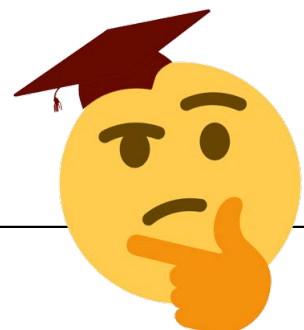
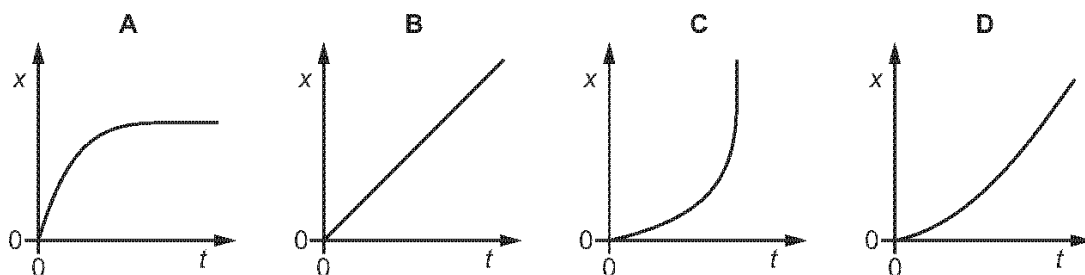
What was the height of the balloon when the sandbag was released?

- A 29 m B 108 m C 123 m D 138 m

13 - (9702/13_Winter_2017_Q6) - Kinematics

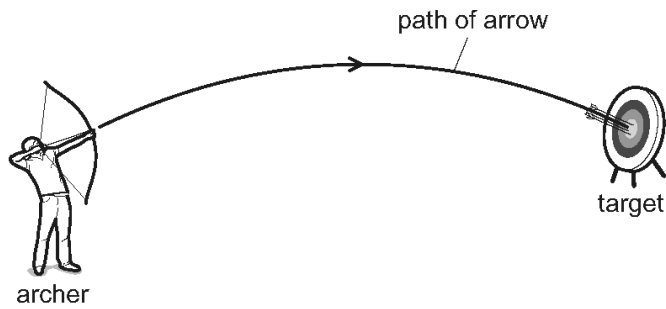
A football falls from the top of a tall building.

Which graph best represents the way in which the distance x fallen varies with time t ?



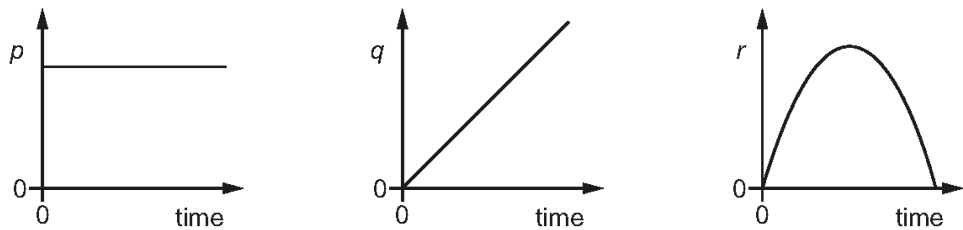
14 – (9702/11_Winter_2017_Q7) – Kinematics

An archer shoots an arrow at a target. The diagram shows the path of the arrow.



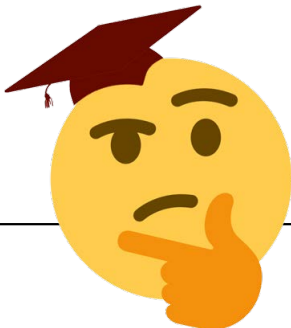
Air resistance is assumed to be negligible.

The graphs show how three different quantities p , q and r , relating to the motion of the arrow, vary with time.



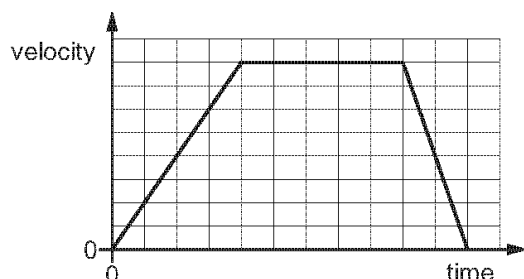
Which quantity is the horizontal component of displacement and which quantity is the vertical component of displacement of the arrow?

	horizontal component of displacement	vertical component of displacement
A	p	q
B	q	r
C	r	p
D	r	q



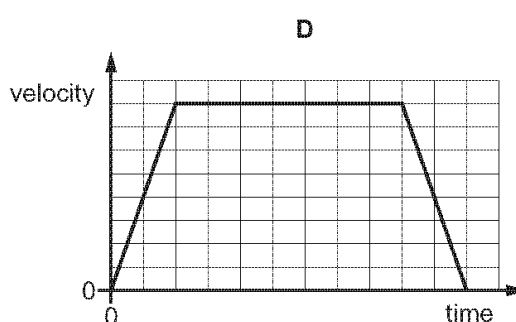
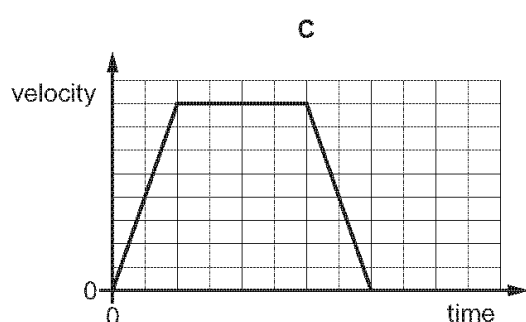
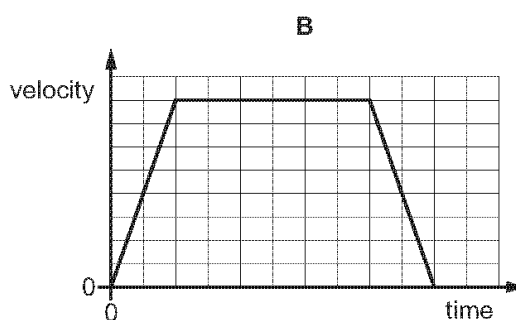
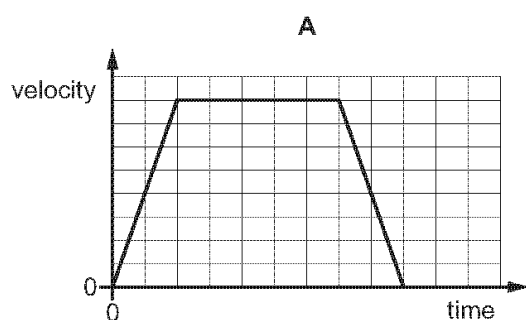
15 - (9702/12_Winter_2017_Q7) - Kinematics

The velocity-time graph for a train starting at one station and stopping at the next is shown.



Another train has double the acceleration but the same maximum speed and the same deceleration.

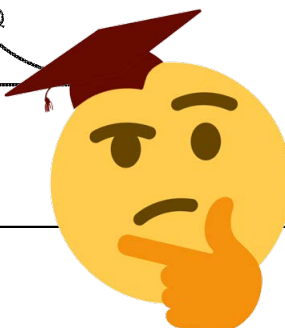
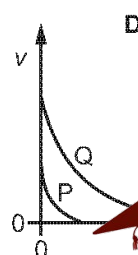
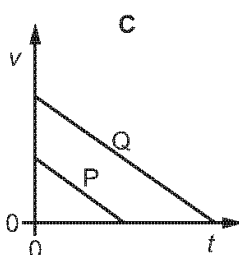
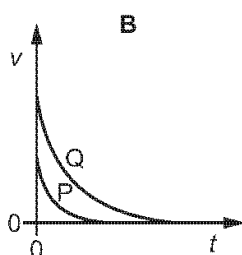
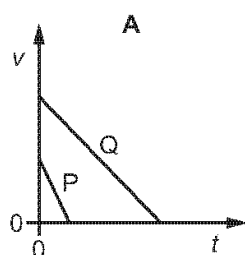
Which velocity-time graph, on the same scale, shows the motion of this train between the same stations?



16 - (9702/13_Winter_2017_Q7) - Kinematics

Two identical cars P and Q are travelling along a straight road. Car Q is travelling at twice the speed of car P. The brakes are applied to both cars, producing the same constant deceleration.

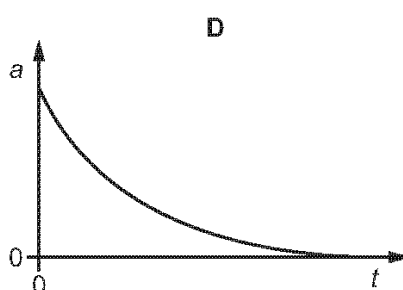
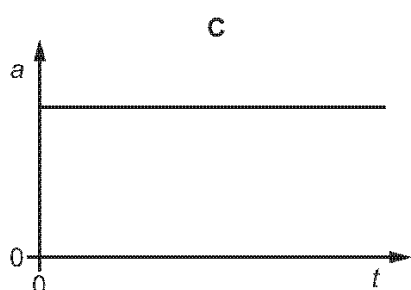
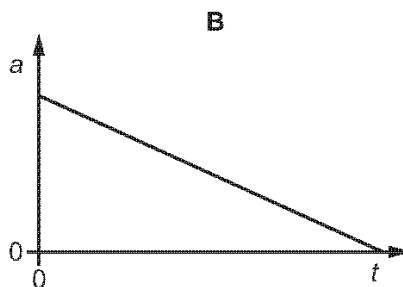
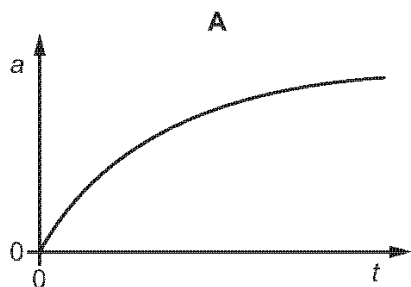
Which graph shows how the velocity v of each car varies with time t ?



17 - (9702/12_Winter_2017_Q8) - Kinematics

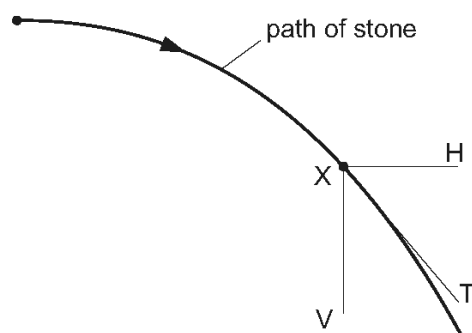
A stone is released from rest and falls a long distance in air.

Which graph could show the variation with time t of the acceleration a of the stone?



18 - (9702/13_Winter_2017_Q11) - Kinematics, Dynamics

A stone is projected horizontally in a vacuum and moves along the path shown.



X is a point on this path. XV and XH are vertical and horizontal lines respectively through X . XT is the tangent to the path at X .

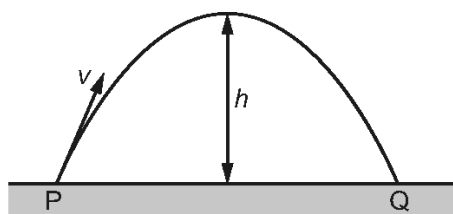
Along which directions do forces act on the stone at X ?

- A** XV and XH **B** XV only **C** XH only **D** XT only



19 - (9702/12_Winter_2017_Q16) - Kinematics

A ball of mass m is thrown up to height h in air with an initial velocity v , as shown.



Air resistance is negligible. The acceleration of free fall is g .

What is the **total** work done by the gravitational force on the ball during its flight from P to Q?

- A zero B $\frac{1}{2}mv^2$ C mgh D $2mgh$

20 - (9702/11_Winter_2017_Q18) - Kinematics

A stone is projected vertically upwards from the ground at an initial speed of 15 m s^{-1} . Air resistance is negligible.

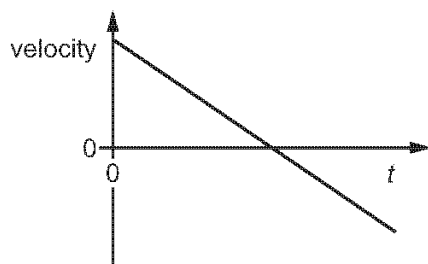
What is the maximum height reached by the stone?

- A 0.76 m B 11 m C 23 m D 110 m

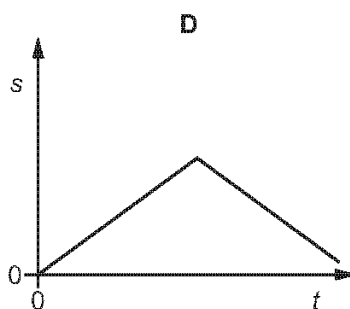
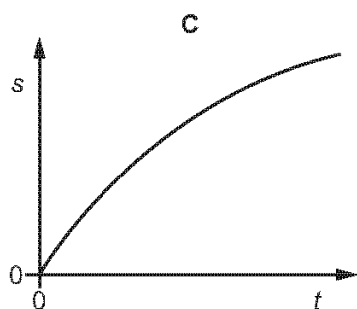
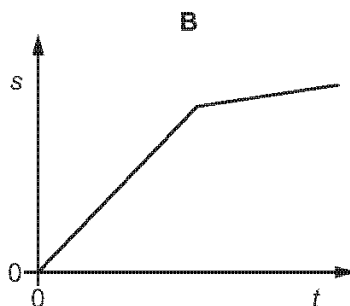
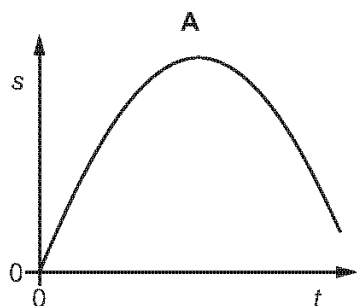


21 - (9702/12_Summer_2018_Q5) - Kinematics

The velocity of an object changes with time t as shown.



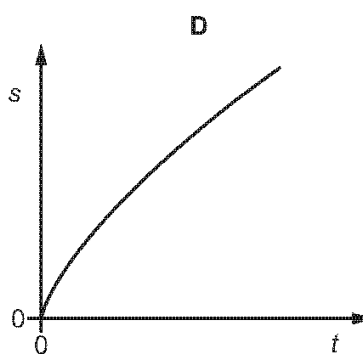
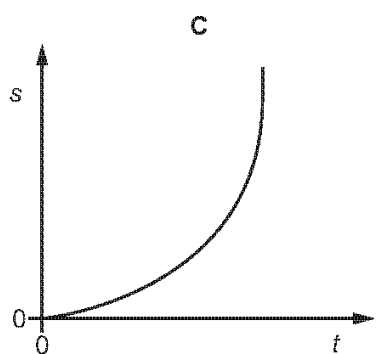
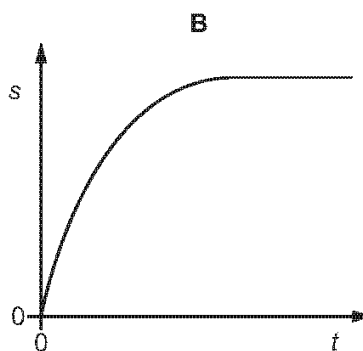
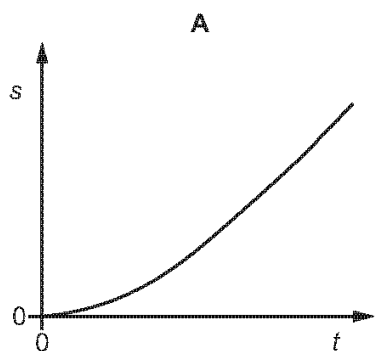
Which graph best shows the variation with time t of the displacement s of the object?



22 - (9702/11_Summer_2018_Q6) - Kinematics

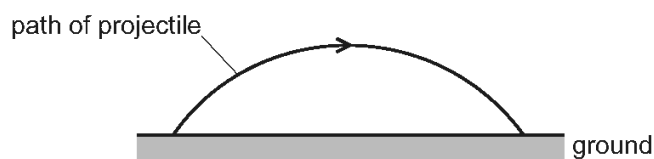
A tennis ball falls freely, in air, from the top of a tall building.

Which graph best represents the variation with time t of the distance s fallen?



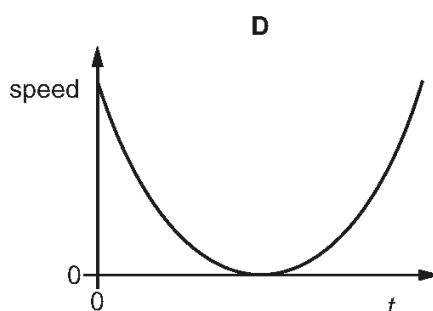
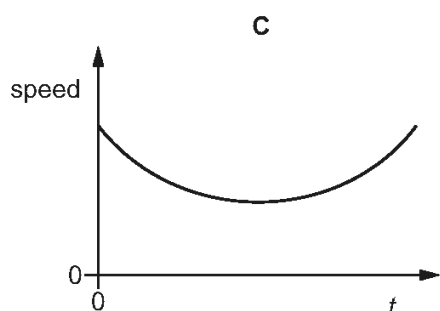
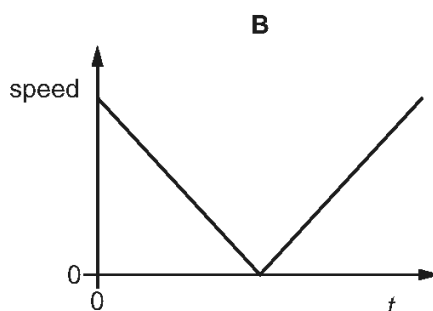
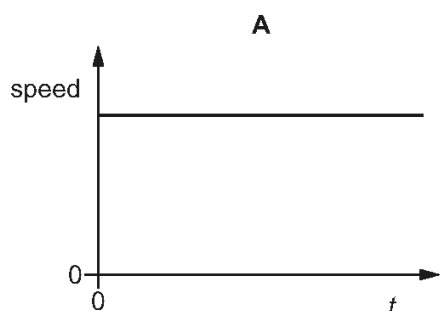
23 - (9702/12_Summer_2018_Q6) - Kinematics

A projectile is launched at an angle to the horizontal at time $t = 0$. It travels over horizontal ground, as shown.



Assume that air resistance is negligible.

Which graph best shows the variation with t of the speed of the projectile from when it is launched to when it lands on the ground?



24 - (9702/13_Summer_2018_Q6) - Kinematics

A rock on the surface of Mars is projected vertically upwards with an initial speed of 9.4 ms^{-1} . The rock rises to a height of 12 m above the surface.

Assume there is no atmosphere on Mars.

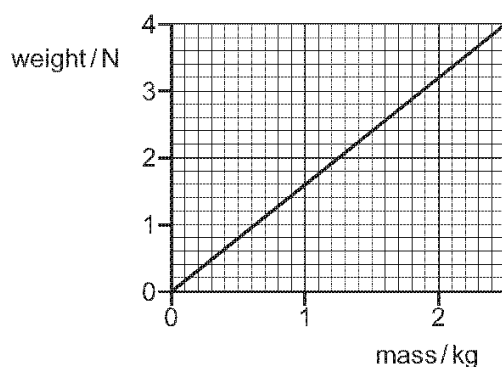
What is the acceleration of free fall near the surface of Mars?

- A** 0.39 ms^{-2} **B** 3.7 ms^{-2} **C** 7.4 ms^{-2} **D** 9.8 ms^{-2}



25 - (9702/11_Summer_2018_Q7) - Kinematics

The graph shows the variation with mass of the weight of objects on a particular planet.

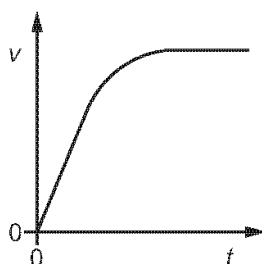


What is the value of the acceleration of free fall on the planet?

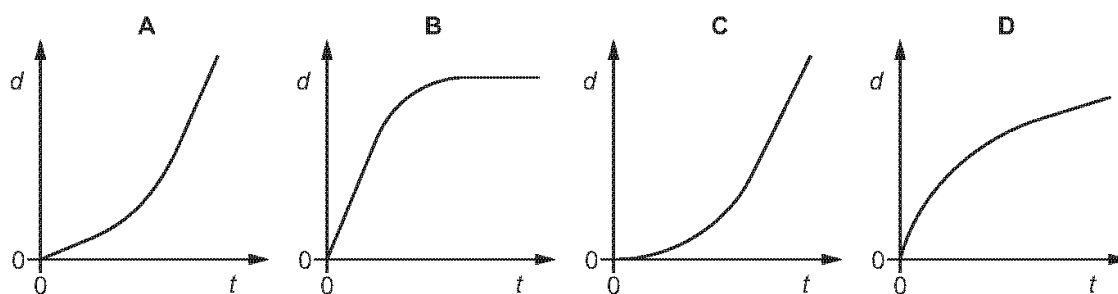
- A 0.63 ms^{-2} B 1.6 ms^{-2} C 3.2 ms^{-2} D 9.8 ms^{-2}

26 - (9702/12_Summer_2018_Q7) - Kinematics

A sky-diver falls vertically from a helicopter and reaches constant (terminal) velocity. The graph shows the variation with time t of the speed v of the sky-diver.



Which graph shows the variation with time t of the distance d fallen by the sky-diver?



27 - (9702/11_Summer_2018_Q8) - Kinematics, Work, Energy & Power

The momentum of a car of mass m increases from p_1 to p_2 .

What is the increase in the kinetic energy of the car?

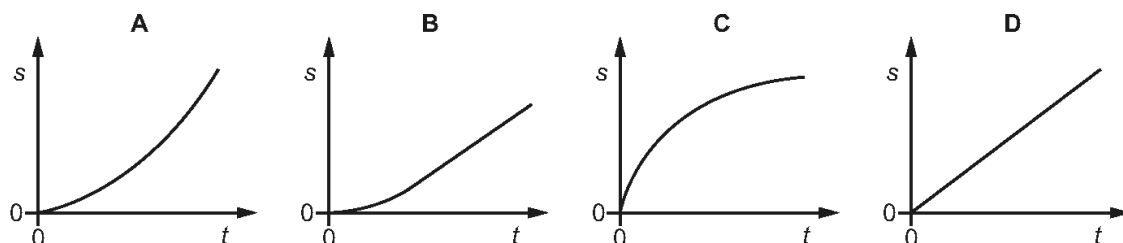
- A $\frac{(p_2^2 - p_1^2)}{2m}$ B $\frac{(p_2 - p_1)^2}{2m}$ C $\frac{p_2 - p_1}{2m}$ D $\frac{p_1 - p_2}{2m}$



28 - (9702/13_Summer_2018_Q8) - Kinematics

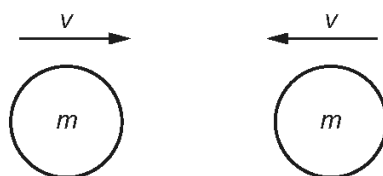
A sky-diver falls from a stationary balloon at time $t = 0$. As the sky-diver falls, her speed and the air resistance increase until the force of the air resistance is equal to her weight.

Which graph best shows the variation with time t of the displacement s for the motion of the sky-diver?



29 - (9702/11_Summer_2018_Q9) - Kinematics

Two similar spheres, each of mass m and travelling with speed v , are moving towards each other.



The spheres have a head-on elastic collision.

Which statement is correct?

- A The spheres stick together on impact.
- B The total kinetic energy after impact is mv^2 .
- C The total kinetic energy before impact is zero.
- D The total momentum before impact is $2mv$.

30 - (9702/12_Summer_2018_Q9) - Kinematics, Work, Energy & Power

An elastic collision occurs between two bodies X and Y. The mass of body X is m and the mass of body Y is $4m$. Body X travels at speed v before the collision and speed $\frac{3v}{5}$ in the opposite direction after the collision. Body Y is stationary before the collision.



What is the kinetic energy of body Y after the collision?

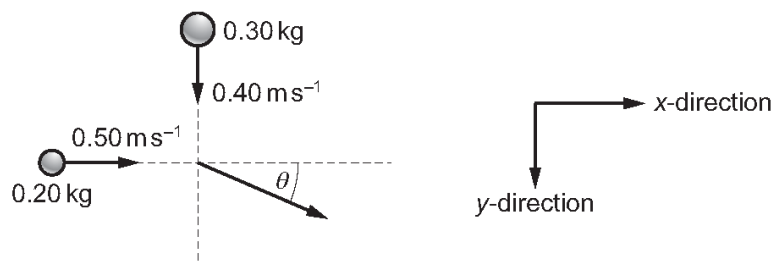
- A $\frac{8}{10}mv^2$
- B $\frac{34}{50}mv^2$
- C $\frac{16}{50}mv^2$
- D $\frac{1}{5}mv^2$



31 - (9702/13_Summer_2018_Q9) - Kinematics

A ball of mass 0.20 kg , travelling in the x -direction at a speed of 0.50 m s^{-1} , collides with a ball of mass 0.30 kg travelling in the y -direction at a speed of 0.40 m s^{-1} .

The two balls stick together after the collision, travelling at an angle θ to the x -direction.

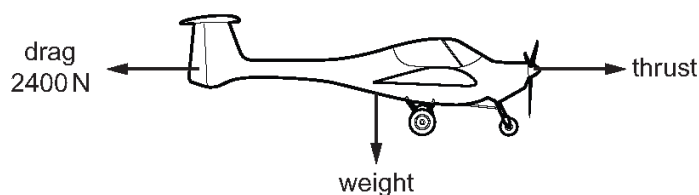


What is the value of θ ?

- A 39° B 40° C 50° D 51°

32 - (9702/11_Summer_2018_Q16) - Kinematics, Work, Energy & Power

An aircraft travels at a constant velocity of 90 m s^{-1} in horizontal flight. The diagram shows some of the forces acting on the aircraft.



The mass of the aircraft is 2000 kg .

What is the power produced by the thrust force?

- A $1.8 \times 10^5\text{ W}$ B $2.2 \times 10^5\text{ W}$ C $1.8 \times 10^6\text{ W}$ D $2.0 \times 10^6\text{ W}$

33 - (9702/11_Winter_2018_Q3) - Kinematics

A ship is travelling with a velocity of 8.0 km h^{-1} in a direction 30° east of north.

What are the components of the ship's velocity in the east and north directions?

	component of velocity in east direction $/\text{ km h}^{-1}$	component of velocity in north direction $/\text{ km h}^{-1}$
A	4.0	4.0
B	4.0	6.9
C	4.6	6.9
D	6.9	4.0



34 - (9702/11_Winter_2018_Q6) - Kinematics

A tennis ball is thrown horizontally in air from the top of a tall building.

The effect of air resistance is **not** negligible.

What happens to the horizontal and to the vertical components of the ball's velocity?

	horizontal component of velocity	vertical component of velocity
A	constant	constant
B	constant	increases at a constant rate
C	decreases to zero	increases at a constant rate
D	decreases to zero	increases to a maximum value

35 - (9702/12_Winter_2018_Q6) - Kinematics

A sprinter runs a 100 m race. The sprinter has a constant acceleration from rest of 2.5 m s^{-2} until reaching a speed of 10 m s^{-1} . The speed then remains constant until the end of the race.

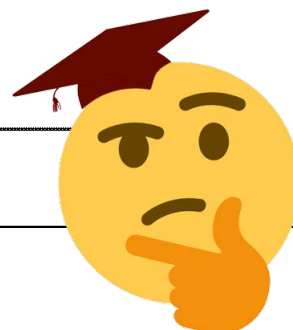
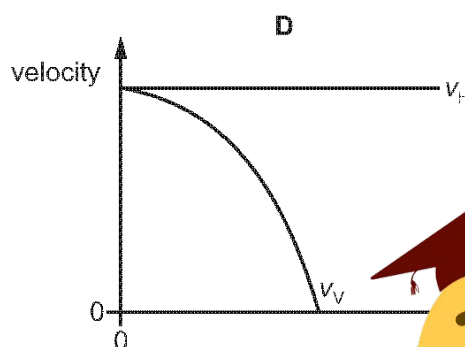
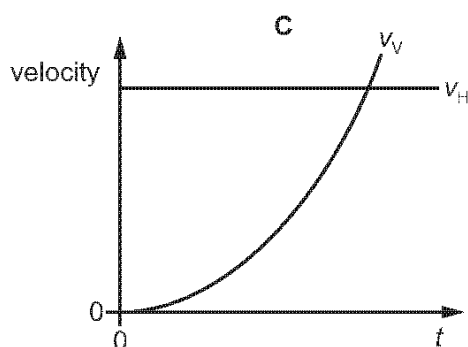
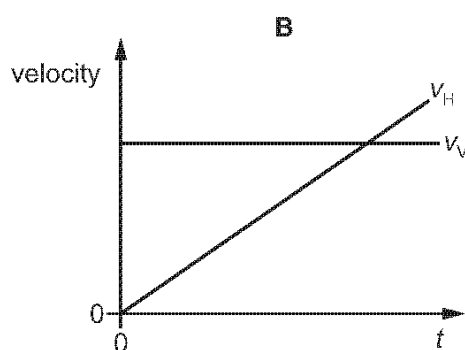
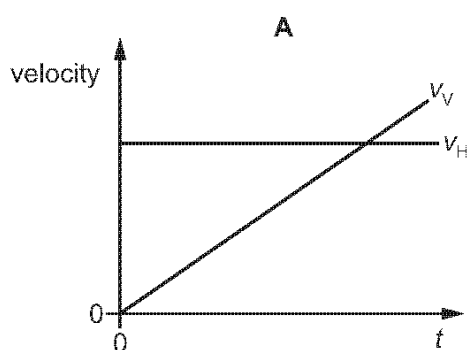
Which time does it take the sprinter to run the race?

A 8.9 s **B** 10 s **C** 12 s **D** 14 s

36 - (9702/13_Winter_2018_Q6) - Kinematics

A stone is projected horizontally at time $t = 0$ and falls. Air resistance is negligible. The stone has a horizontal component of velocity v_H and a vertical component of velocity v_V .

Which graph shows how v_H and v_V vary with time t ?



37 - (9702/13_Winter_2018_Q7) - Kinematics

Two isolated spheres have masses 2.0 kg and 4.0 kg. The spheres collide and then move apart.

During the collision, the 2.0 kg mass has an average acceleration of 8.0 m s^{-2} .

What is the average acceleration of the 4.0 kg mass?

- A** 2.0 m s^{-2} **B** 4.0 m s^{-2} **C** 8.0 m s^{-2} **D** 16 m s^{-2}

38 - (9702/11_Winter_2018_Q8) - Kinematics

A ball of mass m is thrown vertically into the air. When the ball has speed v , the air resistance acting on the ball is F .

What is the magnitude of the acceleration of the ball when its speed is v as it rises and as it falls?

	acceleration when ball is rising	acceleration when ball is falling
A	$g - \frac{F}{m}$	$g - \frac{F}{m}$
B	$g - \frac{F}{m}$	$g + \frac{F}{m}$
C	$g + \frac{F}{m}$	$g - \frac{F}{m}$
D	$g + \frac{F}{m}$	$g + \frac{F}{m}$

39 - (9702/13_Winter_2018_Q8) - Kinematics

A mass is placed on a frictionless slope inclined at 30° to the horizontal. The mass is then released.

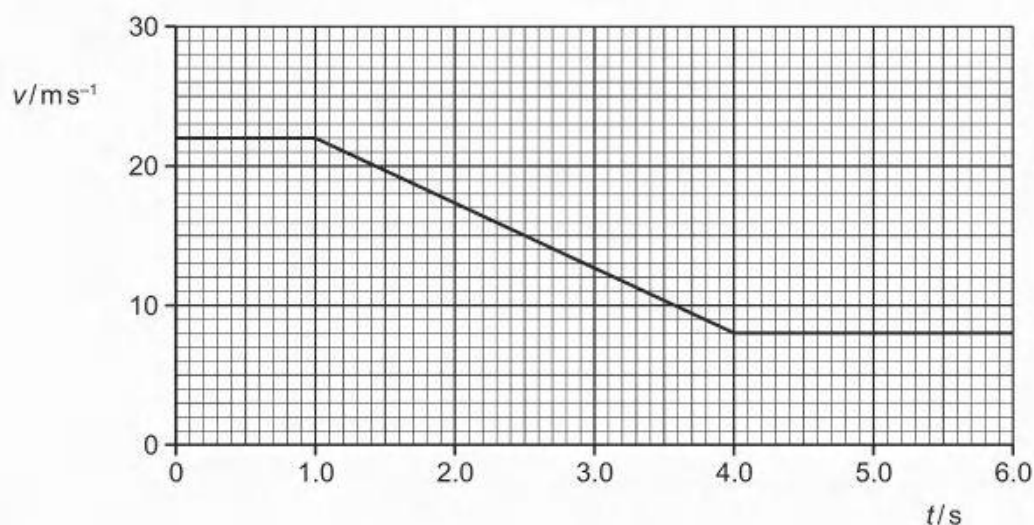
What is its acceleration down the slope?

- A** 4.9 m s^{-2} **B** 5.7 m s^{-2} **C** 8.5 m s^{-2} **D** 9.8 m s^{-2}



40 - (9702/11_Summer_2019_Q6) - Kinematics

A car travels along a straight horizontal road. The graph shows the variation of the velocity v of the car with time t for 6.0 s of its journey.



The brakes of the car are applied from $t = 1.0$ s to $t = 4.0$ s.

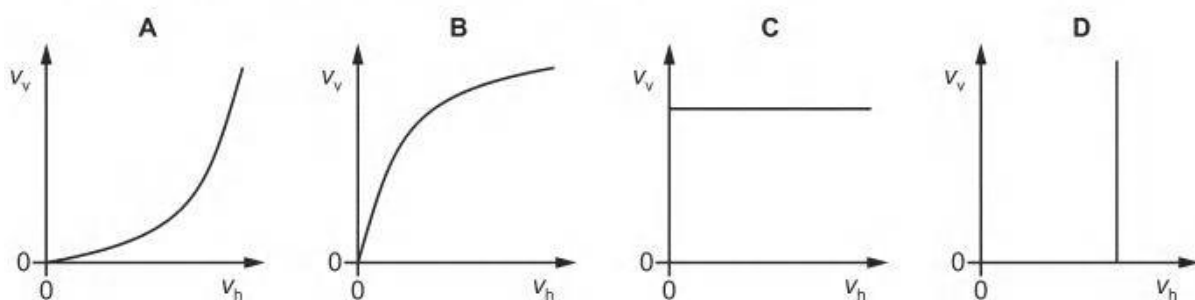
How far does the car travel while the brakes are applied?

- A** 21 m **B** 45 m **C** 67 m **D** 83 m

41 - (9702/11_Summer_2019_Q7) - Kinematics

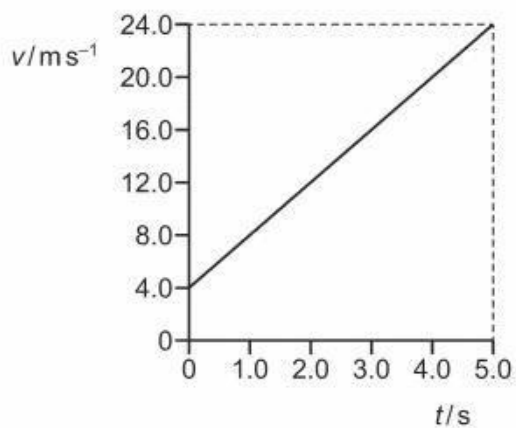
A stone is thrown horizontally from the top of a cliff and falls into the sea some time later. Air resistance is negligible.

Which graph shows how the vertical component v_v of velocity of this stone varies with its horizontal component v_h of velocity as it moves through the air?



42 - (9702/13_Summer_2019_Q7) - Kinematics

The graph shows the variation of velocity v with time t for an object.



The object passes a fixed point at time $t = 0$.

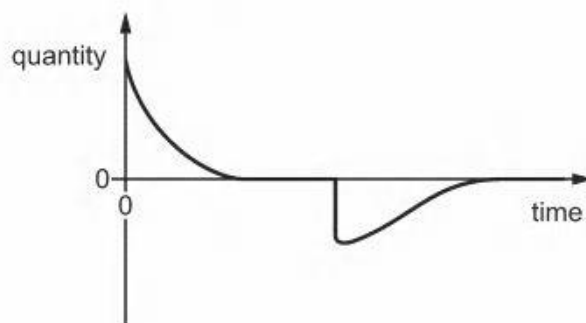
What is the displacement of the object from the fixed point at time $t = 5.0$ s and what is the acceleration of the object?

	displacement /m	acceleration /ms ⁻²
A	60	4.0
B	70	4.0
C	60	4.8
D	70	4.8



43 - (9702/12_Summer_2019_Q8) - Kinematics

The graph shows how a physical quantity varies with time.



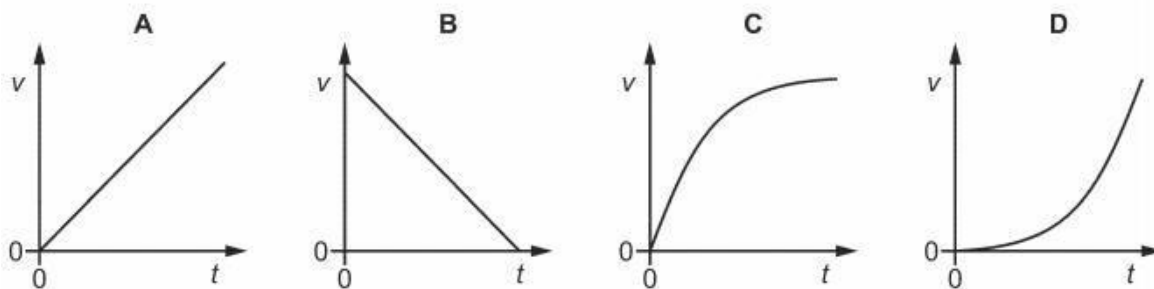
Which event could best be represented by the graph?

- A the acceleration of a firework rising to a maximum height and falling to the ground
- B the acceleration of a skydiver leaving an aircraft, falling, opening a parachute and falling to the ground
- C the speed of a javelin as it leaves an athlete's hand, falls and sinks into the ground
- D the speed of a high jump athlete leaving the ground, jumping over a bar and descending to the ground

44 - (9702/13_Summer_2019_Q8) - Kinematics

A skydiver jumps from an aeroplane and falls vertically through the air.

Which graph shows the variation with time t of the skydiver's vertical velocity v ?

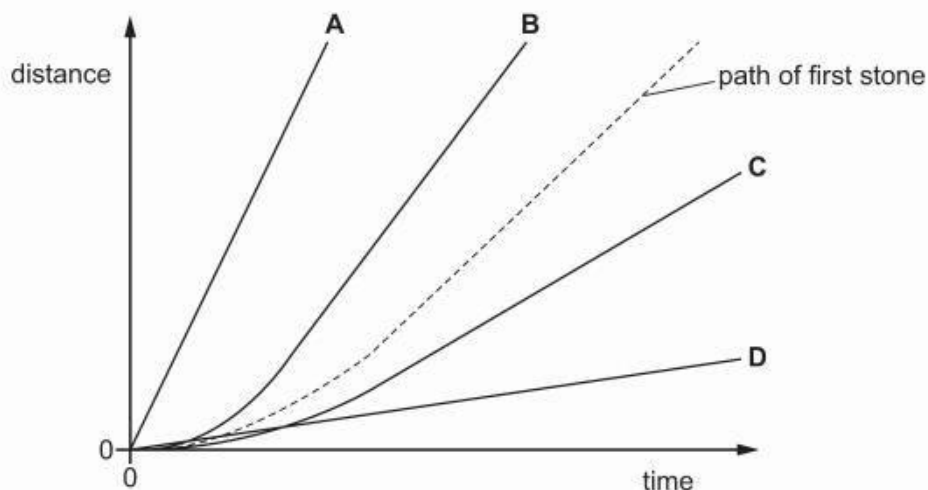


45 - (9702/11_Summer_2019_Q10) - Kinematics

A stone is dropped from a tall building. Air resistance is significant. The variation of distance fallen with time is shown by the dashed line.

A second stone with the same dimensions but a smaller mass is dropped from the same building.

Which line represents the motion of the second stone?



46 - (9702/11_Summer_2019_Q11) - Kinematics

A helium atom of mass m collides normally with a wall. The atom arrives at the wall with speed v and then rebounds along its original path. Assume that the collision is perfectly elastic.

What is the change in the momentum of the atom during its collision?

- A zero B $0.5mv$ C mv D $2mv$

47 - (9702/11_Winter_2019_Q2) - Kinematics

The speed of a wave in deep water depends on its wavelength L and the acceleration of free fall g .

What is a possible equation for the speed v of the wave?

- A $v = \sqrt{\left(\frac{gL}{2\pi}\right)}$ B $v = \frac{gL}{4\pi^2}$ C $v = 2\pi\sqrt{\left(\frac{g}{L}\right)}$ D $v = \frac{2\pi g}{L}$

48 - (9702/11_Winter_2019_Q5) - Kinematics

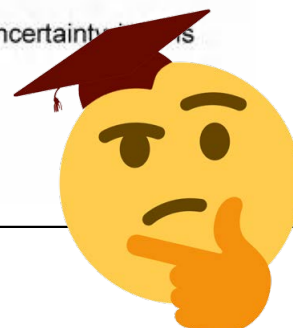
The power P dissipated in a resistor of resistance R is calculated using the expression

$$P = \frac{V^2}{R}$$

where V is the potential difference (p.d.) across the resistor. The percentage uncertainty in V is 5% and in R is 2%.

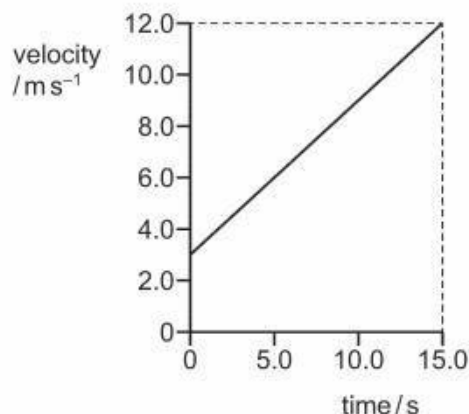
What is the percentage uncertainty in P ?

- A 3% B 7% C 8% D 12%



49 - (9702/11_Winter_2019_Q6) - Kinematics

The velocity-time graph for an object of mass 2.5 kg is shown.



What is the resultant force acting on the object?

- A 0.60 N B 0.80 N C 1.5 N D 2.0 N

50 - (9702/12_Winter_2019_Q6) - Kinematics

A ball is thrown vertically upwards from ground level and reaches a maximum height of 12.7 m before falling back to ground level.

Assume air resistance is negligible.

What is the total time for which the ball is in the air?

- A 1.61 s B 3.22 s C 3.88 s D 5.18 s

51 - (9702/13_Winter_2019_Q6) - Kinematics

A lead sphere is released from rest at point X, a long way above the surface of a planet. The sphere falls in a vacuum. After a time of 4.0 s, it has fallen through a vertical distance of 3.0 m. Assume the acceleration of free fall is constant.

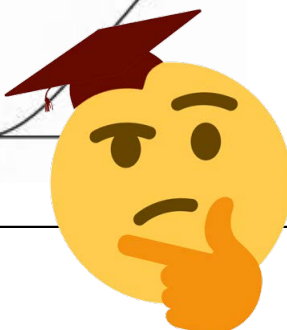
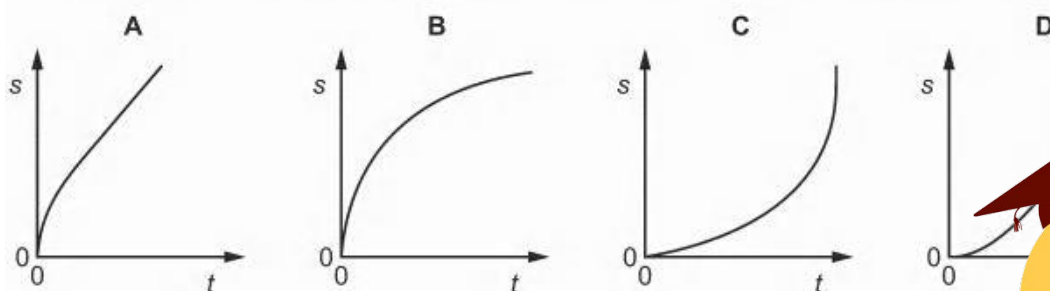
How far will the sphere have fallen from point X at a time of 20 s after its release?

- A 15 m B 75 m C 80 m D 2000 m

52 - (9702/12_Winter_2019_Q8) - Kinematics

A tennis ball is released from rest at time $t = 0$ and falls through air for a long time.

Which graph of its displacement s against time t best represents the motion of the ball?



53 - (9702/11_Winter_2019_Q9) - Kinematics

A skydiver falls from an aircraft that is moving horizontally.

The vertical component of the velocity of the skydiver is v .

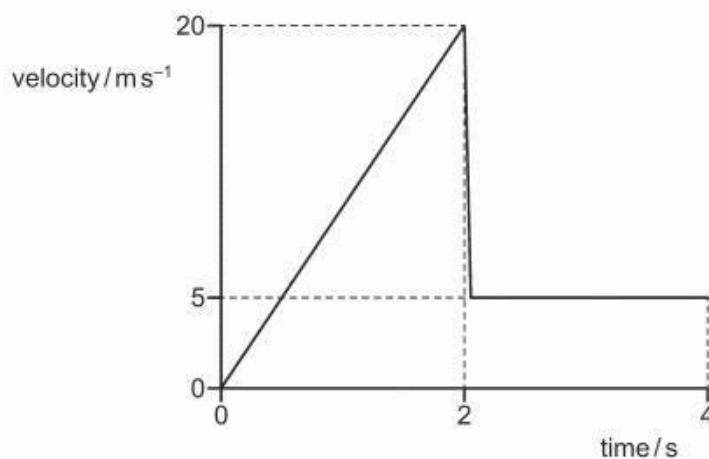
The vertical component of the acceleration of the skydiver is a .

Which row describes v and a during the first few seconds after the skydiver leaves the aircraft?

	v	a
A	constant	constant
B	constant	decreasing
C	increasing	constant
D	increasing	decreasing

54 - (9702/12_Summer_2020_Q5) - Kinematics

A stone is dropped from a height of 20 m above water. The graph shows the variation with time of the velocity of the stone.



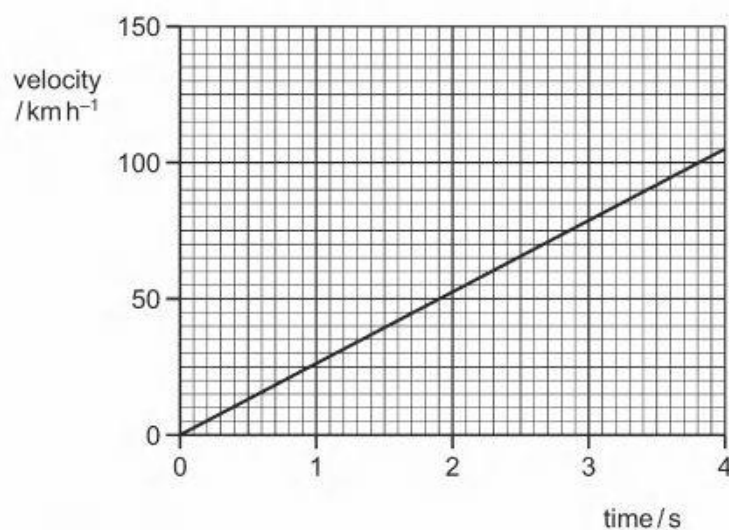
Which statement describes the approximate position of the stone four seconds after it is dropped?

- A** It is at a distance of 10 m above the surface of the water.
- B** It is at a distance of 10 m below the surface of the water.
- C** It is at a distance of 20 m below the surface of the water.
- D** It is at a distance of 30 m below the surface of the water.



55 - (9702/11_Summer_2020_Q6) - Kinematics

The velocity of an electric car changes as shown.

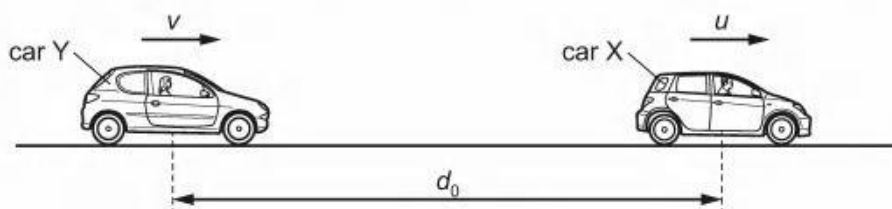


What is the acceleration of the car?

- A** 210 ms^{-2} **B** 58 ms^{-2} **C** 26 ms^{-2} **D** 7.3 ms^{-2}

56 - (9702/12_Summer_2020_Q6) - Kinematics

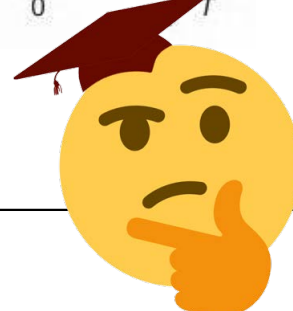
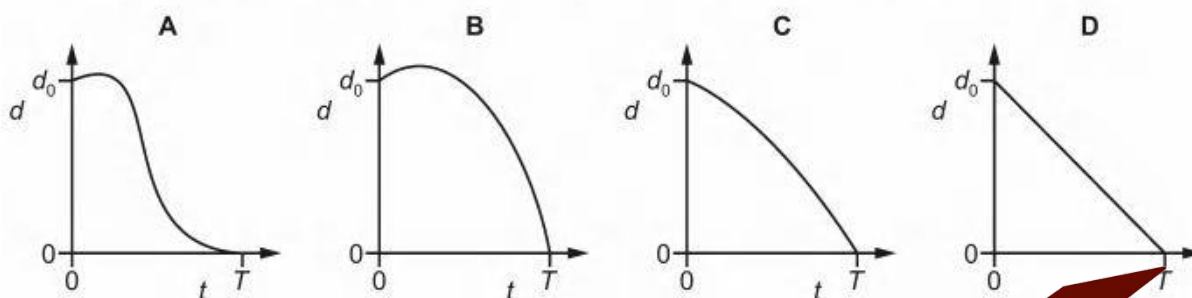
A car X is travelling at a constant speed u along a straight road. At time $t = 0$ a second car Y is a distance d_0 behind car X and travelling at a speed v in the same direction. Speed v is less than speed u .



At time $t = 0$ car Y begins to accelerate with a constant acceleration.

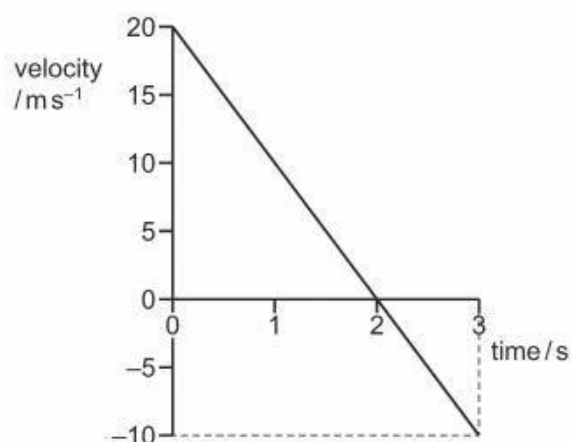
Car Y overtakes car X at time $t = T$.

Which graph could best show the variation with time t of the distance d between the cars?



57 - (9702/13_Summer_2020_Q6) - Kinematics

The graph shows how the velocity of a ball varies with time from the moment it is hit vertically upwards from the ground.

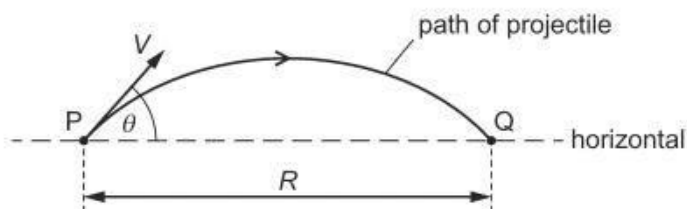


What is the displacement of the ball from the ground after a time of 3.0 s?

- A 15 m B 25 m C 30 m D 45 m

58 - (9702/11_Summer_2020_Q7) - Kinematics

A projectile is fired from point P with velocity V at an angle θ to the horizontal. It lands at point Q, a horizontal distance R from P, after time T .



The acceleration of free fall is g . Air resistance is negligible.

Which equation is correct?

- A $R = VT \cos \theta$
B $R = VT \sin \theta$
C $R = VT \cos \theta - \frac{1}{2} g T^2$
D $R = VT \sin \theta - \frac{1}{2} g T^2$



59 - (9702/13_Summer_2020_Q7) - Kinematics

Two students each throw a ball horizontally from the top of a tower. The two balls are released at the same time.

The first student throws her ball with a speed of 20 ms^{-1} and the second student throws his ball with a speed of 10 ms^{-1} .

Assume air resistance is negligible and that the balls land on horizontal ground.

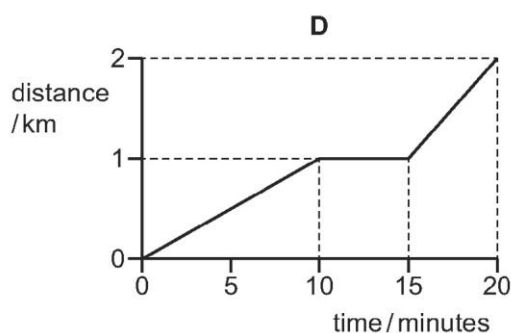
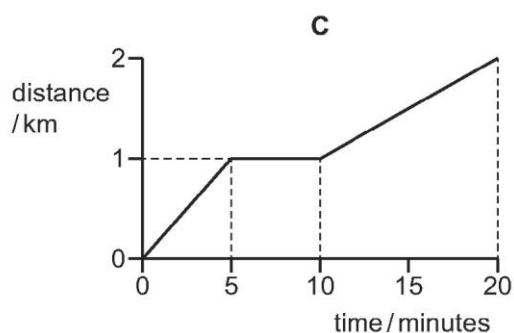
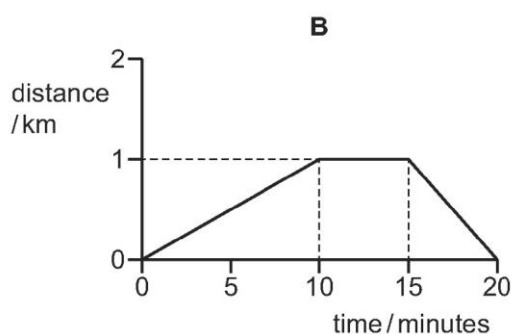
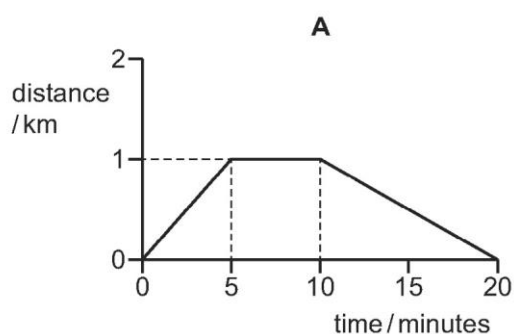
Which row describes the horizontal distances travelled and the landing times of the two balls on the ground?

	horizontal distances	landing times
A	same	same
B	same	different
C	different	same
D	different	different

60 - (9702/11_Winter_2020_Q6) - Kinematics

A student cycles uphill from home to a shop, taking 10 minutes. The student then spends 5 minutes in the shop, before cycling home downhill at twice the initial speed.

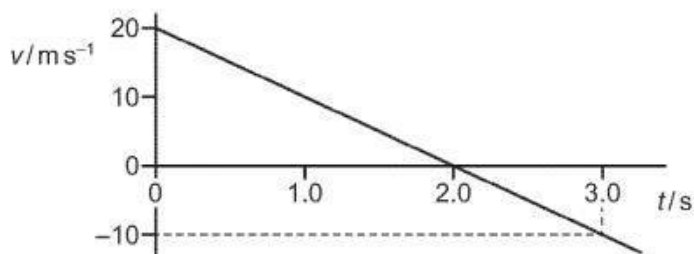
Which graph could show the variation with time of the distance travelled by the cyclist?



61 - (9702/12_Winter_2020_Q6) - Kinematics

A stone is thrown vertically upwards from a point X at time $t = 0$.

The variation with time t of the velocity v of the stone is shown.

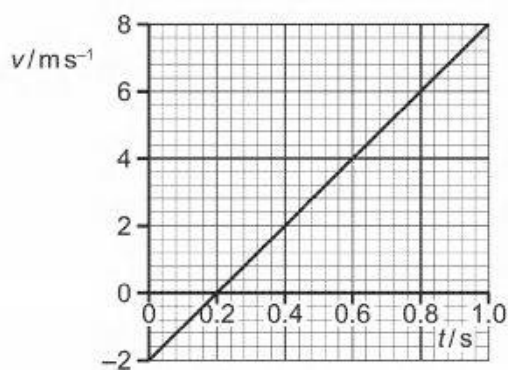


What is the displacement of the stone from point X at time $t = 3.0\text{ s}$?

- A 15 m above X
- B 15 m below X
- C 25 m above X
- D 25 m below X

62 - (9702/13_Winter_2020_Q6) - Kinematics

An object moves in a straight line. The graph shows the variation with time t of the velocity v of the object.



At time $t = 0$ the object is at point X.

What is the displacement of the object from point X at time $t = 0.80\text{ s}$?

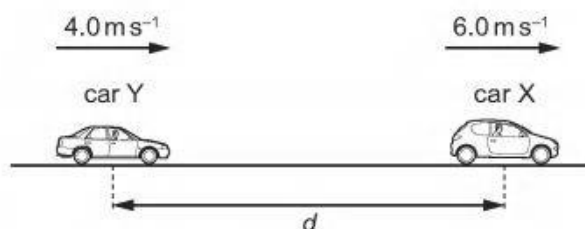
- A 1.6 m
- B 1.8 m
- C 2.0 m
- D 3.2 m



63 - (9702/11_Winter_2020_Q7) - Kinematics

Two cars X and Y are travelling along the same straight road. Car X is travelling at a constant speed of 6.0 m s^{-1} . Car Y has a constant acceleration of 0.50 m s^{-2} .

At the instant shown, car X is a distance d ahead of car Y. Car Y is travelling at a speed of 4.0 m s^{-1} .



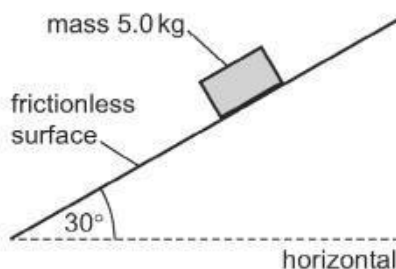
Car Y is level with car X after a time of 20 seconds.

What is the distance d ?

- A 40 m B 60 m C 180 m D 300 m

64 - (9702/12_Winter_2020_Q7) - Kinematics

A mass of 5.0 kg is released from rest on a frictionless surface inclined at 30° to the horizontal. Air resistance is negligible.



How far does the mass travel in a time of 0.80 s ?

- A 1.6 m B 2.0 m C 2.7 m D 3.1 m

65 - (9702/13_Winter_2020_Q7) - Kinematics

An object accelerates uniformly from rest to speed v . It then moves at constant speed v for a time of 8.0 s before decelerating uniformly to rest. The total time taken is 12.0 s , and the total distance travelled is 60 m .

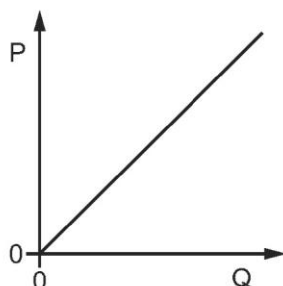
What is the speed v ?

- A 3.0 m s^{-1} B 5.0 m s^{-1} C 6.0 m s^{-1} D 15 m s^{-1}



66 - (9702/11_Winter_2020_Q8) - Kinematics

The graph shows how quantity P varies with quantity Q for an object falling in air for a long time in a uniform gravitational field.

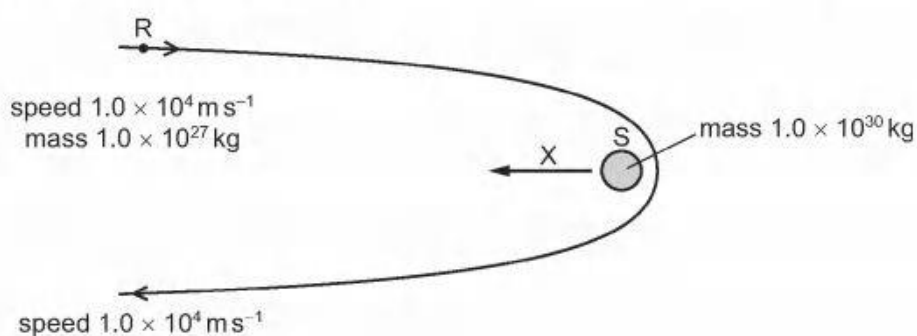


What could be the identities of P and Q?

	P	Q
A	force of air resistance	acceleration
B	kinetic energy	time
C	potential energy	height
D	work done against air resistance	speed

67 - (9702/11_Winter_2020_Q9) - Kinematics

A rock R of mass 1.0×10^{27} kg is a large distance from a star S and is travelling at a speed of 1.0×10^4 m s⁻¹. The star has mass 1.0×10^{30} kg. The rock travels around the star on the path shown so that it reverses its direction of motion and, when finally again a large distance from the star, has the same speed as initially.



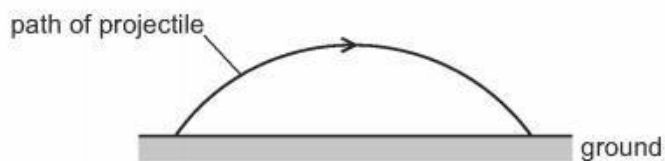
Which statement is correct?

- A The change in the momentum of S is in the direction of arrow X.
- B The change in the velocity of S is approximately 20 m s⁻¹.
- C The magnitude of the change of momentum of R is 10^3 times greater than the magnitude of the change of momentum of S.
- D The momentum of R does not change.



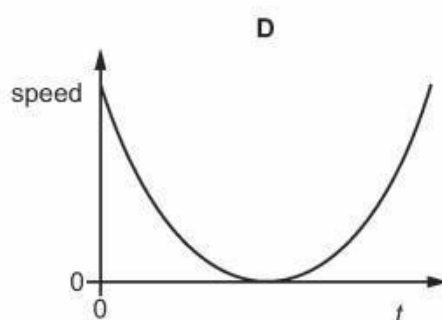
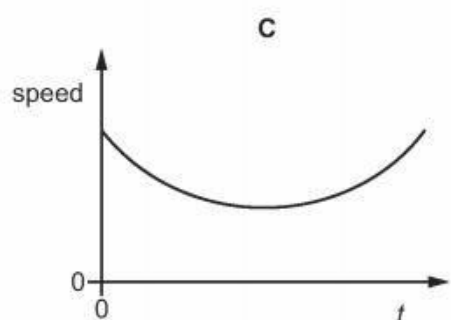
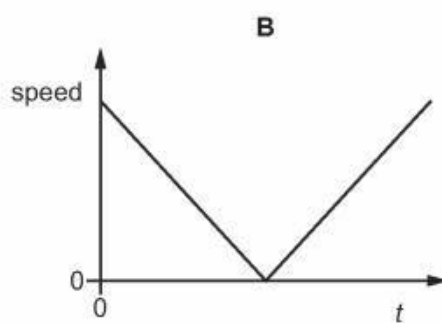
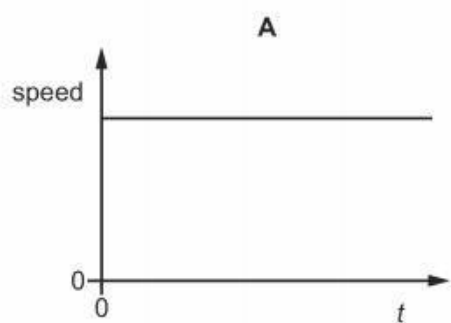
68 - (9702/11_Summer_2021_Q6) - Kinematics

A projectile is launched at an angle to the horizontal at time $t = 0$. It travels over horizontal ground, as shown.



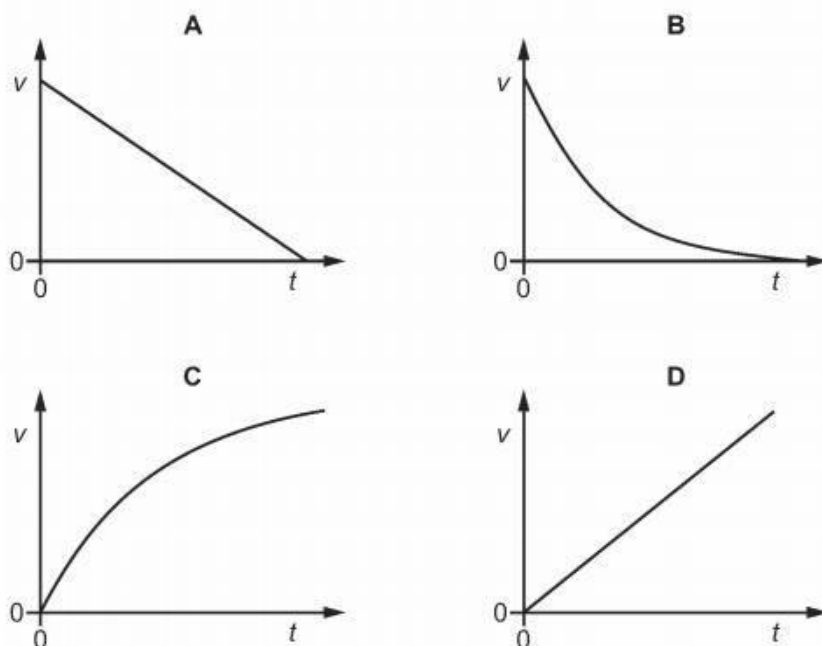
Air resistance is negligible.

Which graph best shows the variation with t of the speed of the projectile from when it is launched to when it lands on the ground?



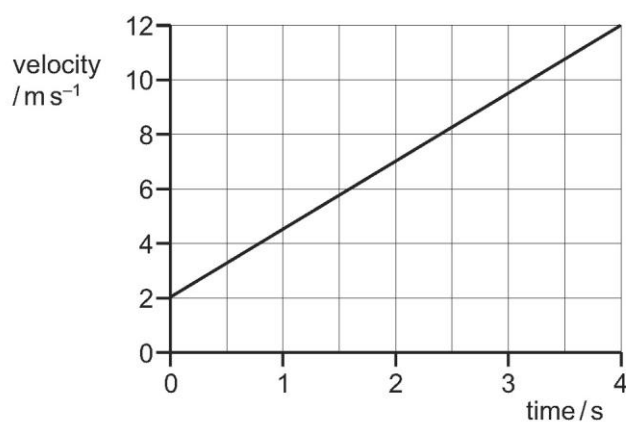
69 - (9702/12_Summer_2021_Q6) - Kinematics

Which graph shows the variation with time t of the velocity v of an object falling vertically downwards in a vacuum?



70 - (9702/13_Summer_2021_Q6) - Kinematics

The diagram shows a velocity–time graph for a car.



What is the distance travelled during the first 4.0 s?

- A 2.5 m B 3.0 m C 20 m D 28 m



71 - (9702/11_Summer_2021_Q7) - Kinematics

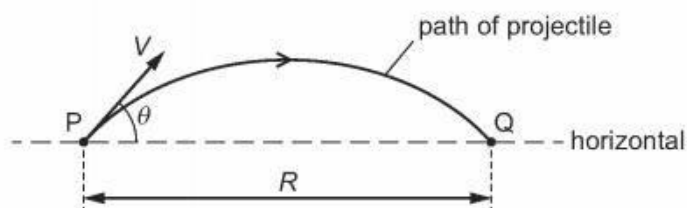
A train, initially at rest at a station, has a uniform acceleration of 0.20 m s^{-2} until it reaches a speed of 20 m s^{-1} . It travels for a time at this constant speed and then has a uniform deceleration of 0.40 m s^{-2} until it comes to rest at the next station. The distance between the two stations is 3000 m .

What is the time taken by the train to travel between the two stations?

- A 75 s B 150 s C 230 s D 300 s

72 - (9702/12_Summer_2021_Q7) - Kinematics

A projectile is fired from point P with velocity V at an angle θ to the horizontal. It lands at point Q, a horizontal distance R from P. Air resistance is negligible.



The acceleration of free fall is g .

Which equation for R is correct?

- A $R = \frac{V^2 \sin \theta \cos \theta}{g}$
- B $R = \frac{2V^2 \sin \theta \cos \theta}{g}$
- C $R = \frac{V^2 \sin \theta \cos \theta}{2g}$
- D $R = \frac{V^2 g \sin \theta \cos \theta}{2}$

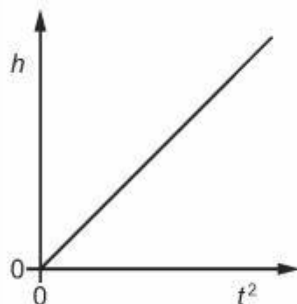


73 - (9702/13_Summer_2021_Q7) - Kinematics

A steel ball is dropped from rest from a height h above the ground. The ball hits the ground after a time t .

This is repeated for a number of different heights.

The graph shows the variation of h with t^2 for the ball.



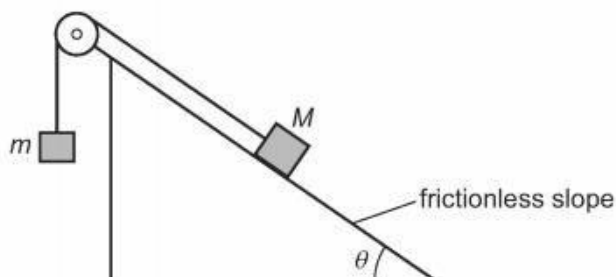
The gradient of the graph is G .

Which expression gives the acceleration of the ball?

- A $\frac{G}{2}$ B G C $2G$ D G^2

74 - (9702/13_Summer_2021_Q8) - Kinematics

Two masses, M and m , are connected by an inextensible string which passes over a frictionless pulley. Mass M rests on a frictionless slope, as shown.



The slope is at an angle θ to the horizontal.

The two masses are initially held stationary and then released. Mass M accelerates down the slope.

Which expression **must** be correct?

- A $\sin \theta < \frac{m}{M}$ B $\cos \theta < \frac{m}{M}$ C $\sin \theta > \frac{m}{M}$ D $\cos \theta > \frac{m}{M}$



75 - (9702/13_Summer_2021_Q9) - Kinematics

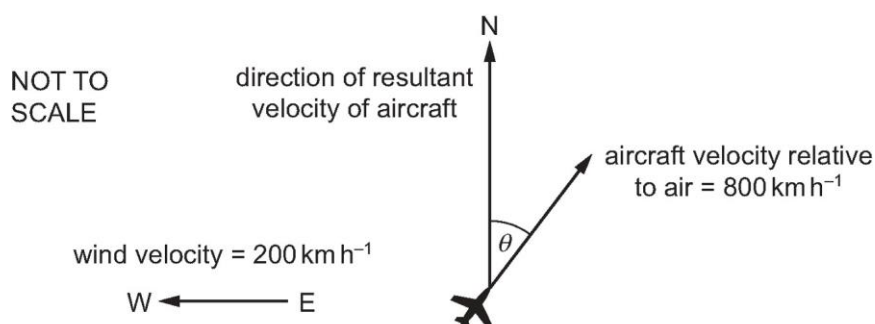
The weights and masses of four different objects on the surfaces of four different planets are shown.

Which planet has the lowest value of acceleration of free fall at its surface?

	weight	mass
A	40 mN	6.0 g
B	3.0 N	500 g
C	10 N	1 kg
D	2.6 kN	750 kg

76 - (9702/11_Winter_2021_Q3) - Kinematics

An aircraft heads in a direction at an angle θ east of north with a horizontal velocity relative to the air of 800 km h^{-1} . The wind blows with a horizontal velocity of 200 km h^{-1} from east to west, as shown.



The resultant velocity of the aircraft is in a direction due north.

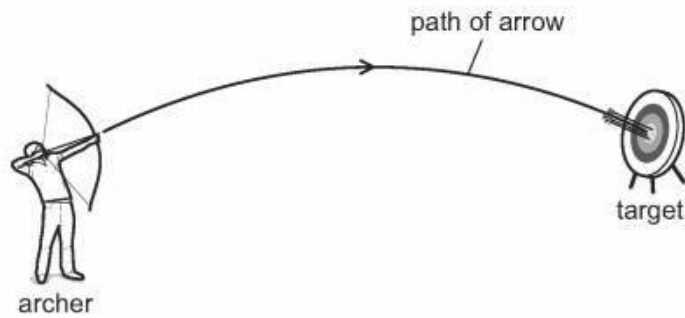
What is angle θ and what is the magnitude of the resultant velocity?

	$\theta / ^\circ$	resultant velocity / km h^{-1}
A	14	770
B	14	820
C	76	770
D	76	820



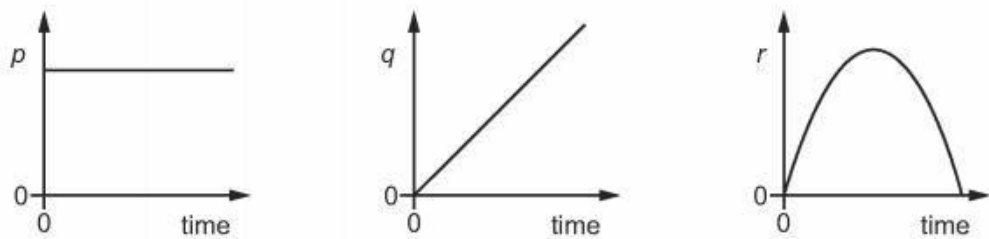
77 - (9702/11_Winter_2021_Q6) - Kinematics

An archer shoots an arrow at a target. The diagram shows the path of the arrow.



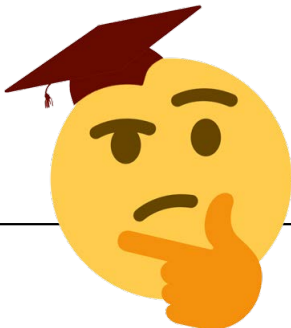
Air resistance is negligible.

The graphs show how three different quantities p , q and r vary with time.



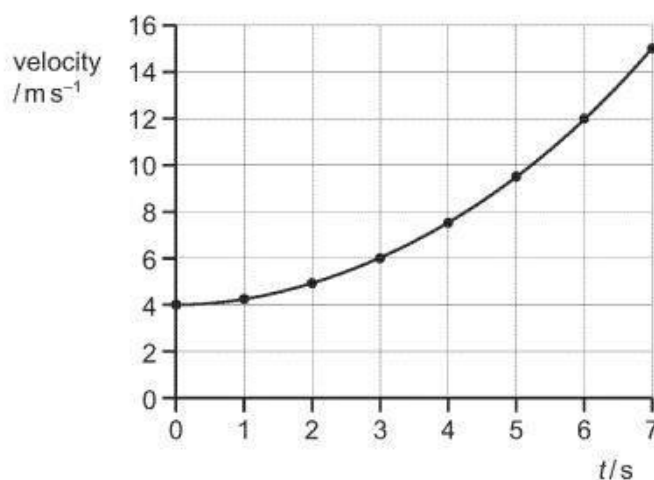
Which quantity could be the horizontal component of displacement and which quantity could be the vertical component of displacement of the arrow?

	horizontal component of displacement	vertical component of displacement
A	p	q
B	q	r
C	r	p
D	r	q



78 - (9702/12_Winter_2021_Q6) - Kinematics

The graph shows the variation with time t of the velocity of a vehicle moving in a straight line.



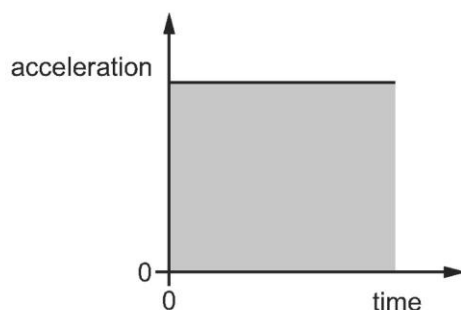
The vehicle, moving at 4.0 m s^{-1} , begins to accelerate at time $t = 0$.

What is the vehicle's acceleration at time $t = 3.0 \text{ s}$?

- A 0.67 m s^{-2} B 1.0 m s^{-2} C 1.3 m s^{-2} D 2.0 m s^{-2}

79 - (9702/13_Winter_2021_Q6) - Kinematics

The graph shows the variation with time of the acceleration of a car.



What **must** the shaded area under the graph represent?

- A the average velocity of the car
B the change in velocity of the car
C the final velocity of the car
D the initial velocity of the car

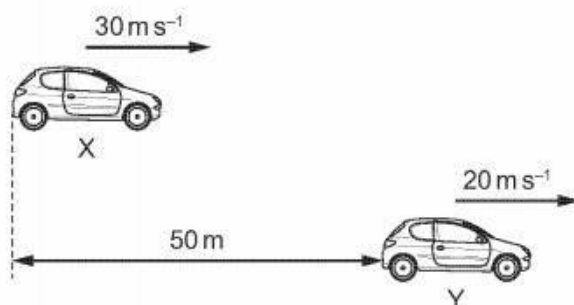


80 - (9702/11_Winter_2021_Q7) - Kinematics

Two cars X and Y are positioned as shown at time $t = 0$.

They are travelling in the same direction.

X is 50 m behind Y and has a constant velocity of 30 m s^{-1} . Y has a constant velocity of 20 m s^{-1} .



What is the value of t when X is level with Y?

- A 1.0 s B 1.7 s C 2.5 s D 5.0 s

81 - (9702/12_Winter_2021_Q7) - Kinematics

A stone is projected vertically upwards from the ground at an initial speed of 15 m s^{-1} . Air resistance is negligible.

What is the maximum height reached by the stone?

- A 0.76 m B 11 m C 23 m D 110 m

82 - (9702/13_Winter_2021_Q7) - Kinematics

A stone is thrown horizontally off a cliff and then lands in the sea. Air resistance is negligible.

Which statement about the stone's motion is **not** correct?

- A The final displacement of the stone depends upon its initial horizontal velocity.
B The stone travels with a constant horizontal component of velocity until it hits the water.
C The stone travels with an increasing vertical component of velocity.
D The time taken for the stone to hit the surface of the water depends on its initial horizontal velocity.

83 - (9702/12_Winter_2021_Q8) - Kinematics

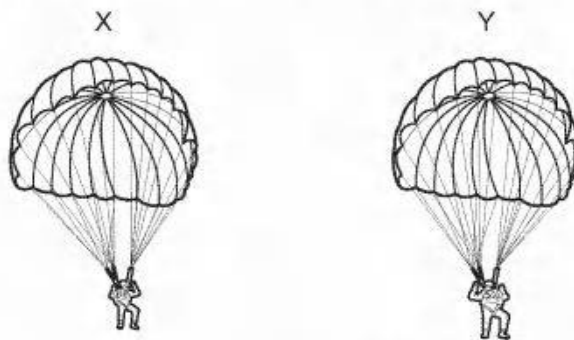
What is meant by the mass of an object?

- A the property of the object that resists a change in motion
B the pull of the Earth on the object
C the total number of atoms in the object
D the weight of the object



84 - (9702/12_Winter_2021_Q9) - Kinematics

The diagram shows two parachutists, X and Y, moving vertically downwards.



The total mass of parachutist Y and his parachute is twice the total mass of parachutist X and his parachute. At this moment, the air resistance on parachute Y is twice the air resistance on parachute X. Neither parachutist has reached his constant (terminal) velocity.

Which statement describes the acceleration of Y compared with the acceleration of X?

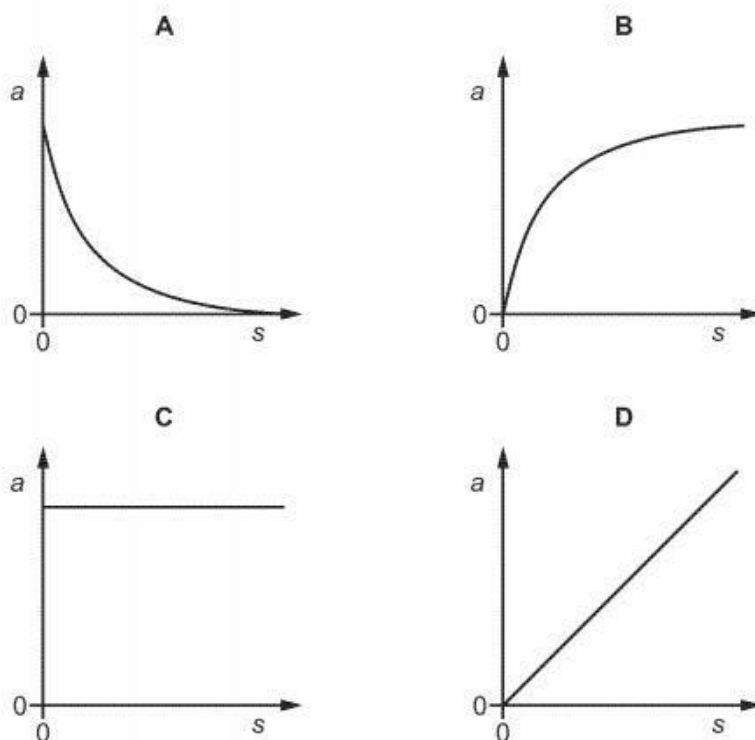
- A The acceleration of Y is half the acceleration of X.
- B The acceleration of Y is the same as the acceleration of X.
- C The acceleration of Y is more than the acceleration of X, but less than twice the value.
- D The acceleration of Y is twice the acceleration of X.



85 - (9702/13_Winter_2021_Q9) - Kinematics

A skydiver leaves a stationary balloon and falls vertically through a long distance.

Which graph best represents the variation of the acceleration a of the skydiver with the distance s travelled as she falls through the air?

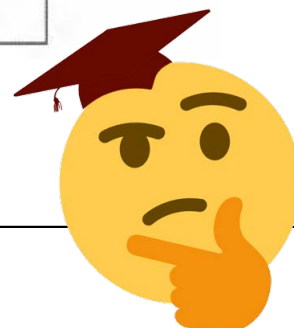


86 - (9702/12_Winter_2021_Q10) - Kinematics

The table shows four different collisions between two blocks, each of mass 0.50 kg .

Which collision is perfectly elastic?

	before collision		after collision	
A	$4.0\text{ m s}^{-1} \rightarrow$ 0.50 kg	0.0 m s^{-1} 0.50 kg	$2.0\text{ m s}^{-1} \rightarrow$ 0.50 kg	0.50 kg
B	$2.0\text{ m s}^{-1} \rightarrow$ 0.50 kg	$\leftarrow 2.0\text{ m s}^{-1}$ 0.50 kg	0.0 m s^{-1} 0.50 kg	0.50 kg
C	$2.0\text{ m s}^{-1} \rightarrow$ 0.50 kg	$\leftarrow 1.0\text{ m s}^{-1}$ 0.50 kg	$\leftarrow 2.0\text{ m s}^{-1}$ 0.50 kg	$3.0\text{ m s}^{-1} \rightarrow$ 0.50 kg
D	$4.0\text{ m s}^{-1} \rightarrow$ 0.50 kg	$1.0\text{ m s}^{-1} \rightarrow$ 0.50 kg	$1.0\text{ m s}^{-1} \rightarrow$ 0.50 kg	$4.0\text{ m s}^{-1} \rightarrow$ 0.50 kg

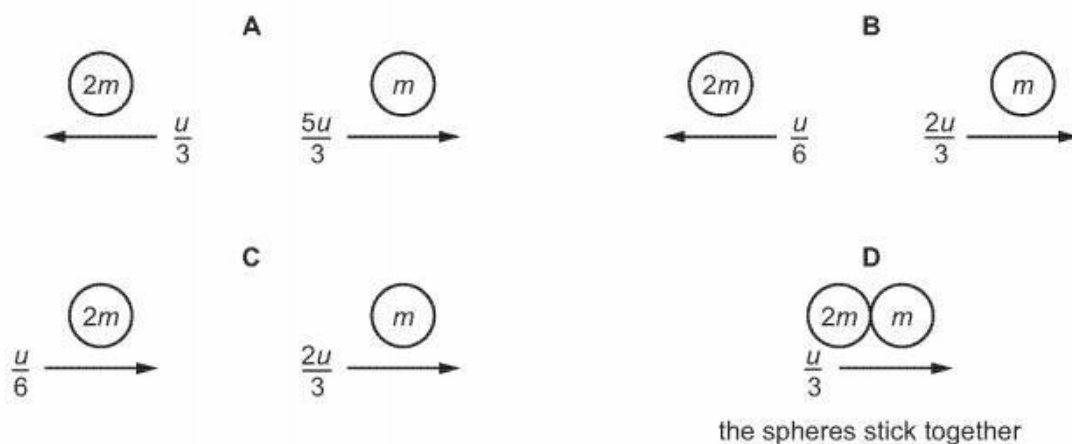


87 - (9702/13_Winter_2021_Q10) - Kinematics

The diagram shows two spheres approaching each other head-on. Each sphere has speed u . One sphere has mass $2m$ and the other has mass m .

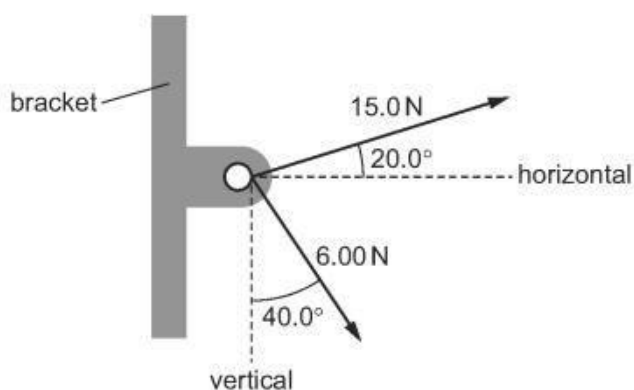


Which diagram shows the result of a perfectly elastic collision?



88 - (9702/11_Summer_2022_Q4) - Kinematics

Two cables are attached to a bracket and exert forces as shown.



What are the magnitudes of the horizontal and vertical components of the resultant of the two forces?

	horizontal component / N	vertical component / N
A	9.73	0.534
B	9.73	10.2
C	18.0	0.534
D	18.0	10.2

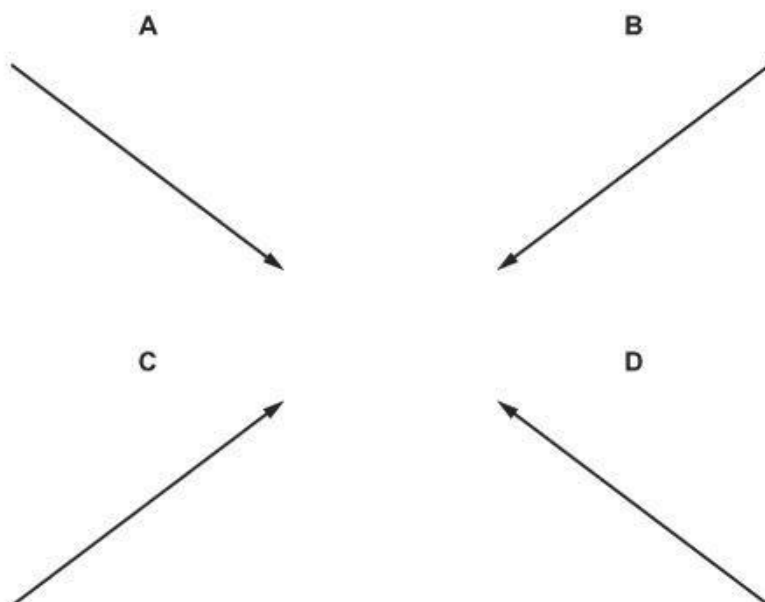


89 - (9702/12_Summer_2022_Q4) - Kinematics

An object is moving with an initial velocity of 4.0 m s^{-1} to the right. The velocity of the object changes so that its final velocity is 3.0 m s^{-1} downwards, as shown.

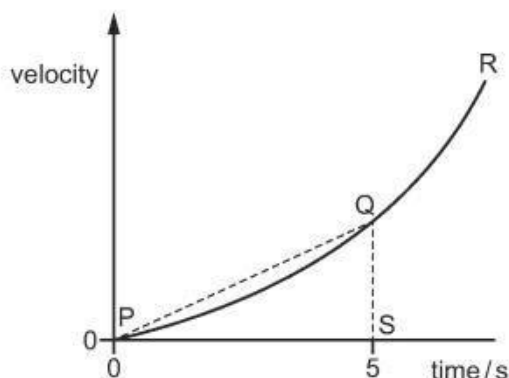


Which arrow represents the change in velocity of the object?



90 - (9702/11_Summer_2022_Q5) - Kinematics

The curved line PQR is the velocity–time graph for a car starting from rest.



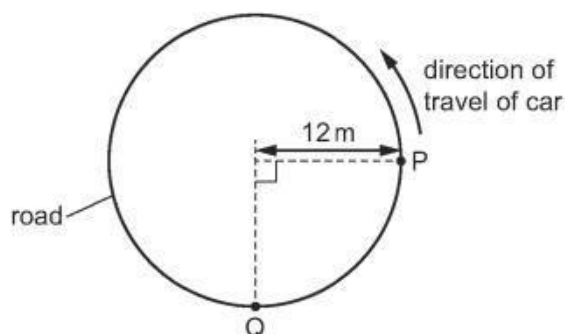
What is the average acceleration of the car over the first 5 s?

- A the area below the curve PQ
- B the area of the triangle PQS
- C the gradient of the straight line PQ
- D the gradient of the tangent at Q

91 - (9702/12_Summer_2022_Q5) - Kinematics

A car travels anticlockwise along a horizontal circular road of radius 12 m, as shown.

The car takes a time of 4.0 s to move from position P to position Q.



What is the magnitude of the average velocity of the car for the journey from P to Q?

- A 4.2 ms^{-1} B 4.7 ms^{-1} C 6.0 ms^{-1} D 14 ms^{-1}

92 - (9702/13_Summer_2022_Q5) - Kinematics

Forces of magnitudes 2 N, 4 N and 7 N combine to produce a resultant force.

The magnitudes of the three forces are fixed, but the forces may act in any direction in the same plane.

What is **not** a possible magnitude of the resultant force?

- A 0 N B 5 N C 8 N D 13 N



93 - (9702/11_Summer_2022_Q6) - Kinematics

A ball is thrown horizontally with a speed of 10.0 m s^{-1} above horizontal ground. The ball hits the ground after a time of 3.0 s.

Air resistance is negligible.

What is the speed of the ball just before it hits the ground?

- A 10 m s^{-1} B 29 m s^{-1} C 31 m s^{-1} D 39 m s^{-1}

94 - (9702/12_Summer_2022_Q6) - Kinematics

The water surface in a deep well is 78.0 m below the top of the well. A person at the top of the well drops a heavy stone down the well.

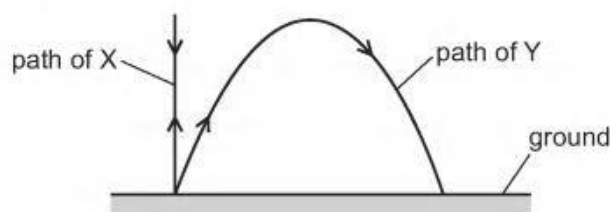
Air resistance is negligible. The speed of sound in the air is 330 m s^{-1} .

What is the time interval between the person dropping the stone and hearing it hitting the water?

- A 3.75 s B 3.99 s C 4.19 s D 4.22 s

95 - (9702/13_Summer_2022_Q6) - Kinematics

Two projectiles, X and Y, are fired into the air from the same place on level ground and reach the same maximum height, as shown.



Projectile X is fired vertically upwards and projectile Y is fired at an angle to the horizontal.

Air resistance is negligible.

Which statement is correct?

- A X and Y are at rest at their maximum heights.
B X and Y are fired with the same speed.
C X and Y take the same time to return to the ground.
D X and Y travel the same distance.



96 - (9702/11_Summer_2022_Q7) - Kinematics

An object is moving along the ground in a straight line at a constant speed.

Which statement about the resultant force acting on the object is correct?

- A The resultant force acting on the object is equal to its weight.
- B The resultant force acting on the object is equal to the product of its mass and its velocity.
- C The resultant force acting on the object is equal to the resistive force.
- D The resultant force acting on the object is equal to zero.

97 - (9702/12_Summer_2022_Q7) - Kinematics

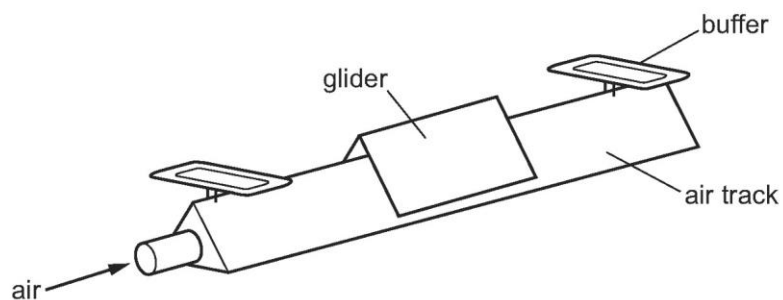
Which statement is **not** a requirement of a pair of forces that obey Newton's third law of motion?

- A The forces act in opposite directions.
- B The forces act on different objects.
- C The forces act on objects in contact.
- D The forces are of equal magnitude.



98 - (9702/13_Summer_2022_Q7) - Kinematics

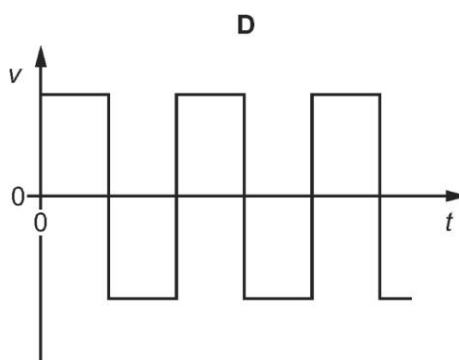
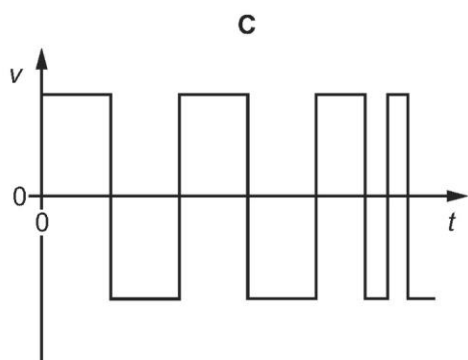
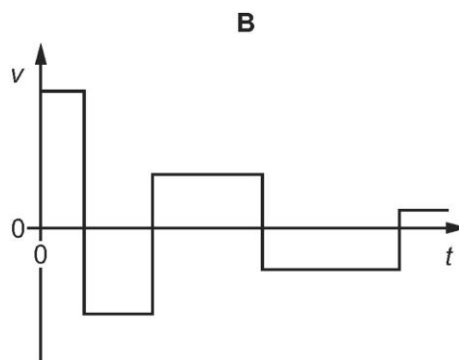
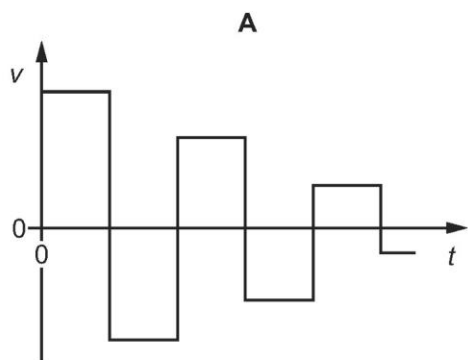
A small glider moves along a horizontal air track as shown.



At each end of the air track, the glider has a perfectly elastic collision with a fixed buffer.

The glider moves at a constant speed between collisions.

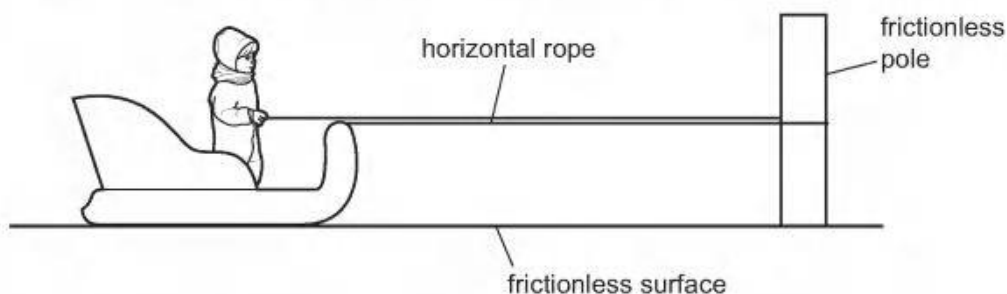
Which graph represents the variation with time t of the velocity v of the glider as it moves between the two buffers?



99 - (9702/12_Summer_2022_Q8) - Kinematics

A child of mass 20 kg stands on the rough surface of a sledge of mass 40 kg. The sledge can slide on a horizontal frictionless surface.

One end of a rope is attached to the sledge. The rope passes around a fixed frictionless pole, and the other end of the rope is held by the child, as shown.



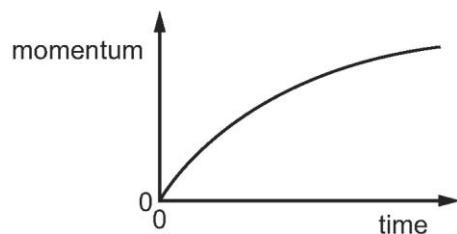
The rope is horizontal. The child pulls on the rope with a horizontal force of 12 N. This causes the child and the sledge to move with equal acceleration towards the pole.

What is the frictional force between the child and the sledge?

- A 4.0 N B 6.0 N C 8.0 N D 12 N

100 - (9702/13_Summer_2022_Q8) - Kinematics

A car accelerates from rest. The graph shows the variation of the momentum of the car with time.



What is the meaning of the gradient of the graph at a particular time?

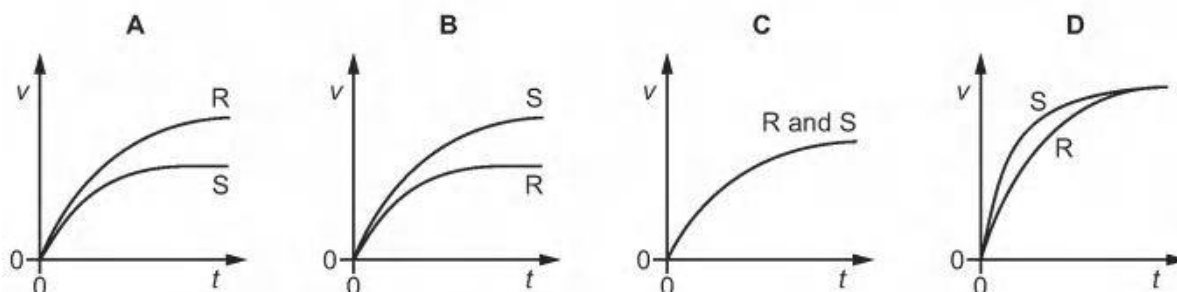
- A the kinetic energy of the car
B the rate of change of kinetic energy of the car
C the resultant force on the car
D the velocity of the car



101 - (9702/12_Summer_2022_Q9) - Kinematics

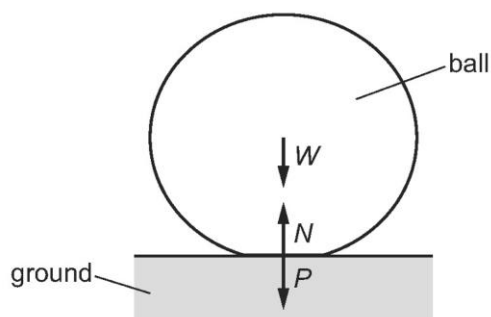
A stone S and a foam rubber ball R are identical spheres of equal volume. They are released from rest at time $t = 0$ and fall vertically through the air. Both reach terminal velocity.

Which graph best shows the variation with time t of the speed v of the stone and of the rubber ball?

**102** - (9702/13_Summer_2022_Q9) - Kinematics

A ball is dropped onto horizontal ground and bounces vertically upwards. When the ball is in contact with the ground, the following forces act:

- the weight W of the ball
- the contact force P exerted on the ground by the ball
- the contact force N exerted on the ball by the ground.



When the ball is in contact with the ground, the ball is momentarily stationary.

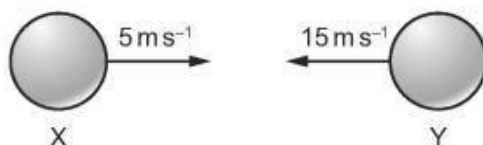
At this instant, which relationship is correct?

- A $N = P + W$ B $N > P + W$ C $N = W$ D $N > W$



103 - (9702/12_Summer_2022_Q10) - Kinematics

Two balls X and Y are moving towards each other with speeds of 5 m s^{-1} and 15 m s^{-1} respectively.



They make a perfectly elastic head-on collision and ball Y moves to the right with a speed of 7 m s^{-1} .

What is the speed and direction of ball X after the collision?

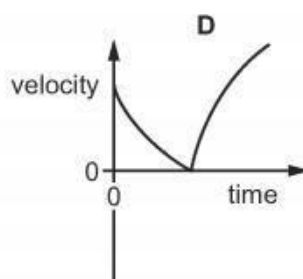
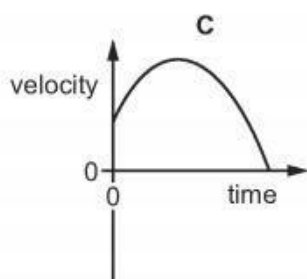
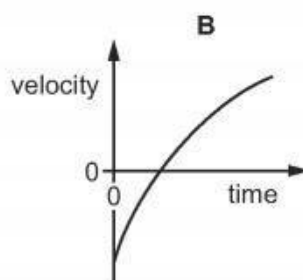
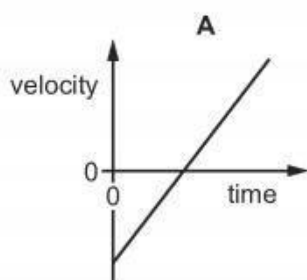
- A 3 m s^{-1} to the left
- B 13 m s^{-1} to the left
- C 3 m s^{-1} to the right
- D 13 m s^{-1} to the right

104 - (9702/13_Summer_2022_Q10) - Kinematics

A person stands on the edge of a high cliff that is next to the sea. The person throws a stone vertically upwards. Air resistance acts on the stone.

The stone eventually hits the sea.

Which velocity–time graph best shows the motion of the stone from when it is released until it hits the sea?



105 - (9702/13_Summer_2022_Q11) - Kinematics

Skaters of masses 80 kg and 40 kg move directly towards each other and collide.

Before the collision, the heavier skater is moving to the right at a speed of 2.0 m s^{-1} and the lighter skater is moving to the left at a speed of 1.0 m s^{-1} .

After the collision, the heavier skater moves to the right at a speed of 0.80 m s^{-1} .

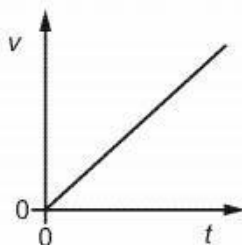
What is the relative speed of separation of the two skaters?

- A 0.6 m s^{-1} B 1.4 m s^{-1} C 2.2 m s^{-1} D 2.6 m s^{-1}

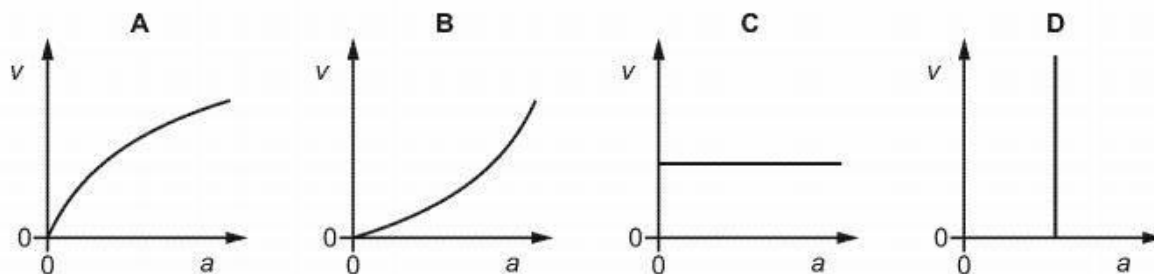
106 - (9702/11_Winter_2022_Q5) - Kinematics

A particle accelerates from rest.

The graph shows the variation of the velocity v of the particle with time t .



Which graph shows the variation of the velocity v with the acceleration a of the particle?



107 - (9702/12_Winter_2022_Q5) - Kinematics

A toy car travels on a circular track at a constant speed of 0.50 m s^{-1} . It passes a point on the track at time $t = 0$ and takes a time of 40 s to travel once around the track.

The magnitude of the average velocity of the car between $t = 0$ and $t = 20 \text{ s}$ is v_{20} .

The magnitude of the average velocity of the car between $t = 0$ and $t = 40 \text{ s}$ is v_{40} .

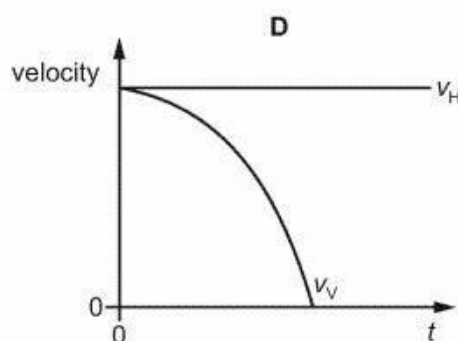
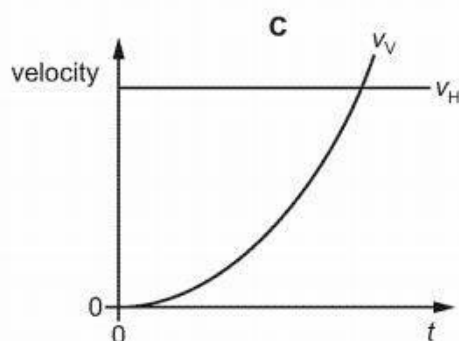
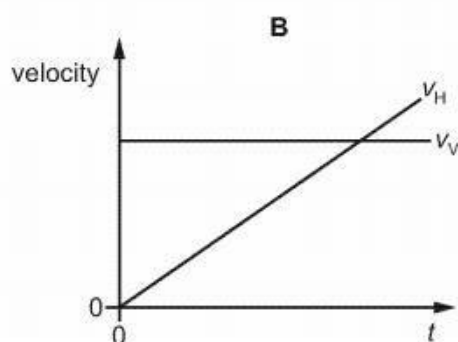
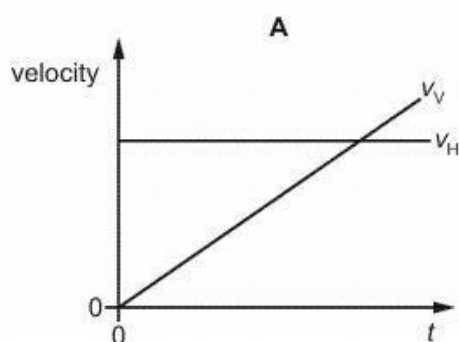
What are v_{20} and v_{40} ?

	$v_{20} / \text{m s}^{-1}$	$v_{40} / \text{m s}^{-1}$
A	0.32	0
B	0.32	0.32
C	0.50	0
D	0.50	0.50

108 - (9702/13_Winter_2022_Q5) - Kinematics

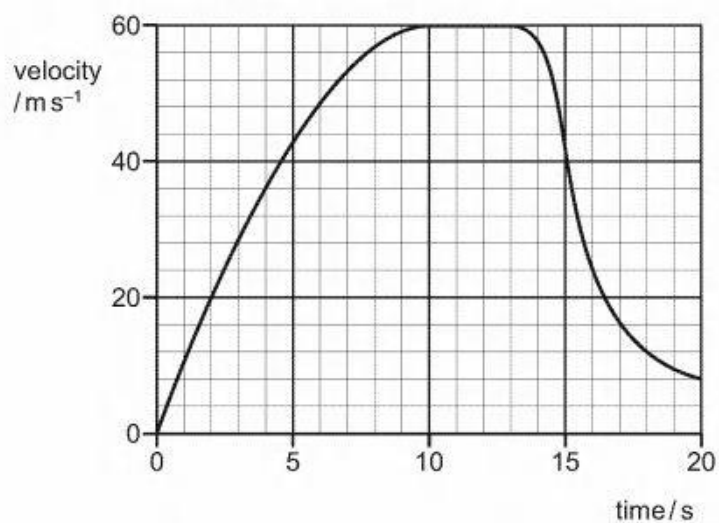
A stone is projected horizontally at time $t = 0$ and falls. Air resistance is negligible. The stone has a horizontal component of velocity v_H and a vertical component of velocity v_V .

Which graph shows how v_H and v_V vary with time t ?



109 - (9702/11_Winter_2022_Q6) - Kinematics

The graph shows the vertical velocity of a parachutist during the first 20 s of her jump.



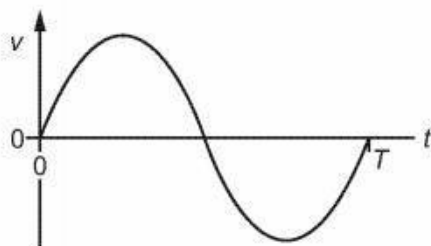
Approximately how far does she fall **before** opening the parachute?

- A 390m B 570m C 710m D 770m

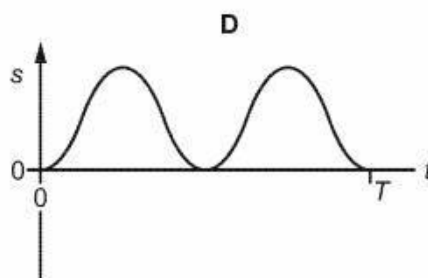
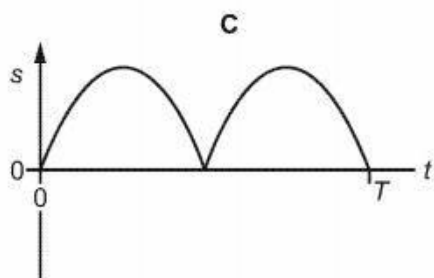
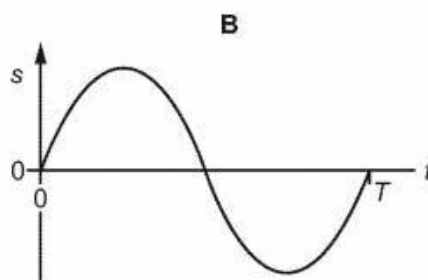
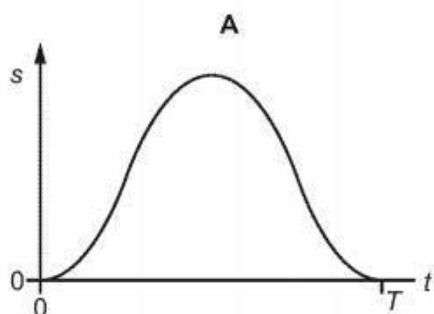


110 - (9702/12_Winter_2022_Q6) - Kinematics

The graph shows how the velocity v of an object moving in a straight line varies with time t from $t = 0$ to $t = T$.



Which graph could represent the displacement s of the object from time $t = 0$ to $t = T$?



111 - (9702/13_Winter_2022_Q6) - Kinematics

On the Earth, an object takes time T_E to fall from rest through a vertical distance h .

On the Moon, the same object takes time T_M to fall from rest through the same vertical distance h .

The ratio $\frac{\text{acceleration of free fall on the Earth}}{\text{acceleration of free fall on the Moon}}$ is equal to 6.

Air resistance is negligible for the object on the Earth and on the Moon.

What is the ratio $\frac{T_E}{T_M}$?

A $\frac{1}{6}$

B $\frac{1}{\sqrt{6}}$

C $\sqrt{6}$

D 6



112 - (9702/12_Winter_2022_Q7) - Kinematics

A goods train passes through a station at a steady speed of 10 m s^{-1} at time $t = 0$. An express train is at rest at the station. The express train leaves the station with a uniform acceleration of 0.5 m s^{-2} just as the goods train goes past. Both trains move in the same direction on straight, parallel tracks.

At which time t does the express train overtake the goods train?

- A 6 s B 10 s C 20 s D 40 s

113 - (9702/13_Winter_2022_Q7) - Kinematics

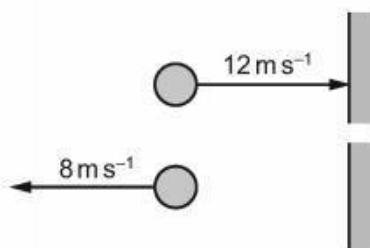
A cyclist in still air pedals as hard as she can. She reaches a maximum speed. However, after a certain time her maximum speed increases.

What could be a possible cause for this?

- A She cycles into a wind.
B She cycles over rougher ground.
C She sits more upright on the bicycle.
D She starts to travel downhill.

114 - (9702/13_Winter_2022_Q8) - Kinematics

A ball of mass 0.5 kg hits a vertical wall at a speed of 12 m s^{-1} . It bounces back along its original path with a speed of 8 m s^{-1} . The collision lasts for 0.10 s .



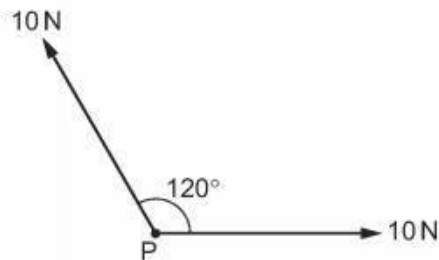
What is the average force on the ball due to the collision?

- A 0.2 N B 1 N C 20 N D 100 N



115 - (9702/11_Summer_2023_Q4) - Kinematics

Two forces, each of 10 N, act at a point P, as shown. The angle between the directions of the forces is 120° .

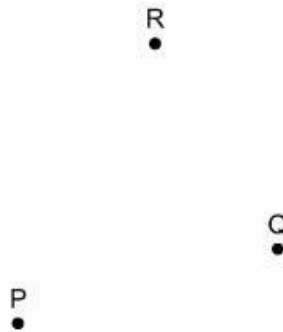


What is the magnitude of the resultant force?

- A 5 N B 10 N C 17 N D 20 N

116 - (9702/11_Summer_2023_Q5) - Kinematics

One object moves directly from P to R.



In a shorter time, a second object moves from P to Q to R.

Which statement about the two objects is correct for the journey from P to R?

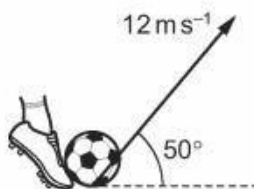
- A They have the same average speed.
B They have the same average velocity.
C They have the same displacement.
D They travel the same distance.



117 - (9702/11_Summer_2023_Q6) - Kinematics

A ball is kicked so that it has an initial velocity of 12 m s^{-1} at an angle of 50° to horizontal ground.

Assume that air resistance is negligible.

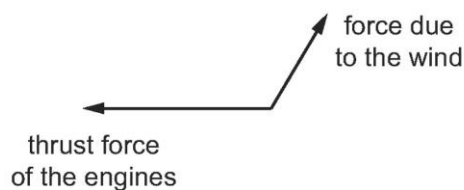


What is the maximum height above the ground that is reached by the ball?

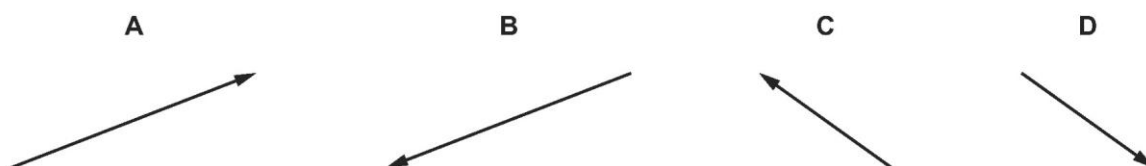
- A 0.47 m B 3.0 m C 4.3 m D 7.3 m

118 - (9702/12_Summer_2023_Q4) - Kinematics

An aircraft travels along a horizontal path. Two of the forces that act horizontally on the aircraft are the thrust force of the engines and the force due to the wind. The vector diagram for these forces is shown.

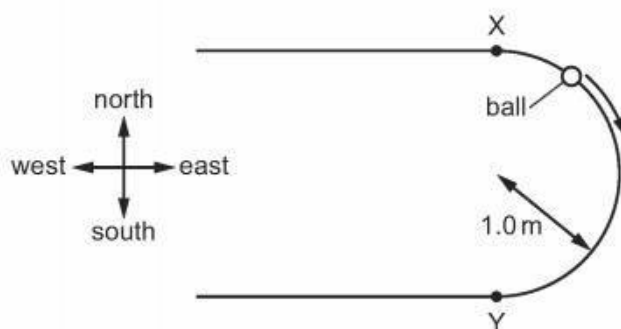


Which vector represents the resultant horizontal force acting on the aircraft due to these two forces?



119 - (9702/12_Summer_2023_Q5) - Kinematics

A ball travels from point X to point Y around a semicircular track of radius 1.0 m, as shown.



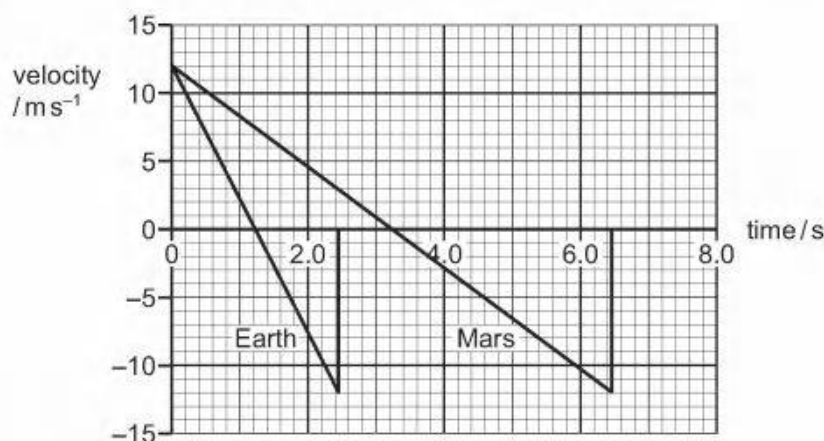
What is the displacement of the ball from X to Y?

- A 2.0 m
- B 2.0 m due south
- C 3.1 m
- D 3.1 m due south

120 - (9702/12_Summer_2023_Q6) - Kinematics

A rock is launched vertically upwards from the surface of the Earth and an identical rock is launched vertically upwards from the surface of Mars. Each rock is launched with an initial velocity of 12 m s^{-1} .

Each rock then reaches its maximum height above the surface before returning back down to the surface. The velocity–time graph for each rock is shown. In both cases, air resistance is negligible.



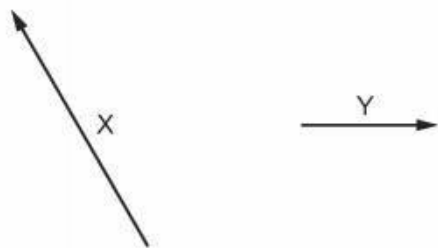
What is the difference in the maximum heights of the two rocks?

- A 12 m
- B 15 m
- C 19 m
- D 24 m

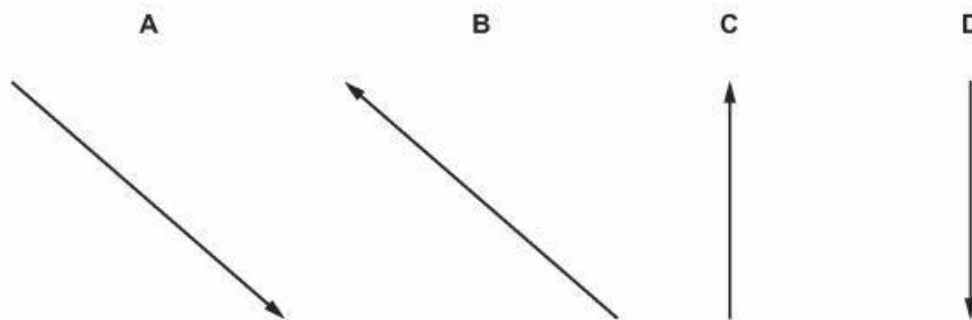


121 - (9702/13_Summer_2023_Q4) - Kinematics

The diagram shows two vectors, X and Y, drawn to scale.



If $X = Y - Z$, which diagram represents the vector Z?



122 - (9702/13_Summer_2023_Q5) - Kinematics

Which equation, representing uniformly accelerated motion in a straight line, can be determined using **only** the definition of acceleration?

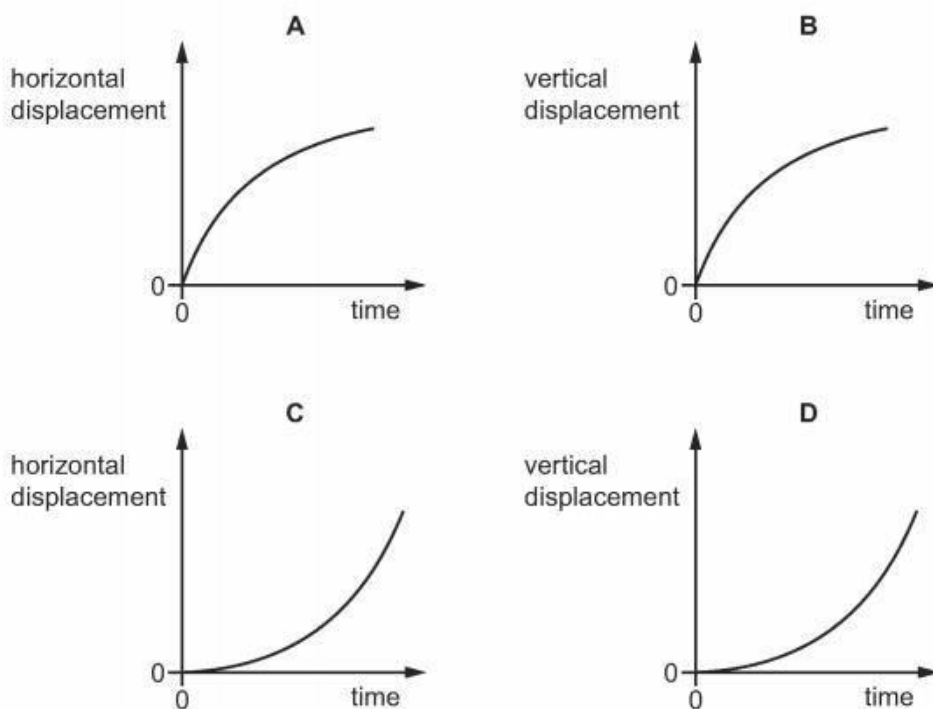
- A $s = ut + \frac{1}{2}at^2$
- B $s = \frac{1}{2}(u + v)t$
- C $v = u + at$
- D $v^2 = u^2 + 2as$



123 - (9702/13_Summer_2023_Q6) - Kinematics

An object moves from rest with uniform velocity horizontally and uniform acceleration vertically.

Which graph showing the variation with time of the displacement of the object from its initial position is correct?



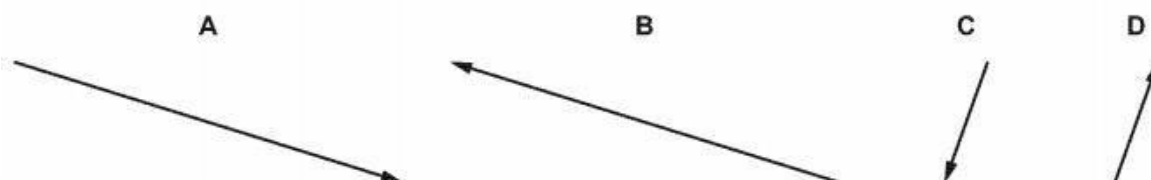
124 - (9702/11_Winter_2023_Q4) - Kinematics

The diagram shows two coplanar forces, P and Q , drawn to scale.



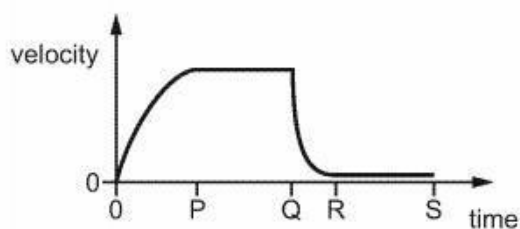
Force R is given by $R = Q - P$.

Which diagram represents R ?

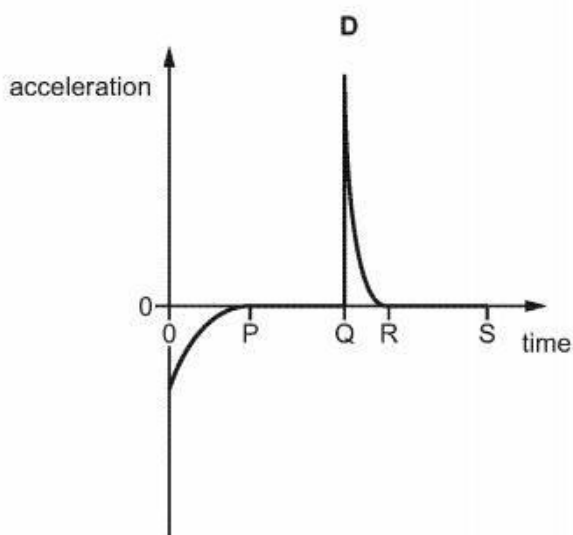
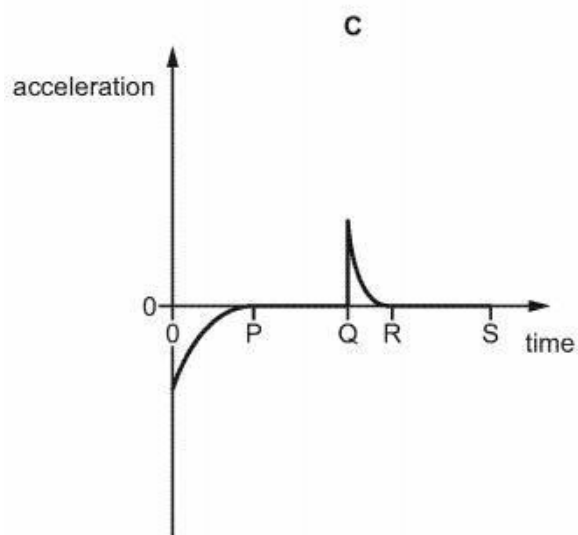
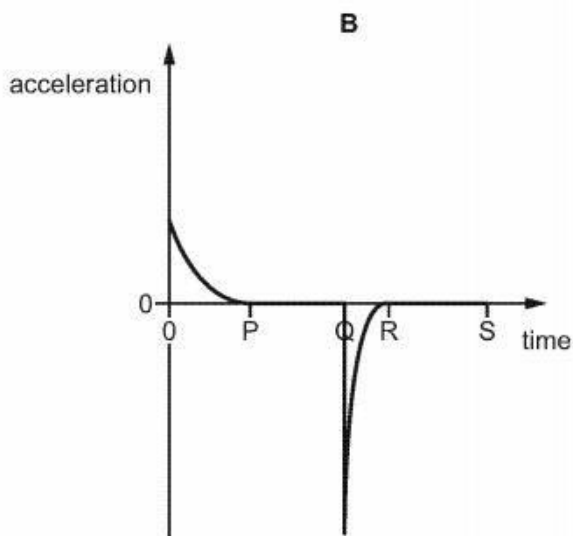
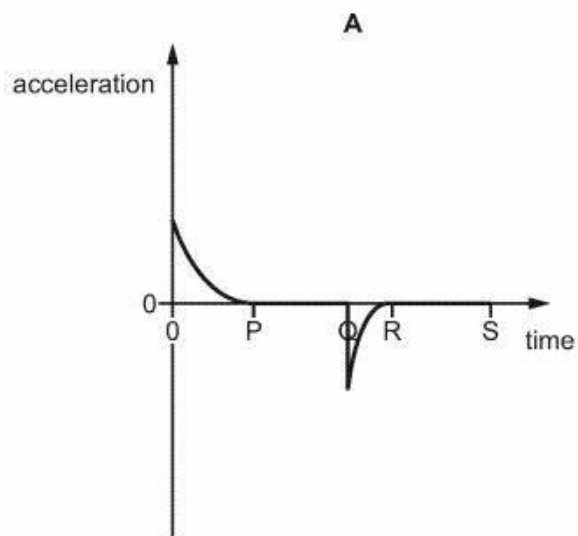


125 - (9702/11_Winter_2023_Q5) - Kinematics

A parachutist falls from a stationary balloon at time $t = 0$. The velocity–time graph for the parachutist from time $t = 0$ until the time when he is just above the ground is shown.

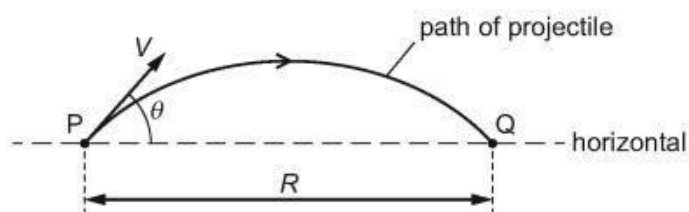


Which graph best shows the variation with time of the acceleration of the parachutist?



126 - (9702/11_Winter_2023_Q6) - Kinematics

A projectile is fired from point P with velocity V at an angle θ to the horizontal. It lands at point Q, a horizontal distance R from P, after time T .



The acceleration of free fall is g . Air resistance is negligible.

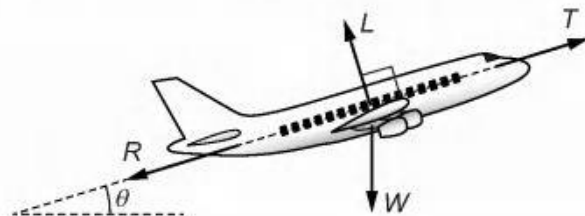
Which equation is correct?

- A $R = VT \cos \theta$
- B $R = VT \sin \theta$
- C $R = VT \cos \theta - \frac{1}{2}gT^2$
- D $R = VT \sin \theta - \frac{1}{2}gT^2$

127 - (9702/12_Winter_2023_Q4) - Kinematics

An aeroplane is moving at a constant speed in a straight line at an angle θ to the horizontal.

Four forces act on the aeroplane: thrust force T , weight W , lift force L and resistive force R .



Which two equations must be correct?

- A $L = W \cos \theta$ and $T = R + W \sin \theta$
- B $L = W \sin \theta$ and $T = R + W \cos \theta$
- C $L = W \cos \theta$ and $T = R - W \sin \theta$
- D $L = W \sin \theta$ and $T = R - W \cos \theta$

128 - (9702/12_Winter_2023_Q5) - Kinematics

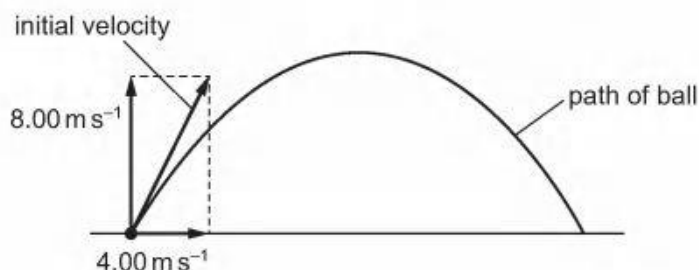
What is the definition of acceleration?

- A the rate of change of displacement
- B the rate of change of kinetic energy
- C the rate of change of momentum
- D the rate of change of velocity



129 - (9702/12_Winter_2023_Q6) - Kinematics

An astronaut on the Moon, where there is no air resistance, throws a ball. The ball's initial velocity has a vertical component of 8.00 m s^{-1} and a horizontal component of 4.00 m s^{-1} , as shown.



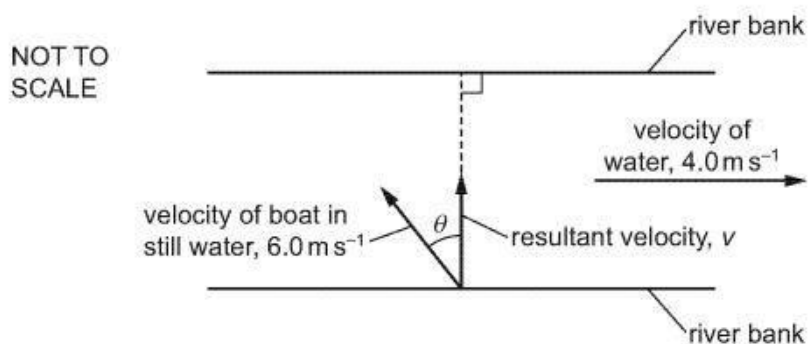
The acceleration of free fall on the Moon is 1.62 m s^{-2} .

What is the speed of the ball 9.00 s after being thrown?

- A 6.58 m s^{-1} B 7.70 m s^{-1} C 10.6 m s^{-1} D 14.6 m s^{-1}

130 - (9702/13_Winter_2023_Q4) - Kinematics

A boat is crossing a river in which the water is moving at a speed of 4.0 m s^{-1} from left to right.



In still water, the speed of the boat is 6.0 m s^{-1} . The boat is directed at an angle θ to a line perpendicular to the river banks. The resultant velocity v of the boat is in a direction perpendicular to the river banks.

What are the values of θ and v ?

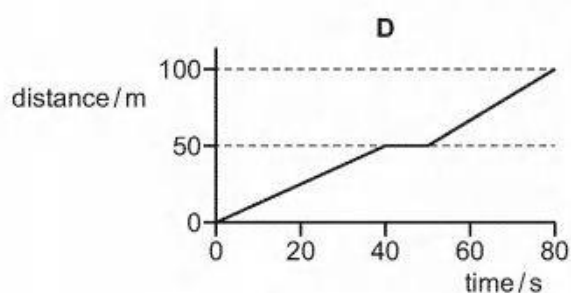
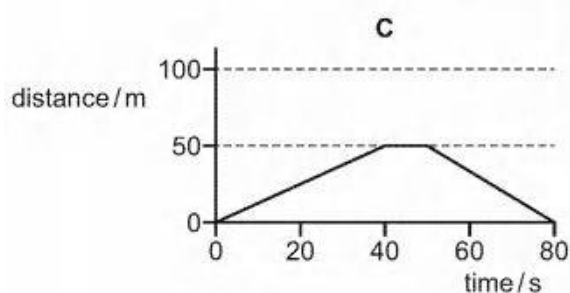
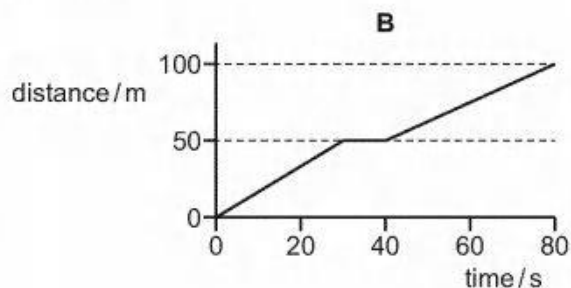
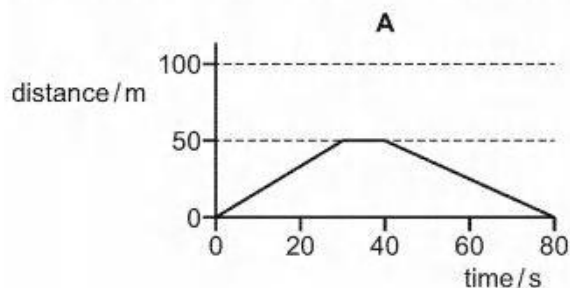
	$\theta / ^\circ$	$v / \text{m s}^{-1}$
A	42	4.5
B	42	7.2
C	48	4.5
D	48	7.2



131 - (9702/13_Winter_2023_Q5) - Kinematics

A student walks at a constant speed for a distance of 50 m in a time of 40 s. The student rests for a time of 10 s and then walks back to the starting point at a constant speed in a time of 30 s.

What is the distance–time graph for the motion of the student?



132 - (9702/13_Winter_2023_Q6) - Kinematics

The time taken for an object to fall from rest through a certain distance on Mars is T_M . The time taken for the same object to fall from rest through the same distance on Earth is T_E . The acceleration of free fall on Mars is 3.71 m s^{-2} .

Assume that air resistance is negligible on both Earth and Mars.

What is the ratio $\frac{T_M}{T_E}$?

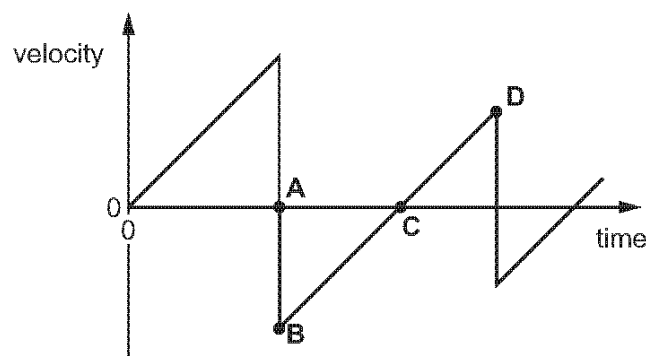
- A 0.378 B 0.615 C 1.63 D 2.64



1 - (9702/11_Summer_2017_Q5) - Dynamics

A ball is released from rest above a hard, horizontal surface. The graph shows how the velocity of the bouncing ball varies with time.

At which point on the graph does the ball reach its maximum height after the first bounce?

**2** - (9702/11_Summer_2017_Q7) - Dynamics

The mass of a rocket-propelled truck is approximately equal to the mass of the fuel in its tank. The fuel is ignited and the truck is propelled along horizontal tracks by a constant force. The effect of air resistance is negligible.

During a test run the fuel is consumed at a constant rate.

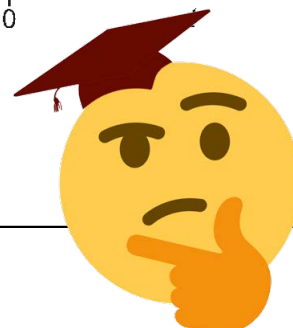
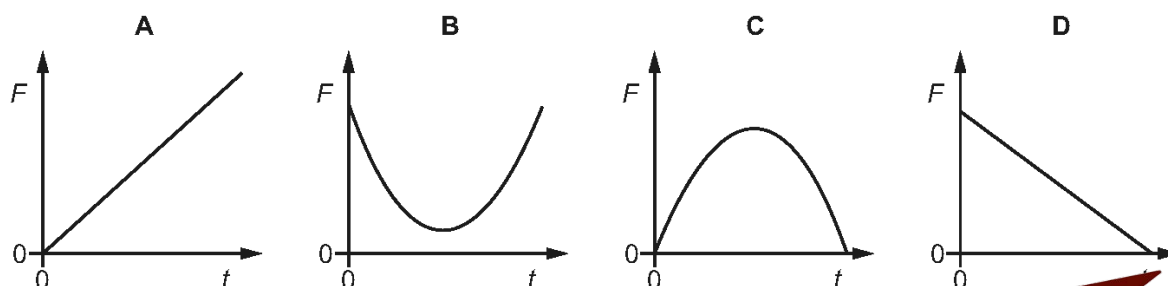
Which statement describes the acceleration of the truck during the test run?

- A** The acceleration of the truck decreases as the fuel is consumed.
- B** The acceleration of the truck increases as the fuel is consumed.
- C** The acceleration of the truck remains constant.
- D** The acceleration of the truck is zero and the truck moves at a constant velocity.

3 - (9702/12_Summer_2017_Q7) - Dynamics

A rubber ball is dropped onto a table and bounces back up. The table exerts a force F on the ball.

Which graph best shows the variation with time t of the force F for the short time that the ball is in contact with the table?

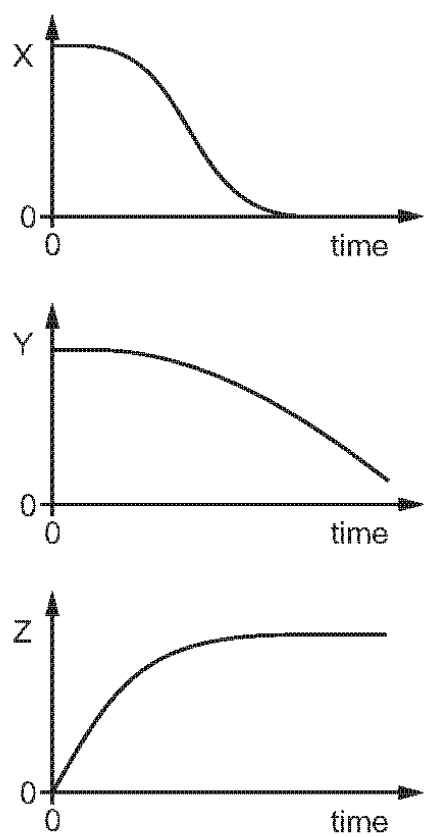


4 - (9702/11_Summer_2017_Q8) - Kinematics, Dynamics

An object is dropped at time $t = 0$ from a high building. Air resistance is significant.

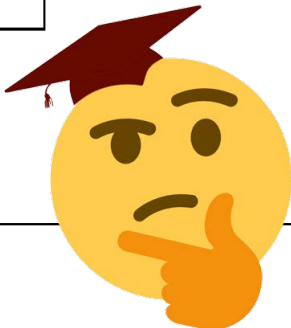
Three graphs are plotted against time.

- the height of the object above the ground
- the speed of the object
- the magnitude of the resultant force on the object



What are the quantities X, Y and Z?

	height of the object above the ground	speed of the object	magnitude of the resultant force on the object
A	X	Y	Z
B	X	Z	Y
C	Y	Z	X
D	Z	Y	X



5 - (9702/12_Summer_2017_Q8) - Dynamics

A golf ball of mass m is dropped onto a hard surface from a height h_1 and rebounds to a height h_2 .

The momentum of the golf ball just as it reaches the surface is different from its momentum just as it leaves the surface.

What is the total change in the momentum of the golf ball between these two instants? (Ignore air resistance.)

A $m\sqrt{2gh_1} - m\sqrt{2gh_2}$

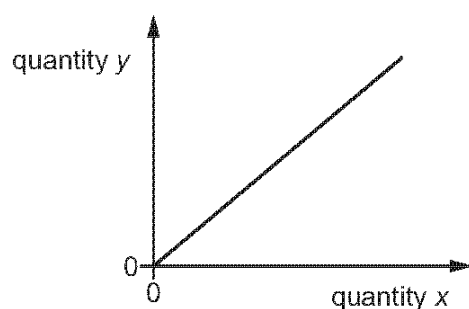
B $m\sqrt{2gh_1} + m\sqrt{2gh_2}$

C $m\sqrt{2g(h_1 - h_2)}$

D $m\sqrt{2g(h_1 + h_2)}$

6 - (9702/13_Summer_2017_Q8) - Kinematics, Dynamics

The graph shows the variation of a quantity y with a quantity x for a body that is falling in air at constant (terminal) velocity in a uniform gravitational field.



Which quantities could x and y represent?

	x	y
A	air resistance	acceleration
B	loss of height	gain in kinetic energy
C	loss of potential energy	work done against air resistance
D	time	velocity

7 - (9702/13_Summer_2017_Q9) - Dynamics

A ball of mass 2.0 kg travels horizontally with a speed of 4.0 ms^{-1} . The ball collides with a wall and rebounds in the opposite direction with a speed of 2.8 ms^{-1} . The time of the collision is 150 ms .

What is the average force exerted on the wall?

A 16 N

B 37 N

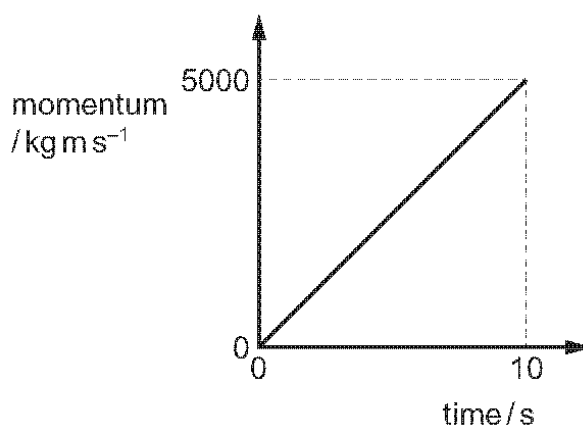
C 53 N

D 91 N



8 - (9702/11_Summer_2017_Q10) - Dynamics

The graph shows how the momentum of a motorcycle changes with time.



What is the resultant force on the motorcycle?

- A** 500 N **B** 5000 N **C** 25 000 N **D** 50 000 N

9 - (9702/13_Summer_2017_Q10) - Dynamics

An ice-hockey puck of mass 150 g moves with an initial speed of 2.0 ms^{-1} along the surface of an ice rink.

The puck slides a distance of 30 m in a straight line before stopping.

What is the average frictional force acting on the puck?

- A** 0.010 N **B** 0.020 N **C** 0.067 N **D** 0.44 N

10 - (9702/12_Summer_2017_Q14) - Dynamics, Work, Energy & Power

Which quantities are conserved in an inelastic collision?

	kinetic energy	total energy	linear momentum
A	conserved	not conserved	conserved
B	conserved	not conserved	not conserved
C	not conserved	conserved	conserved
D	not conserved	conserved	not conserved



11 - (9702/13_Summer_2017_Q16) - *Dynamics*

A constant force pushes a block along a horizontal frictionless surface. The block moves from rest through a fixed distance.

What is the relationship between the final speed v of the block and its mass m ?

- A** $\sqrt{v} \propto \frac{1}{m}$ **B** $v \propto \sqrt{m}$ **C** $v \propto \frac{1}{\sqrt{m}}$ **D** $\sqrt{v} \propto m$

12 - (9702/11_Winter_2017_Q8) - *Dynamics, Forces, Density & Pressure*

The three forces acting on a hot-air balloon that is moving vertically are its weight, the force due to air resistance and the upthrust force.

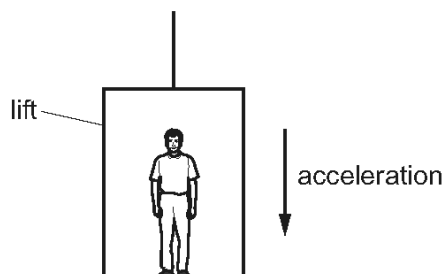
The hot-air balloon descends vertically at constant speed. The force of air resistance on the balloon is F .

Which weight of material must be released from the balloon so that it ascends vertically at the same constant speed?

- A** F **B** $2F$ **C** $3F$ **D** $4F$

13 - (9702/13_Winter_2017_Q8) - *Dynamics*

A man stands in a lift that is accelerating vertically downwards, as shown.



Which statement describes the force exerted by the man on the floor?

- A** It is equal to the weight of the man.
B It is greater than the force exerted by the floor on the man.
C It is less than the force exerted by the floor on the man.
D It is less than the weight of the man.



14 - (9702/11_Winter_2017_Q9) - Dynamics

A car is moving at constant speed in a straight line with the engine providing a driving force equal to the resistive force F .

When the engine is switched off, the car is brought to rest in a distance of 100 m by the resistive force.

It may be assumed that F is constant during the deceleration.

The process is then repeated for the same car with the same initial speed but with a constant resistive force of $0.800 F$.

How far will the car travel while decelerating?

- A 120 m B 125 m C 156 m D 250 m

15 - (9702/12_Winter_2017_Q9) - Dynamics

A slow vehicle and a fast vehicle travel towards each other in a straight line and then collide.

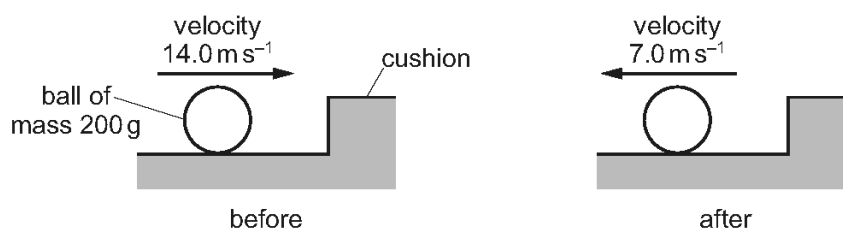
Which outcome is **never** possible, regardless of the masses of the vehicles?

- A Both vehicles stop.
B Only one vehicle stops.
C The fast vehicle's speed increases.
D The slow vehicle's speed increases.

16 - (9702/13_Winter_2017_Q9) - Dynamics

A snooker ball of mass 200 g hits the cushion of a snooker table at right-angles with a speed of 14.0 m s^{-1} .

The ball rebounds with half of its initial speed. The ball is in contact with the cushion for 0.60 s.



What is the average force exerted on the ball by the cushion?

- A 2.3 N B 7.0 N C 2300 N D 7000 N



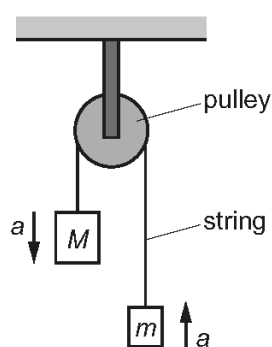
17 - (9702/11_Winter_2017_Q10) - Dynamics

What is a statement of the principle of conservation of momentum?

- A In an elastic collision momentum is constant.
- B Momentum is the product of mass and velocity.
- C The force acting on a body is proportional to its rate of change of momentum.
- D The momentum of an isolated system is constant.

18 - (9702/12_Winter_2017_Q10) - Dynamics

Two blocks of masses M and m are joined by a thin string which passes over a frictionless pulley, as shown.



The acceleration of free fall is g .

What is the acceleration a of the two blocks?

- A $\frac{(M+m)}{(M-m)}g$ B $\frac{(M-m)}{(M+m)}g$ C $\frac{M}{m}g$ D $\frac{m}{M}g$

19 - (9702/13_Winter_2017_Q10) - Dynamics

Two railway trucks of masses m and $3m$ move towards each other in opposite directions with speeds $2v$ and v respectively. These trucks collide and stick together.

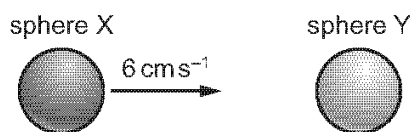
What is the speed of the trucks after the collision?

- A $\frac{v}{4}$ B $\frac{v}{2}$ C v D $\frac{5v}{4}$



20 - (9702/11_Winter_2017_Q11) - Dynamics

Two solid spheres form an isolated system. Sphere X moves with speed 6 cm s^{-1} in a straight line directly towards a stationary sphere Y, as shown.



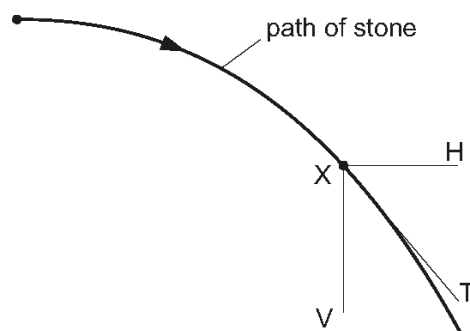
The spheres have a perfectly elastic collision. After the collision, sphere X moves with speed 2 cm s^{-1} in the same direction as before the collision.

What is the speed of sphere Y?

- A 2 cm s^{-1} B 4 cm s^{-1} C 6 cm s^{-1} D 8 cm s^{-1}

21 - (9702/13_Winter_2017_Q11) - Kinematics, Dynamics

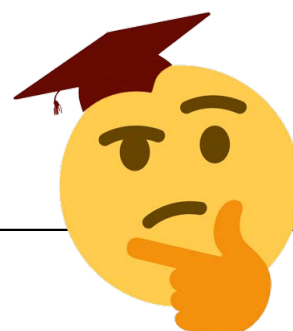
A stone is projected horizontally in a vacuum and moves along the path shown.



X is a point on this path. XV and XH are vertical and horizontal lines respectively through X. XT is the tangent to the path at X.

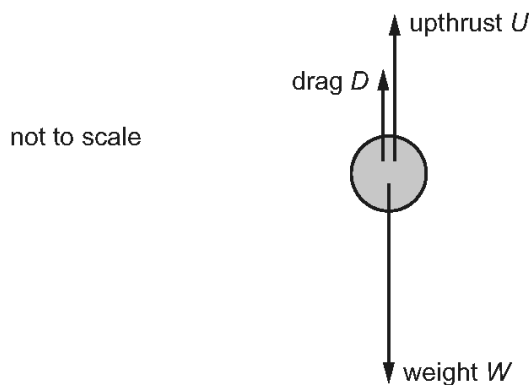
Along which directions do forces act on the stone at X?

- A XV and XH B XV only C XH only D XT only



22 - (9702/13_Winter_2017_Q13) - Dynamics, Forces, Density & Pressure

A solid sphere falls at constant (terminal) velocity in a liquid. The three forces acting on the sphere are shown in the diagram.

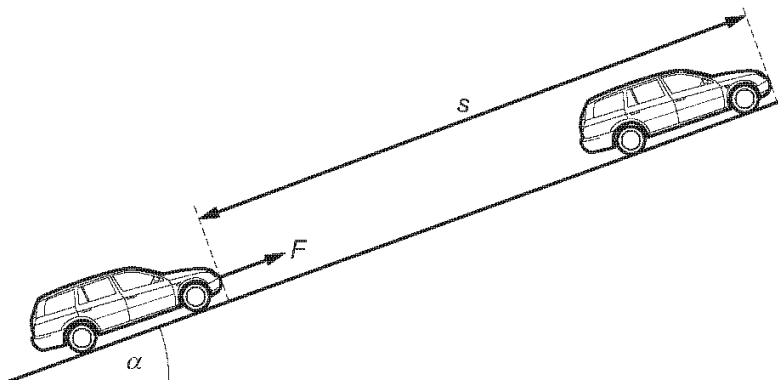


How are the three forces related?

- A $W + D = U$
- B $W > U + D$
- C $W - U = D$
- D $W < D + U$

23 - (9702/12_Winter_2017_Q17) - Dynamics

A constant force F , acting on a car of mass m , moves the car up a slope through a distance s at constant velocity v . The angle of the slope to the horizontal is α .



What is the ratio $\frac{\text{gravitational potential energy gained by car}}{\text{work done by force } F}$?

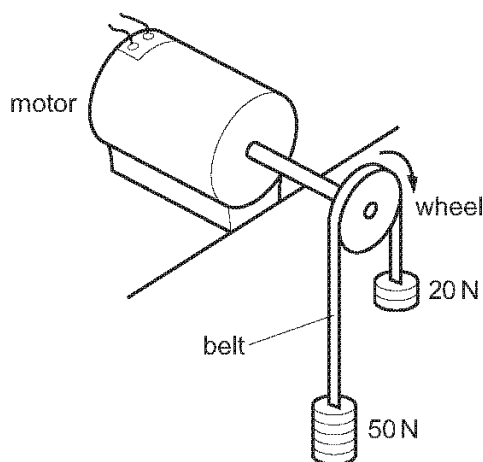
- A $\frac{mgs \sin \alpha}{Fv}$
- B $\frac{mv}{Fs}$
- C $\frac{mv^2}{2Fs}$
- D $\frac{mg \sin \alpha}{F}$



24 - (9702/13_Winter_2017_Q19) - Dynamics, Motion In A Circle

The diagram shows an arrangement used to find the output power of an electric motor.

The wheel attached to the motor's axle has a circumference of 0.5 m and the belt which passes over it is stationary when the weights have the values shown.

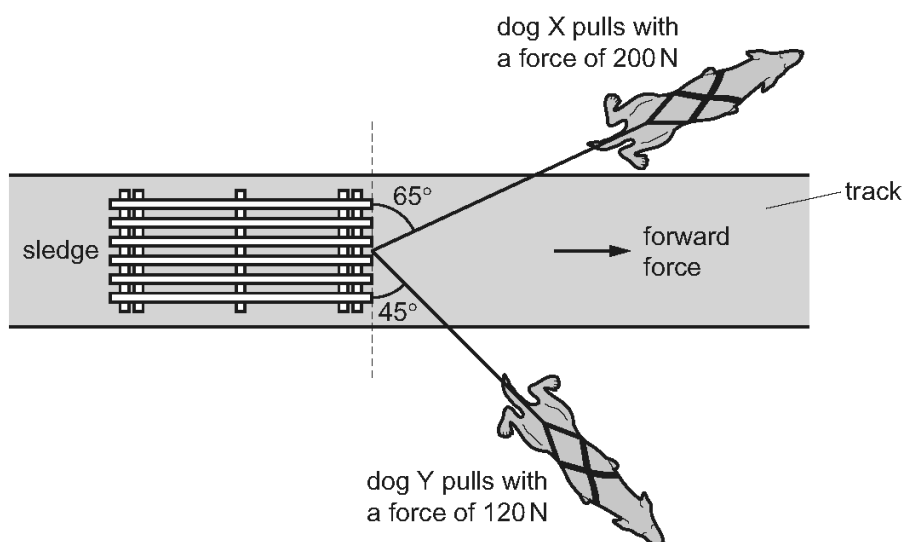


When the wheel is making 20 revolutions per second, what is the output power of the motor?

- A 300 W B 500 W C 600 W D 700 W

25 - (9702/11_Summer_2018_Q3) - Dynamics

Two dogs pull a sledge along an icy track, as shown.



Dog X pulls with a force of 200 N at an angle of 65° to the front edge of the sledge. Dog Y pulls with a force of 120 N at an angle of 45° to the front edge of the sledge.

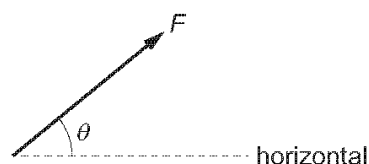
What is the resultant forward force on the sledge exerted by the two dogs?

- A 80 N B 170 N C 270 N D 320 N



26 - (9702/13_Summer_2018_Q3) - Dynamics

A force F acts at an angle θ to the horizontal.

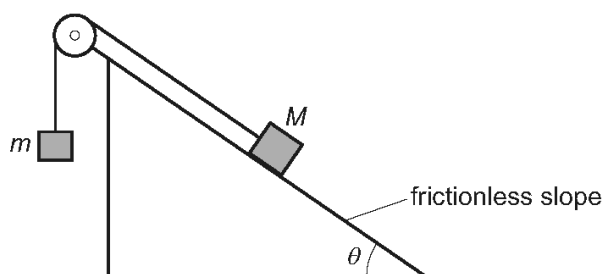


What are the horizontal and the vertical components of the force?

	horizontal component	vertical component
A	$F \cos \theta$	$F \cos (90^\circ - \theta)$
B	$F \cos \theta$	$F \sin (90^\circ - \theta)$
C	$F \sin \theta$	$F \cos \theta$
D	$F \sin \theta$	$F \cos (90^\circ - \theta)$

27 - (9702/13_Summer_2018_Q7) - Dynamics

Two masses, M and m , are connected by an inextensible string which passes over a frictionless pulley. Mass M rests on a frictionless slope, as shown.



The slope is at an angle θ to the horizontal.

The two masses are initially held stationary and then released. Mass M moves down the slope.

Which expression **must** be correct?

- A $\sin \theta < \frac{m}{M}$ B $\cos \theta < \frac{m}{M}$ C $\sin \theta > \frac{m}{M}$ D $\cos \theta > \frac{m}{M}$

28 - (9702/12_Summer_2018_Q8) - Dynamics

A tennis ball of mass 55g is travelling horizontally with a speed of 30 m s^{-1} . The ball makes contact with a wall before rebounding in the horizontal direction with a speed of 20 m s^{-1} . The ball is in contact with the wall for a time of $5.0 \times 10^{-3} \text{ s}$.

What is the average force exerted on the wall by the ball?

- A 110N B 220N C 330N D 550N



29 - (9702/12_Summer_2018_Q11) - Dynamics

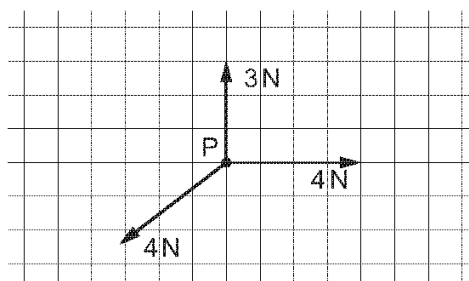
An astronaut throws a stone horizontally near to the surface of the Moon, where there is no atmosphere.

Which row describes the horizontal and vertical forces acting on the stone after release?

	horizontal force	vertical force
A	non-zero and constant	constant
B	non-zero and constant	decreasing
C	zero	constant
D	zero	decreasing

30 - (9702/12_Summer_2018_Q15) - Dynamics, Forces, Density & Pressure

The vector diagram shows three coplanar forces acting on an object at P.



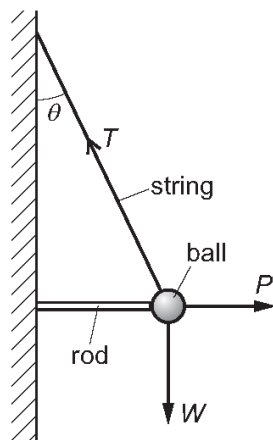
The magnitude of the resultant of these three forces is 1 N.

What is the direction of this resultant force?



31 - (9702/12_Summer_2018_Q17) - Dynamics

The diagram shows a ball of weight W hanging in equilibrium from a string.



The string is at an angle θ to the vertical. The tension in the string is T . The ball is held away from the wall by a horizontal force P from a metal rod.

What is the relationship between the magnitudes of T , P and W ?

- A $P = T \cos \theta$ and $W = T \sin \theta$
- B $T = P + W$
- C $T^2 = P^2 + W^2$
- D $W = P \tan \theta$ and $W = T \cos \theta$

32 - (9702/11_Winter_2018_Q7) - Dynamics

Water is pumped through a hose-pipe at a rate of 90 kg per minute. Water emerges horizontally from the hose-pipe with a speed of 20 m s^{-1} .

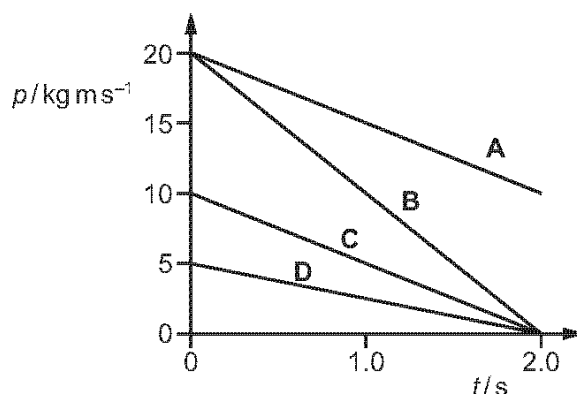
What is the minimum force required from a person holding the hose-pipe to prevent it moving backwards?

- A 30 N B 270 N C 1800 N D 108 000 N

33 - (9702/12_Winter_2018_Q7) - Dynamics

A resultant force of 10 N acts on a body for a time of 2.0 s.

Which graph could show the variation with time t of the momentum p of the body?



34 - (9702/12_Winter_2018_Q8) - Dynamics

The acceleration of free fall on the surface of planet P is one tenth of that on the surface of planet Q.

On the surface of P, a body has a mass of 1.0 kg and a weight of 1.0 N.

What are the mass and the weight of the same body on the surface of planet Q?

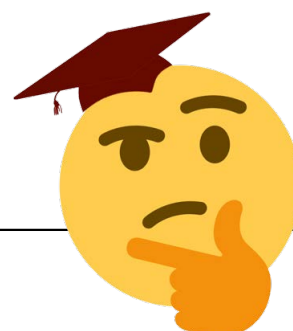
	mass on Q / kg	weight on Q / N
A	1.0	0.1
B	1.0	10
C	10	10
D	10	100

35 - (9702/12_Winter_2018_Q9) - Dynamics

Two bodies travelling along the same straight line collide in a perfectly elastic collision.

Which statement **must** be correct?

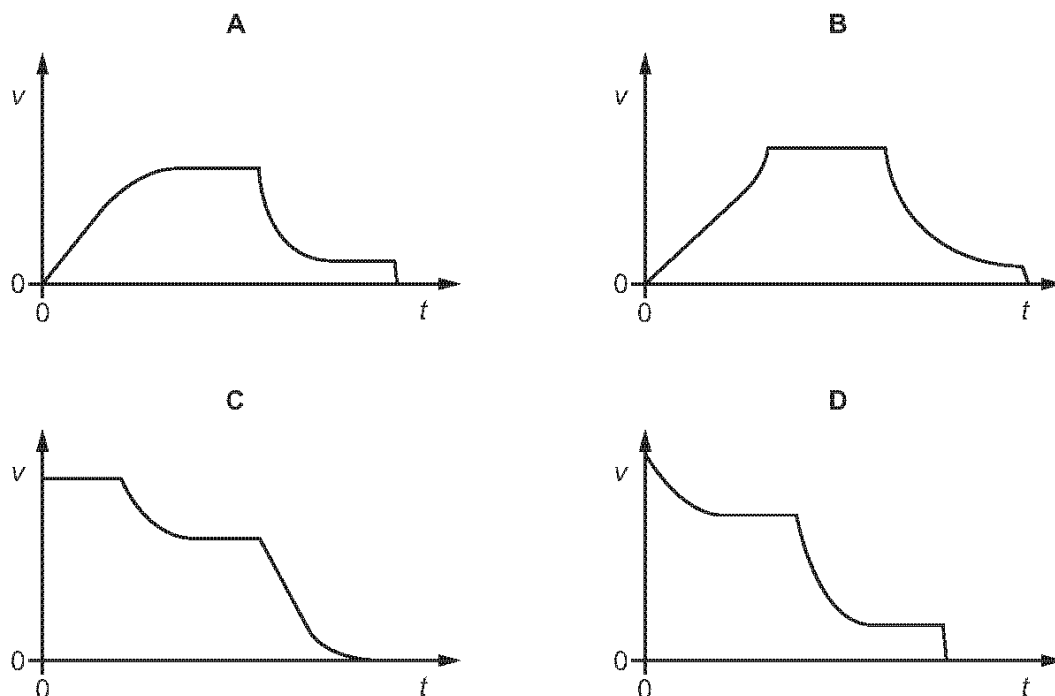
- A The initial speed of one body will be the same as the final speed of the other body.
- B The relative speed of approach between the two bodies equals their relative speed of separation.
- C The total momentum is conserved but the total kinetic energy will be reduced.
- D One of the bodies will be stationary at one instant.



36 - (9702/13_Winter_2018_Q9) - Dynamics

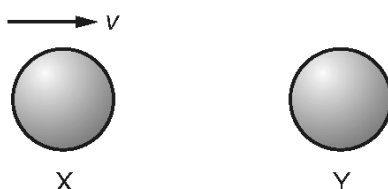
A parachutist falls vertically from rest at time $t = 0$ from a hot-air balloon. She falls for some distance before opening her parachute.

Which graph best shows the variation with time t of the speed v of the parachutist?



37 - (9702/12_Winter_2018_Q10) - Dynamics

The diagram shows two identical spheres X and Y.



Initially, X moves with speed v directly towards Y. Y is stationary. The spheres collide elastically.

What happens?

	X	Y
A	moves with speed $\frac{1}{2}v$ to the right	moves with speed $\frac{1}{2}v$ to the right
B	moves with speed v to the left	remains stationary
C	moves with speed $\frac{1}{2}v$ to the left	moves with speed $\frac{1}{2}v$ to the right
D	stops	moves with speed v to the right



38 - (9702/13_Winter_2018_Q10) - Dynamics

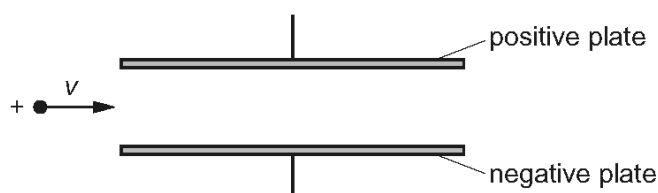
A ship of mass $8.4 \times 10^7 \text{ kg}$ is approaching a harbour with speed 16.4 ms^{-1} . By using reverse thrust it can maintain a constant total stopping force of $920\,000 \text{ N}$.

How long will it take to stop?

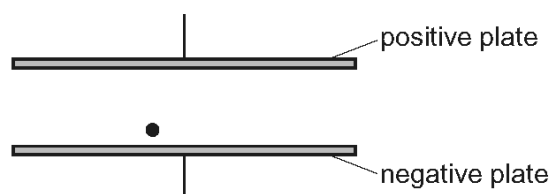
- A 15 seconds
- B 150 seconds
- C 25 minutes
- D 250 minutes

39 - (9702/12_Winter_2018_Q11) - Dynamics, Electric Fields

A positively-charged particle of negligible mass, moving at constant velocity v in a vacuum, enters a uniform electric field between two parallel plates, as shown.



A short time later, the particle is at the position shown.



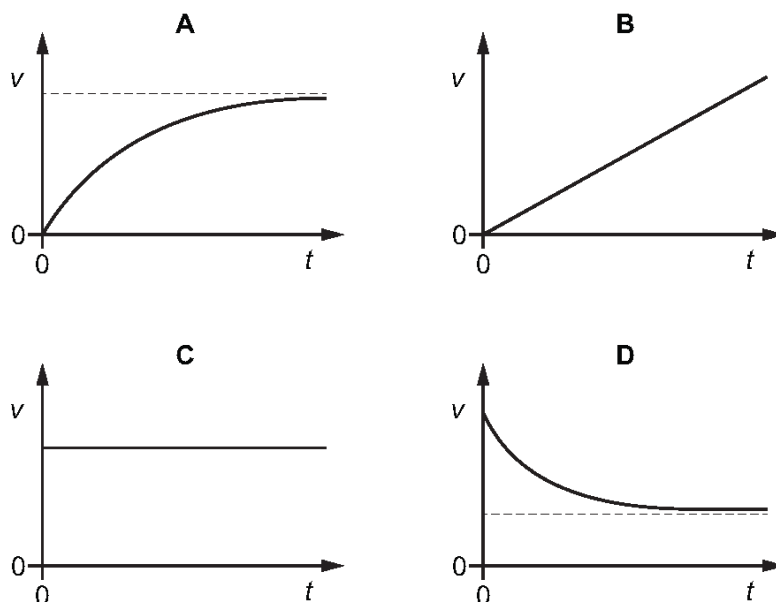
Which diagram represents the force or forces acting on the particle?



40 - (9702/13_Winter_2018_Q11) - Dynamics, Forces, Density & Pressure

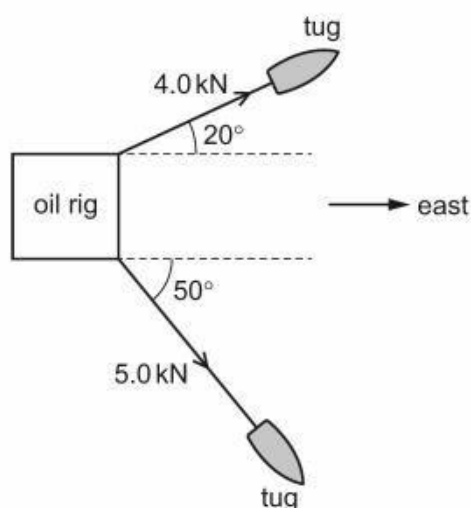
A rigid, hollow sphere is immersed deep in water and released from rest. It experiences an upthrust which propels it towards the surface of the water.

Which graph best shows the variation with time t of its upward velocity v ?



41 - (9702/13_Summer_2019_Q3) - Dynamics

Two tugs are towing an oil rig as shown.



The tensions in the towing cables are 4.0 kN and 5.0 kN.

What is the total force acting on the rig due to the cables, in the direction to the east?

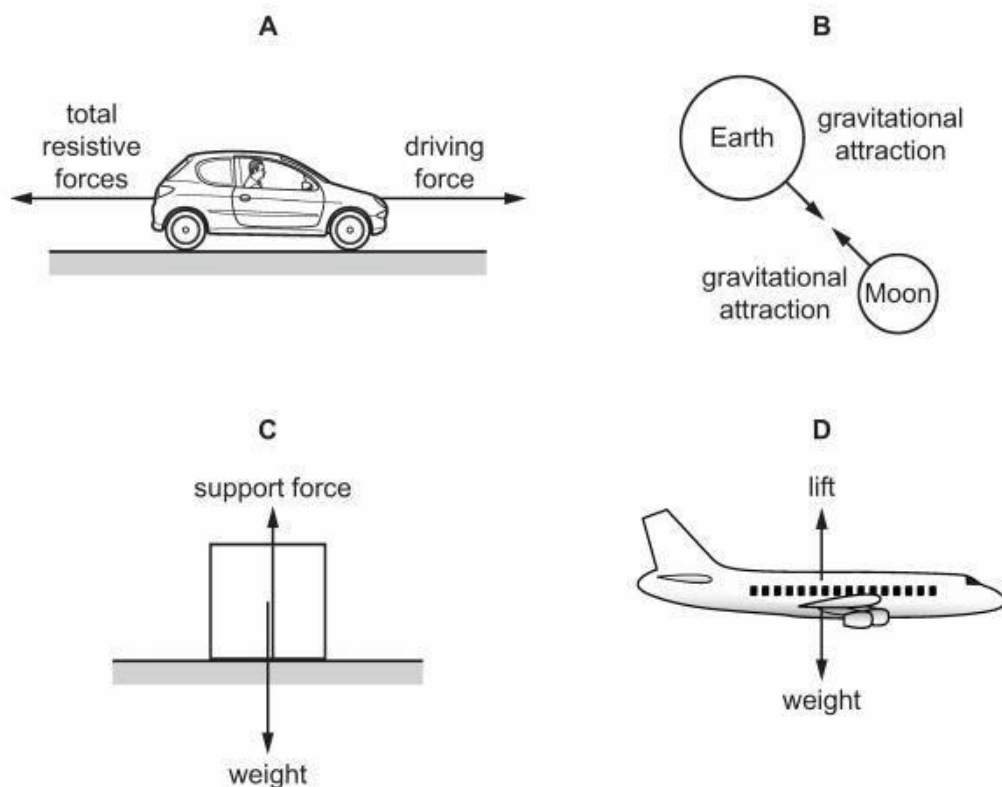
- A** 3.1 kN **B** 5.2 kN **C** 7.0 kN **D** 7.3 kN



42 - (9702/11_Summer_2019_Q9) - Dynamics

Each diagram illustrates a pair of forces of equal magnitude.

Which diagram gives an example of a pair of forces that is described by Newton's third law of motion?



43 - (9702/12_Summer_2019_Q9) - Dynamics

What describes the mass of an object?

- A the force the object experiences due to gravity
- B the momentum of the object before a collision
- C the resistance of the object to changes in motion
- D the weight of the object as measured by a balance

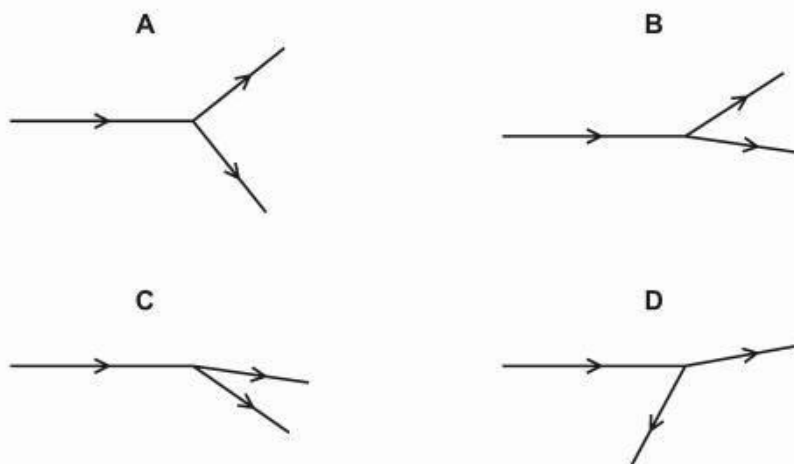


44 - (9702/13_Summer_2019_Q9) - Dynamics

A nucleus collides with a stationary nucleus in a vacuum. The diagrams show the paths of the nuclei before and after the collision.

No other particles are involved in the collision.

Which diagram is **not** possible?

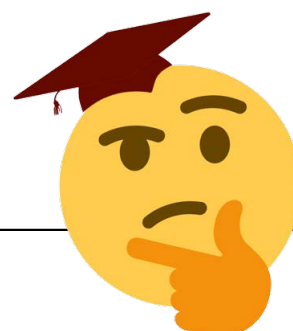


45 - (9702/12_Summer_2019_Q10) - Dynamics

A car has mass m . A person needs to push the car with force F in order to give the car acceleration a . The person needs to push the car with force $2F$ in order to give the car acceleration $3a$.

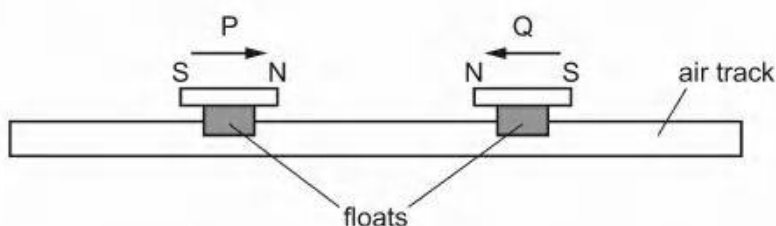
Which expression gives the constant resistive force opposing the motion of the car?

- A ma B $2ma$ C $3ma$ D $4ma$



46 - (9702/12_Summer_2019_Q11) - Dynamics

Two bar magnets P and Q are mounted on floats which can slide without friction along an air track.



The two magnets slide towards each other along the air track and interact, without making contact.

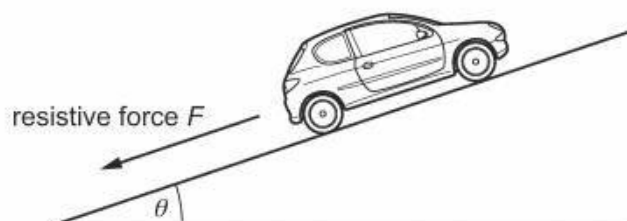
The relative speed of approach of the magnets is equal to their relative speed of separation.

Which statement about P and Q must be correct?

- A During the interaction between P and Q some of the total kinetic energy is lost.
- B During the interaction between P and Q some of the total momentum is lost.
- C The momentum of Q after the interaction is equal to the momentum of P before the interaction.
- D The values of (kinetic energy of P + kinetic energy of Q) before and after the interaction are equal.

47 - (9702/12_Summer_2019_Q14) - Dynamics

A car of mass m travels at constant speed up a slope at an angle θ to the horizontal, as shown in the diagram. Air resistance and friction provide a resistive force F . The acceleration of free fall is g .



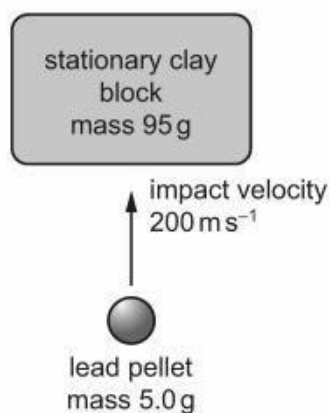
What is the force needed to propel the car at this constant speed?

- A $mg \cos \theta$
- B $mg \sin \theta$
- C $mg \cos \theta + F$
- D $mg \sin \theta + F$



48 - (9702/13_Summer_2019_Q17) - Dynamics, Work, Energy & Power

A lead pellet is shot vertically upwards into a clay block that is stationary at the moment of impact but is able to rise freely after impact.



The mass of the pellet is 5.0 g and the mass of the clay block is 95 g.

The pellet hits the block with an initial vertical velocity of 200 m s⁻¹. It embeds itself in the block and does not emerge.

How high above its initial position will the block rise?

- A** 5.1 m **B** 5.6 m **C** 10 m **D** 100 m

49 - (9702/11_Winter_2019_Q7) - Dynamics

Which statement follows directly from Newton's first law?

- A** A body remains at constant velocity unless acted upon by a resultant force.
B A satellite in circular motion about the Earth has a constant velocity.
C A water drop leaving a spinning umbrella travels at a constant velocity.
D The force acting on an object is equal to its change in momentum.

50 - (9702/12_Winter_2019_Q7) - Dynamics

A snooker ball has a mass of 200 g. It hits the cushion of a snooker table and rebounds along its original path.

The ball arrives at the cushion with a speed of 14.0 m s⁻¹ and then leaves it with a speed of 7.0 m s⁻¹. The ball and the cushion are in contact for a time of 0.60 s.

What is the average force exerted on the ball by the cushion?

- A** 1.4 N **B** 2.3 N **C** 4.2 N **D** 7.0 N

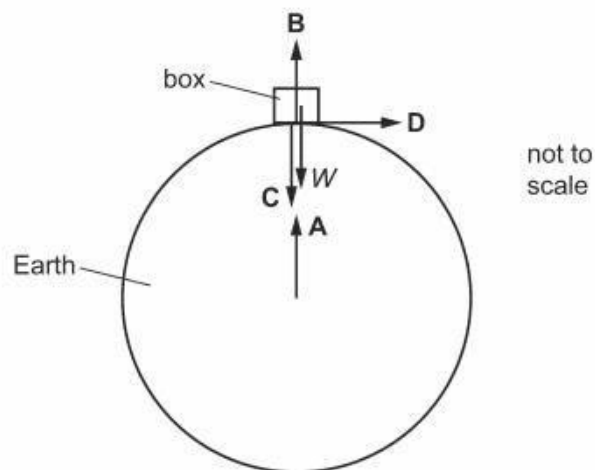


51 - (9702/13_Winter_2019_Q7) - Dynamics

A box rests on the Earth, as shown.

Newton's third law describes how forces of the same type act in pairs. One of the forces of a pair is the weight W of the box.

Which arrow represents the other force of this pair?



52 - (9702/11_Winter_2019_Q8) - Dynamics

A resultant force causes an object to accelerate.

What is equal to the resultant force?

- A the acceleration of the object per unit mass
- B the change in kinetic energy of the object per unit time
- C the change in momentum of the object per unit time
- D the change in velocity of the object per unit time



53 - (9702/13_Winter_2019_Q8) - Dynamics

A snowflake is falling from the sky on a still day. Its weight acts vertically downwards and air resistance acts vertically upwards. As the snowflake falls, air resistance increases until it is equal to the weight and there is no resultant force acting on the snowflake.

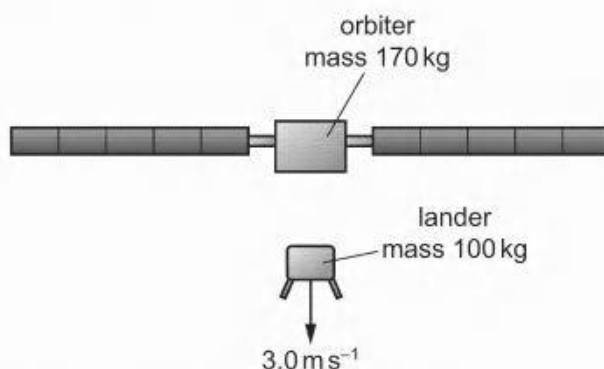


When the forces become equal, which statement is correct?

- A The snowflake accelerates.
- B The snowflake decelerates.
- C The snowflake is stationary.
- D The snowflake moves at a constant velocity.

54 - (9702/12_Winter_2019_Q9) - Dynamics

The space probe Rosetta was designed to investigate a comet. The probe consisted of an orbiter and a lander. The orbiter had a mass of 170 kg and the lander had a mass of 100 kg. When the two parts separated, the lander was pushed towards the surface of the comet so that its change in velocity towards the comet was 3.0 m s^{-1} .



Assume that the orbiter and lander were an isolated system.

The orbiter moved away from the comet during the separation.

What was the change in the speed of the orbiter?

- A 1.8 m s^{-1}
- B 2.3 m s^{-1}
- C 3.0 m s^{-1}
- D 5.1 m s^{-1}



55 - (9702/13_Winter_2019_Q9) - Dynamics

Two objects X and Y in an isolated system undergo a perfectly elastic collision. The velocities of the objects before and after the collision are shown.

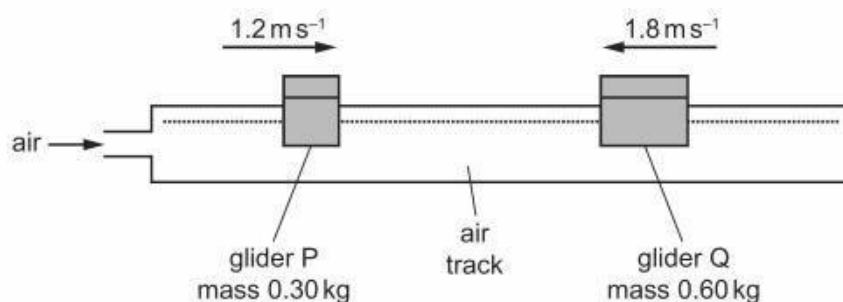


What is the speed v of Y after the collision?

- A** 2.0 ms^{-1} **B** 18 ms^{-1} **C** 22 ms^{-1} **D** 24 ms^{-1}

56 - (9702/11_Winter_2019_Q10) - Dynamics

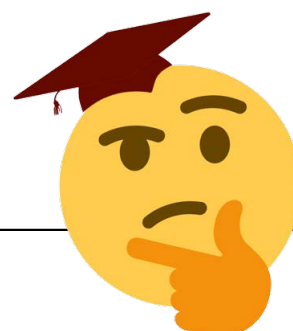
Two gliders are travelling towards each other on a horizontal air track. Glider P has mass 0.30 kg and is moving with a constant speed of 1.2 ms^{-1} . Glider Q has mass 0.60 kg and is moving with a constant speed of 1.8 ms^{-1} .



The gliders have a perfectly elastic collision.

What are the speeds of the two gliders after the collision?

	speed of P $/ \text{ms}^{-1}$	speed of Q $/ \text{ms}^{-1}$
A	1.2	0.6
B	2.0	1.4
C	2.8	0.2
D	3.6	0.6

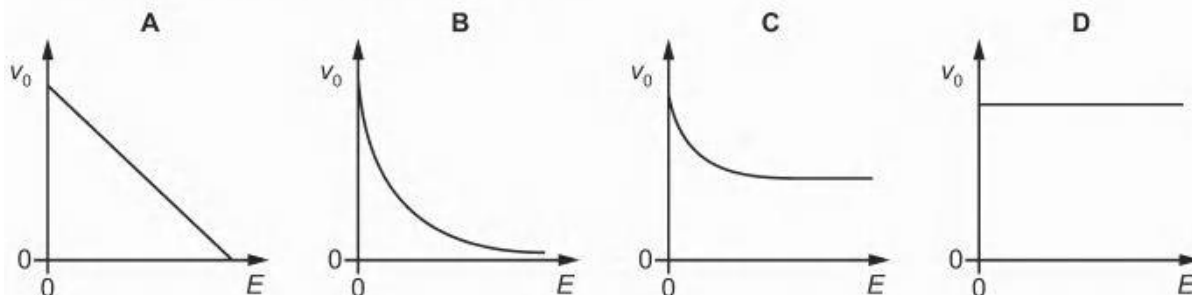


57 - (9702/12_Winter_2019_Q10) - Dynamics, Electric Fields

A positively charged oil droplet falls in air in a uniform electric field that is vertically upwards. The droplet has a constant terminal speed v_0 and the electric field strength is E .

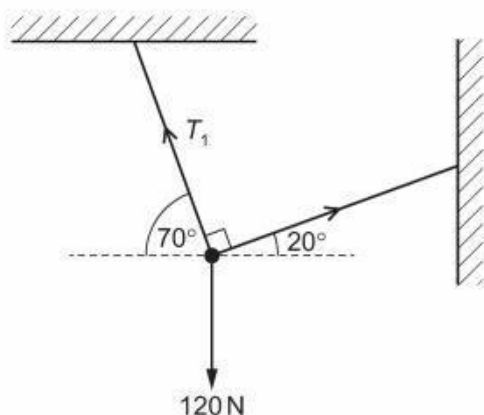
The magnitude of the force due to air resistance acting on the droplet is proportional to the speed of the droplet.

Which graph shows the variation with E of v_0 ?



58 - (9702/11_Winter_2019_Q13) - Dynamics, Forces, Density & Pressure

An object of weight 120 N is supported in equilibrium by two strings as shown.



What is the tension T_1 in the left-hand string?

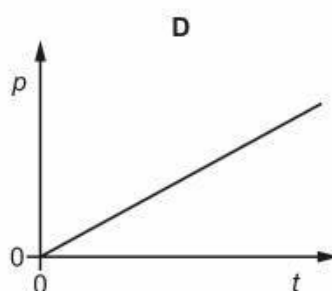
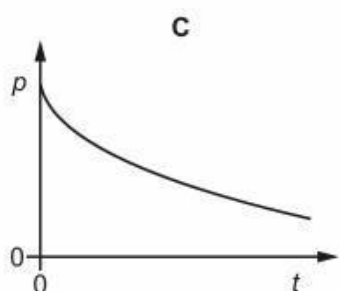
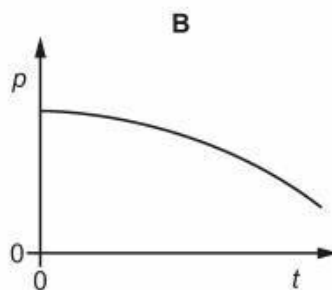
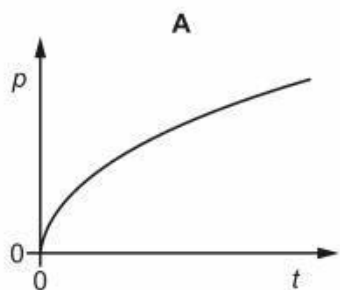
- A 41 N B 77 N C 113 N D 128 N



59 - (9702/12_Summer_2020_Q7) - Dynamics

The resultant force acting on an object is slowly increased.

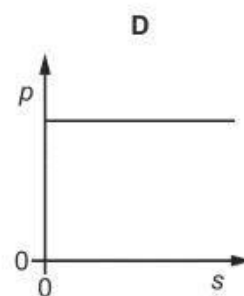
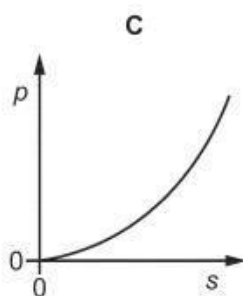
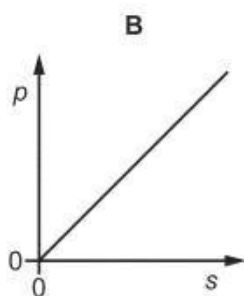
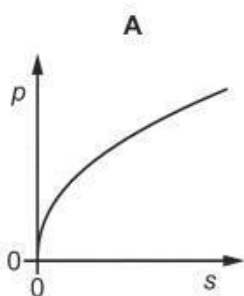
Which graph could show the variation with time t of the momentum p of the object?



60 - (9702/11_Summer_2020_Q8) - Dynamics

A car accelerates from rest in a straight line with constant acceleration.

Which graph best represents the variation of the momentum p of the car with the distance s travelled by the car?



61 - (9702/12_Summer_2020_Q8) - Dynamics

An astronaut has a weight of 660 N when she is standing on the Earth's surface.

The acceleration of free fall on the surface of Mars is 3.71 ms^{-2} .

What would be the weight of the astronaut if she stood on the surface of Mars?

A 67.3 N

B 178 N

C 250 N

D 660 N



62 - (9702/13_Summer_2020_Q8) - Dynamics

A ball of mass m travels vertically downwards and then hits a horizontal floor at speed u .

It rebounds vertically upwards with speed v .

The collision lasts a time Δt .

What is the average resultant force exerted on the ball during the collision?

A $\frac{mv - mu}{\Delta t}$ downwards

B $\frac{mv - mu}{\Delta t}$ upwards

C $\frac{mv + mu}{\Delta t}$ downwards

D $\frac{mv + mu}{\Delta t}$ upwards

63 - (9702/11_Summer_2020_Q9) - Dynamics

The resultant force F on a raindrop of mass m falling with velocity v is given by the equation

$$F = mg - kv^2$$

where k is a constant and g is the acceleration of free fall.

What is the velocity of the raindrop when it reaches a constant (terminal) velocity?

A $\sqrt{\frac{k}{mg}}$

B $\frac{k}{mg}$

C $\sqrt{\frac{mg}{k}}$

D $\frac{mg}{k}$

64 - (9702/12_Summer_2020_Q9) - Dynamics

A mass m_1 travelling with speed u_1 collides with a mass m_2 travelling with speed u_2 in the same direction. After the collision, mass m_1 has speed v_1 and mass m_2 has speed v_2 in the same direction. The collision is perfectly elastic.



before the collision



after the collision

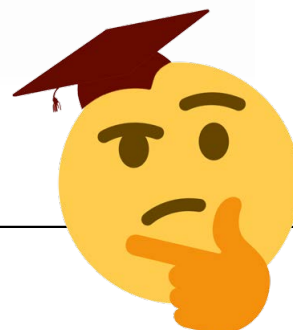
Which equation is **not** correct?

A $m_1 u_1^2 - m_1 v_1^2 = m_2 v_2^2 - m_2 u_2^2$

B $v_2 + u_2 = v_1 + u_1$

C $m_1(u_1 - v_1) = m_2(v_2 - u_2)$

D $m_1(u_1 - v_1)^2 = m_2(u_2 - v_2)^2$



65 - (9702/13_Summer_2020_Q9) - Dynamics

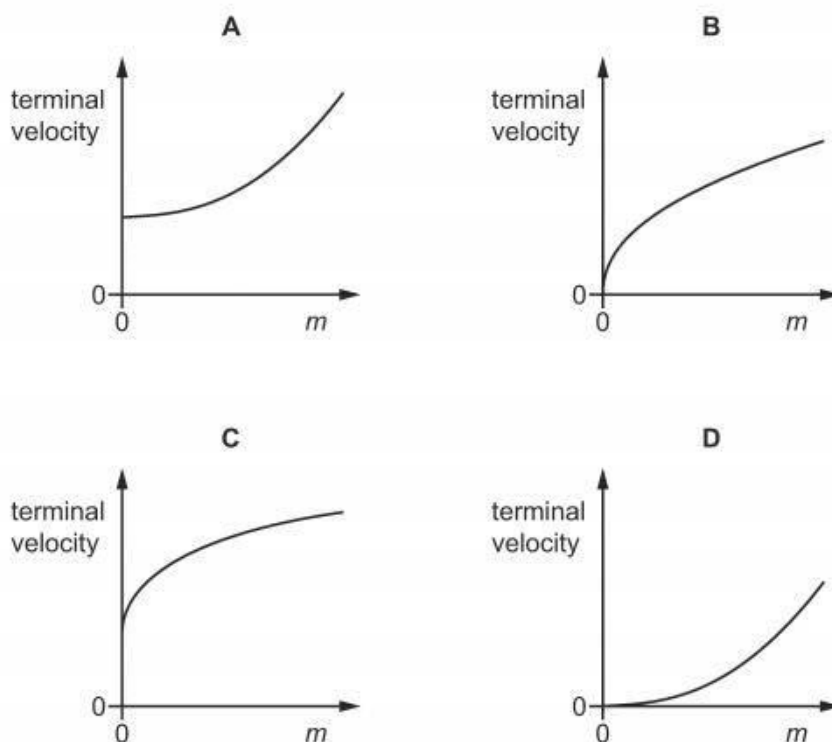
The resultant force F on a raindrop of mass m falling vertically with velocity v is given by the equation

$$F = mg - kv^2$$

where k is a constant and g is the acceleration of free fall.

The falling raindrop eventually reaches a constant (terminal) velocity.

Which graph shows the variation of the terminal velocity of the raindrop with mass m ?



66 - (9702/11_Summer_2020_Q10) - Dynamics

A stationary toy gun fires a bullet.

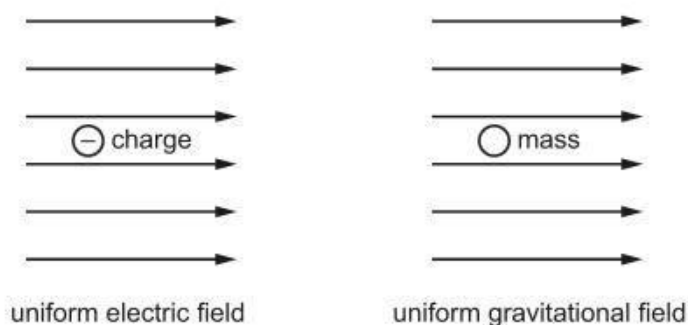
Which statement about the bullet and the gun, immediately after firing, is **not** correct?

- A** The force exerted on the bullet by the gun has the same magnitude as the force exerted on the gun by the bullet.
- B** The force exerted on the bullet by the gun is in the opposite direction to the force exerted on the gun by the bullet.
- C** The gun and the bullet have the same magnitude of momentum.
- D** The kinetic energy of the gun must equal the kinetic energy of the bullet.



67 - (9702/12_Summer_2020_Q10) - Dynamics

The diagrams show a negative electric charge situated in a uniform electric field and a mass situated in a uniform gravitational field.



Which row shows the directions of the forces acting on the charge and on the mass?

	charge	mass
A		
B		
C		
D		

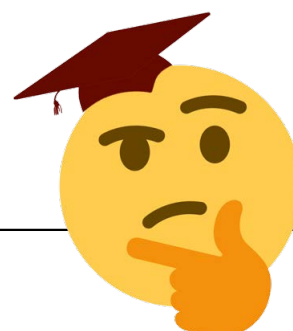
68 - (9702/13_Summer_2020_Q10) - Dynamics

A ball of mass m , moving at a velocity v , collides with a stationary ball of mass $2m$.

The two balls stick together.

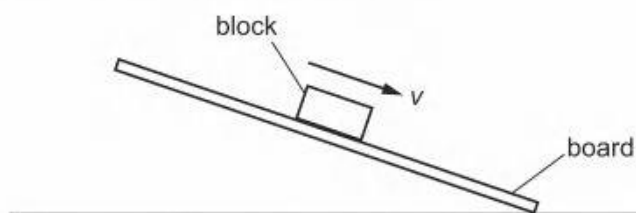
Which fraction of the initial kinetic energy is lost on impact?

- A $\frac{1}{9}$ B $\frac{1}{3}$ C $\frac{2}{3}$ D $\frac{8}{9}$



69 - (9702/11_Summer_2020_Q11) - Dynamics

A wooden block rests on the rough surface of a board. One end of the board is then raised until the block slides down the board at constant velocity v .



What describes the forces acting on the block when it is sliding with constant velocity?

	frictional force on block	resultant force on block
A	down the board	down the board
B	down the board	zero
C	up the board	down the board
D	up the board	zero

70 - (9702/12_Winter_2020_Q8) - Dynamics

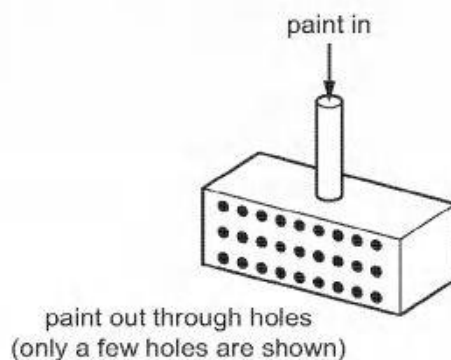
What is **not** a statement of one of Newton's laws of motion?

- A If body X exerts a force on body Y, body Y exerts an equal and opposite force on body X.
- B If no resultant force acts on a body it has constant velocity.
- C The rate of change of momentum of a body is proportional to the resultant force acting on it and takes place in the direction of the force.
- D The total momentum of a system of interacting bodies is constant if there is no external force.



71 - (9702/13_Winter_2020_Q8) - Dynamics

A device for spraying paint consists of a box with its axes horizontal and vertical. One of its vertical faces contains small holes. Paint is fed into the box under pressure via a vertical tube and exits through the holes as fine streams moving horizontally.



The paint is ejected at a speed of 2.5 m s^{-1} through 400 holes, each of area 0.4 mm^2 . The density of the paint is 900 kg m^{-3} .

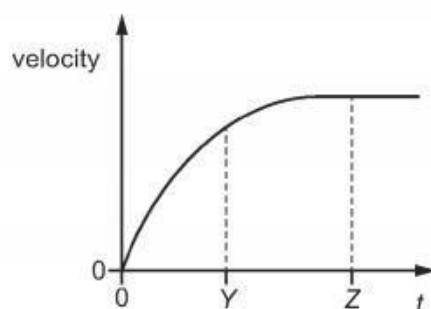
What is the horizontal force required to hold the device stationary as it ejects the paint?

- A 0.36 N B 0.90 N C 2.3 N D 900 N

72 - (9702/12_Winter_2020_Q9) - Dynamics

An object falls from a tall building.

The graph shows how the velocity of the object changes with time t .



The acceleration of free fall is g .

What describes the acceleration of the object at times $t = Y$ and $t = Z$?

	acceleration at $t = Y$	acceleration at $t = Z$
A	decreasing	g
B	decreasing	0
C	constant	g
D	constant	0



73 - (9702/13_Winter_2020_Q9) - Dynamics

A party balloon is filled with air and held stationary at a height of several metres above the ground. The balloon is then dropped in still air.

Which statement describes the motion of the balloon from the moment of release until just before it hits the floor?

- A The balloon decelerates continuously.
- B The balloon falls at a constant speed and then decelerates.
- C The balloon falls at a constant speed.
- D The balloon initially accelerates and then reaches a constant speed.

74 - (9702/11_Winter_2020_Q10) - Dynamics

The diagram shows the masses and velocities of two trolleys that are about to collide.



After the impact they move off together.

What is the kinetic energy lost in the collision?

- A 4 J
- B 6 J
- C 12 J
- D 14 J

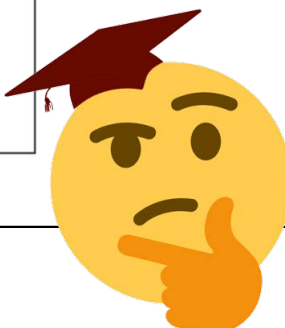
75 - (9702/12_Winter_2020_Q10) - Dynamics

Two balls, one of mass $2m$ and one of mass m , collide.

The diagrams show the initial and final velocities of the balls.

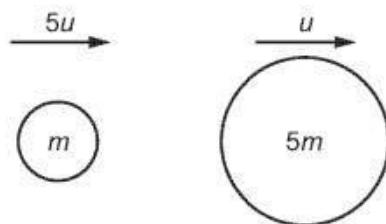
Which collision is **not** elastic?

	before collision	after collision
A	$2m$ 4.0 m s^{-1} m 1.0 m s^{-1}	$2m$ 2.0 m s^{-1} m 5.0 m s^{-1}
B	$2m$ 6.0 m s^{-1} m 3.0 m s^{-1}	$2m$ 4.0 m s^{-1} m 7.0 m s^{-1}
C	$2m$ 8.0 m s^{-1} m 2.0 m s^{-1}	$2m$ 5.0 m s^{-1} m 8.0 m s^{-1}
D	$2m$ 10.0 m s^{-1} m 4.0 m s^{-1}	$2m$ 6.0 m s^{-1} m 12.0 m s^{-1}



76 - (9702/13_Winter_2020_Q10) - Dynamics

An object of mass m travelling with speed $5u$ collides with, and sticks to, an object of mass $5m$ travelling in the same direction with speed u .

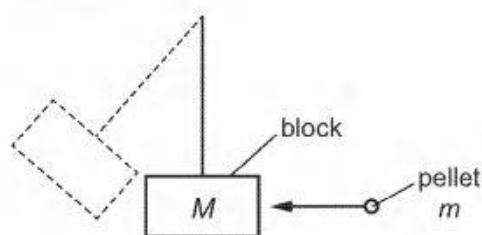


What is the speed with which the two objects travel together in the original direction?

- A $\frac{3}{10}u$ B u C $\frac{6}{5}u$ D $\frac{10}{6}u$

77 - (9702/12_Winter_2020_Q11) - Dynamics

The diagram shows a 'ballistic pendulum'.



A pellet of mass m travelling at a speed u hits a stationary block of mass M . The pellet becomes embedded in the block and causes the block to move at a speed v immediately after the impact.

When a pellet of mass $2m$, travelling at a speed $2u$, hits a block of mass $2M$, what is the speed of the block immediately after the impact? (Neglect the small increase in the mass of the block as the pellet's mass is added during the collision.)

- A v B $v\sqrt{2}$ C $2v$ D $4v$

78 - (9702/11_Summer_2021_Q1) - Dynamics, Forces, Density & Pressure

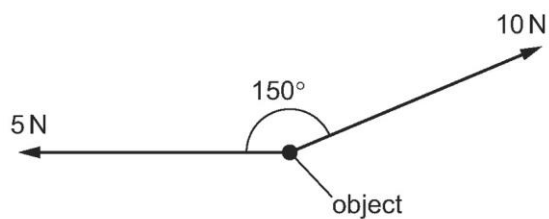
What is a reasonable estimate of the volume of an adult person?

- A 0.10 m^3 B 0.50 m^3 C 1.0 m^3 D 2.0 m^3



79 - (9702/11_Summer_2021_Q3) - Dynamics

A force of 10 N and a force of 5 N act on an object.



The angle between the forces is 150° .

The resultant force on the object can be resolved into a pair of perpendicular components.

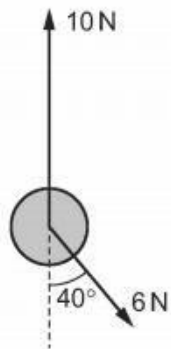
Which row shows numerical expressions for a possible pair of perpendicular components?

	force component / N	force component / N
A	$10 \cos 30^\circ - 5$	$10 \cos 30^\circ$
B	$10 \sin 30^\circ - 5$	$10 \cos 30^\circ$
C	$10 - 5 \cos 30^\circ$	$5 \sin 30^\circ$
D	$10 - 5 \sin 30^\circ$	$5 \cos 30^\circ$

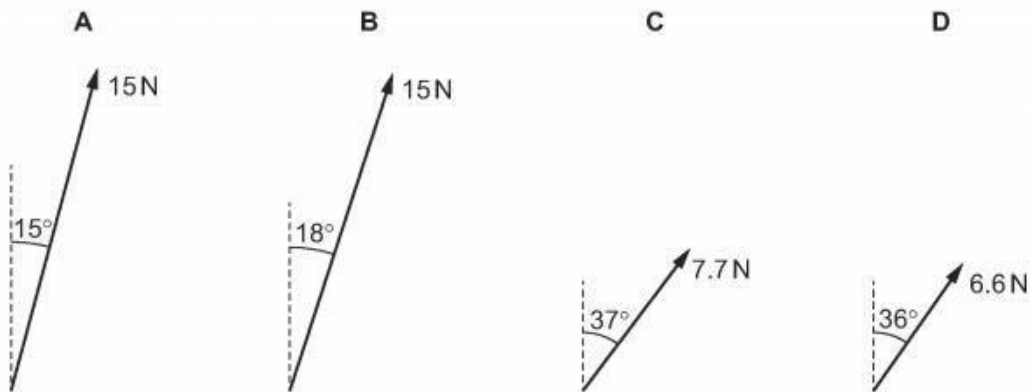


80 - (9702/12_Summer_2021_Q3) - Dynamics

An object is acted upon by two forces, 10 N in the vertical direction and 6 N at 40° to the vertical, as shown.

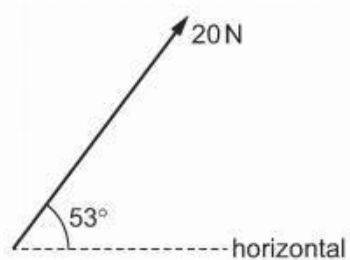


What is the resultant force acting on the object?



81 - (9702/13_Summer_2021_Q3) - Dynamics

What is the horizontal component of the force shown?



- A 12 N B 16 N C 25 N D 27 N



82 - (9702/11_Summer_2021_Q8) - Dynamics

A rocket is fired from the Earth into space.

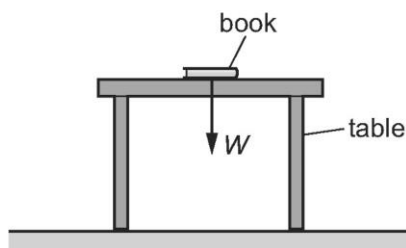
Newton's third law of motion describes how forces act in pairs. One of the forces of a pair is the weight of the rocket.

What is the other force of this pair?

- A air resistance
- B force of the exhaust gases on the rocket
- C force of the rocket on the exhaust gases
- D gravitational force of the rocket on the Earth

83 - (9702/12_Summer_2021_Q8) - Dynamics

A book of weight W is at rest on a table. A student attempts to state Newton's third law of motion by saying that 'action equals reaction'.



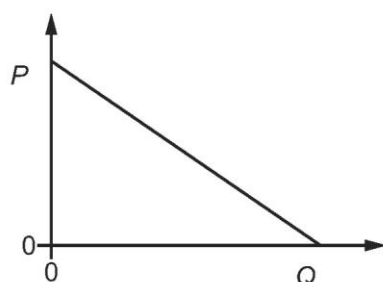
If the weight of the book is the 'action' force, what is the 'reaction' force?

- A the force W acting downwards on the Earth from the table
- B the force W acting upwards on the book from the table
- C the force W acting upwards on the Earth from the book
- D the force W acting upwards on the table from the floor



84 - (9702/11_Summer_2021_Q9) - Dynamics

The graph shows how quantity P varies with quantity Q for a body falling vertically downwards in a uniform gravitational field with air resistance.



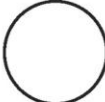
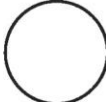
Which pair of quantities could be represented by P and Q ?

	P	Q
A	acceleration	force of air resistance
B	acceleration	time
C	velocity	force of air resistance
D	velocity	time

85 - (9702/12_Summer_2021_Q9) - Dynamics

Four balls are dropped at the same time from the top of a very tall tower. There is no wind blowing.

Which ball hits the ground first?

A	B	C	D
			
mass M diameter D	mass $4M$ diameter D	mass M diameter $2D$	mass $4M$ diameter $2D$

86 - (9702/11_Summer_2021_Q10) - Dynamics

Which quantities are conserved in an inelastic collision?

	kinetic energy	total energy	linear momentum
A	conserved	not conserved	conserved
B	conserved	not conserved	not conserved
C	not conserved	conserved	conserved
D	not conserved	conserved	not conserved

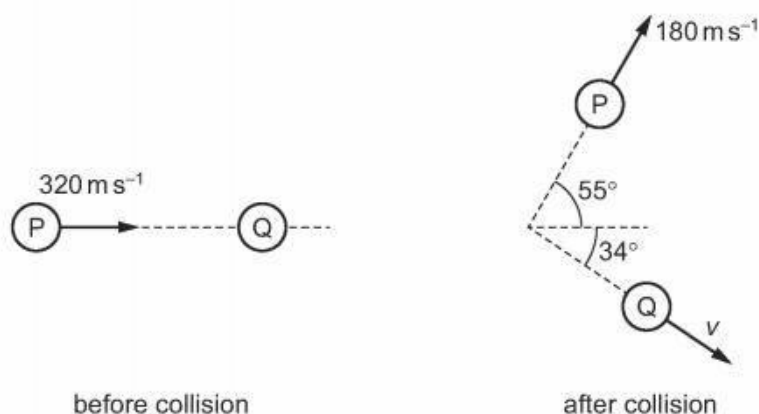


87 - (9702/12_Summer_2021_Q10) - Dynamics

A nitrogen molecule P travelling at a speed of 320 m s^{-1} in a vacuum collides with a stationary nitrogen molecule Q.

After the collision, P travels at a velocity of 180 m s^{-1} at an angle of 55° to its original path.

Q travels in a direction at an angle of 34° to the initial path of P.



Assume that there are no external forces acting on the molecules.

What is the magnitude v of the velocity of Q after the collision?

- A 120 m s^{-1} B 140 m s^{-1} C 180 m s^{-1} D 260 m s^{-1}

88 - (9702/13_Summer_2021_Q10) - Dynamics

A rock in deep space is travelling towards a distant star and collides with a stationary spacecraft.

What is **not** a possible outcome of the collision?

- A The rock becomes stationary and the spacecraft moves towards the star.
B The rock moves away from the star and so does the spacecraft.
C The rock moves away from the star and the spacecraft moves towards the star.
D The rock moves towards the star and so does the spacecraft.

89 - (9702/13_Summer_2021_Q11) - Dynamics

A steel ball is falling at a constant (terminal) speed in still air. The forces acting on the ball are upthrust, viscous drag and weight.

What is the order of increasing magnitude of these three forces?

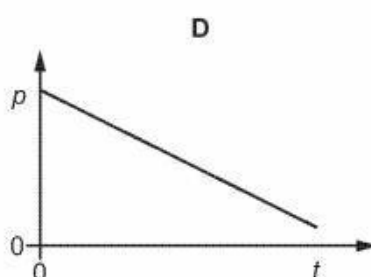
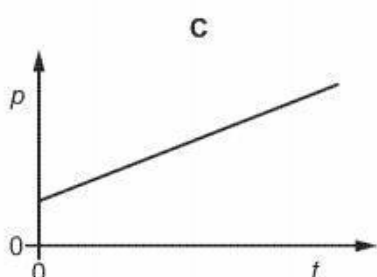
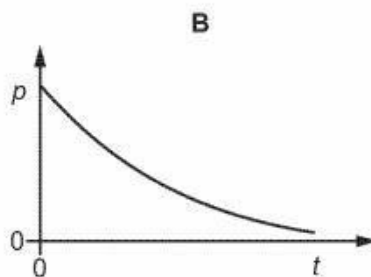
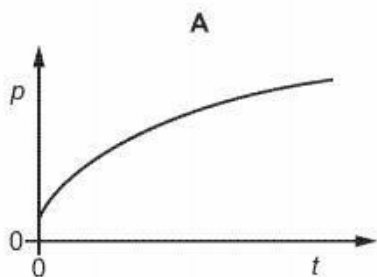
- A upthrust $\rightarrow$ viscous drag $\rightarrow$ weight
B viscous drag $\rightarrow$ upthrust $\rightarrow$ weight
C viscous drag $\rightarrow$ weight $\rightarrow$ upthrust
D weight $\rightarrow$ upthrust $\rightarrow$ viscous drag



90 - (9702/11_Winter_2021_Q8) - Dynamics

A constant resultant force acts on an object in the direction of the object's velocity.

Which graph could show the variation with time t of the momentum p of the object?



91 - (9702/13_Winter_2021_Q8) - Dynamics

Water is pumped through a hose-pipe at a rate of 90 kg per minute. Water emerges horizontally from the hose-pipe with a speed of 20 m s^{-1} .

What is the minimum force required from a person holding the hose-pipe to prevent it moving backwards?

- A** 30 N **B** 270 N **C** 1800 N **D** 110 000 N

92 - (9702/11_Winter_2021_Q9) - Dynamics

Which statement **must** be true for an object in a gravitational field?

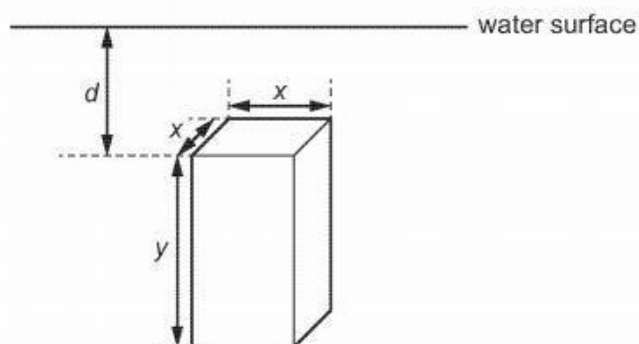
- A** If the object has mass then the field causes it to accelerate.
B If the object has mass then the field causes it to have weight.
C If the object has weight then the field causes it to accelerate.
D If the object has weight then the field causes it to have mass.



93 - (9702/11_Winter_2021_Q11) - Dynamics

A uniform solid block is fully submerged in a tank of water.

The dimensions of the block are x and y , as shown.



The block is held vertically in the position shown. The density of the block is the same as the density of the water.

If the block is always held at the same depth d below the surface of the water, which single change would **increase** the magnitude of the upthrust force on the block?

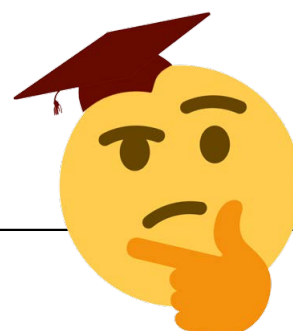
- A decrease the density of the block
- B hold the block horizontally
- C increase dimension y
- D increase the density of the block

94 - (9702/12_Winter_2021_Q11) - Dynamics

A cylindrical block of wood has cross-sectional area A and weight W . It is totally immersed in water with its axis vertical. The block experiences pressures p_t and p_b at its top and bottom surfaces respectively.

What is the upthrust on the block?

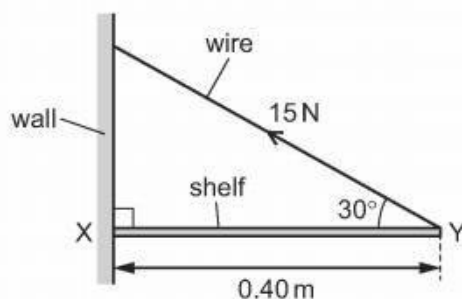
- A $(p_b - p_t)$
- B $(p_b - p_t)A$
- C $(p_b - p_t)A - W$
- D $(p_b - p_t)A + W$



95 - (9702/11_Winter_2021_Q12) - Dynamics

A shelf XY is 0.40 m long and is attached to a wall at end X.

It is kept horizontal by a wire attached to Y and to the wall, as shown.



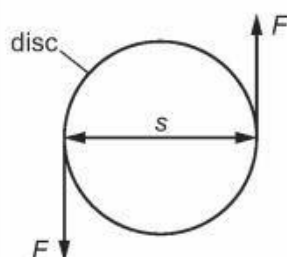
The tension force in the wire is 15 N at an angle of 30° to the horizontal.

What is the moment of this force about point X?

- A 3.0 Nm B 5.2 Nm C 6.9 Nm D 12 Nm

96 - (9702/12_Winter_2021_Q12) - Dynamics

Two forces, each of magnitude F , act on a disc of diameter s , as shown.



What is the torque exerted on the disc?

- A zero B $\frac{1}{2}Fs$ C Fs D $2Fs$

97 - (9702/11_Winter_2021_Q13) - Dynamics

A statement about the principle of moments with some words omitted is shown.

'For an object in a state of rotational equilibrium, the sum of the clockwise moments about any point is equal to the sum of the anticlockwise moments about'

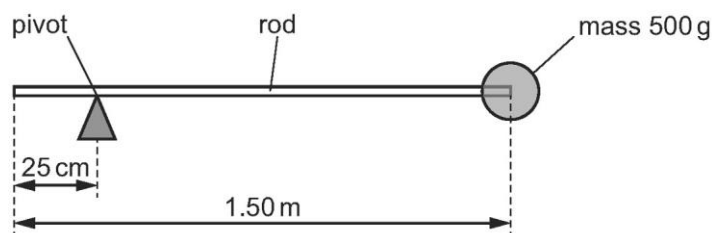
Which words correctly complete the statement?

- A any point
B the centre of gravity of the object
C the pivot
D the same point



98 - (9702/12_Winter_2021_Q13) - Dynamics

A mass of 500 g is attached at one end of a rod of length 1.50 m. The rod is pivoted at a distance of 25 cm from the other end. The rod is horizontal.

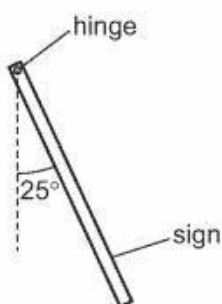


What is the moment about the pivot due to the mass?

- A 0.63 Nm B 1.2 Nm C 6.1 Nm D 7.4 Nm

99 - (9702/13_Winter_2021_Q13) - Dynamics

A sign outside a shop is suspended from a rusty horizontal hinge at its top end. The sign hangs in equilibrium at an angle of 25° to the vertical, as shown.



The sign is a square of side length 52 cm and uniform thickness. It has a mass of 36 kg.

What is the moment of the weight of the sign about the hinge?

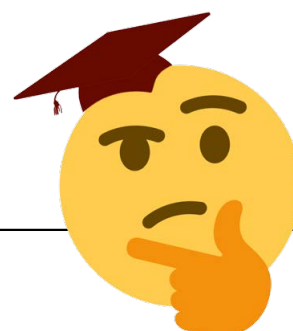
- A 39 Nm B 78 Nm C 83 Nm D 92 Nm

100 - (9702/11_Winter_2021_Q14) - Dynamics

A bird dives to a depth of 1.50 m below the surface of a lake. Atmospheric pressure is 101 kPa. The density of water is 1000 kg m^{-3} .

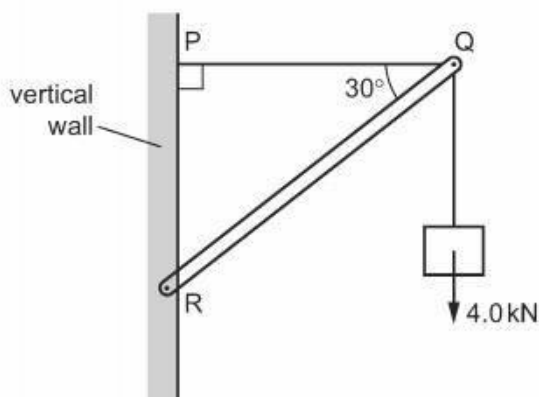
What is the pressure at this depth?

- A 14.7 kPa B 86.3 kPa C 103 kPa D 116 kPa



101 - (9702/12_Winter_2021_Q14) - Dynamics

A beam QR is held in position by a wire PQ. The structure is used to form a crane supporting a stationary load of 4.0 kN, as shown.

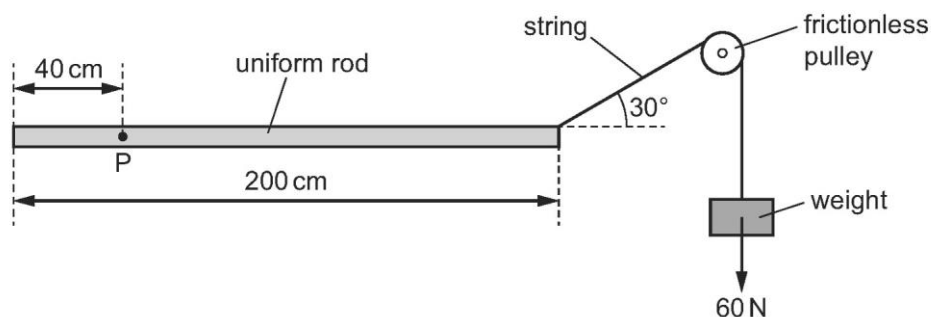


What is the force exerted by the beam QR on point Q?

- A 4.0 kN B 4.6 kN C 6.9 kN D 8.0 kN

102 - (9702/13_Winter_2021_Q14) - Dynamics

A uniform rod of length 200 cm is freely pivoted at point P. The rod is held horizontally in equilibrium by a 60 N weight that is attached to the rod by a string passing over a frictionless pulley.



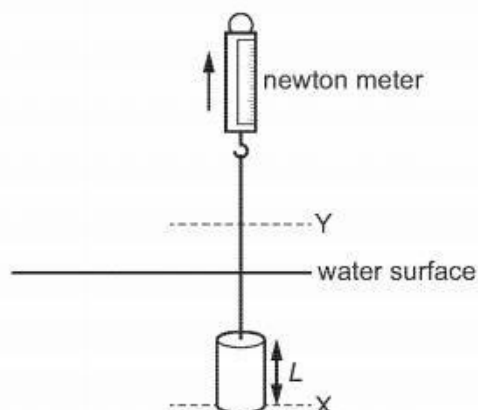
What is the weight of the rod?

- A 30 N B 60 N C 80 N D 140 N



103 - (9702/12_Winter_2021_Q15) - Dynamics

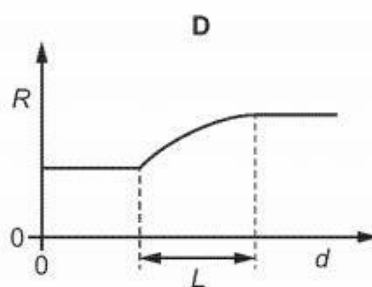
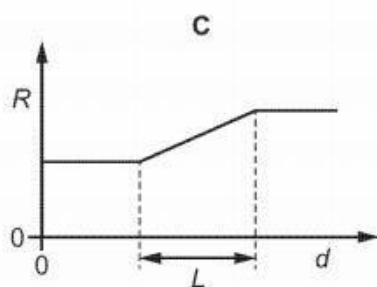
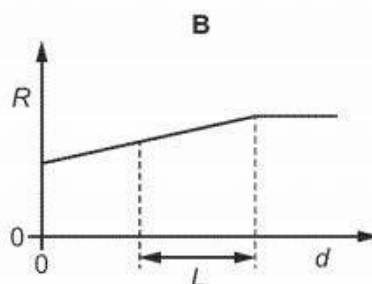
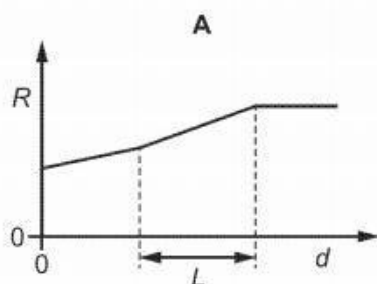
A metal cylinder, totally immersed in water, is hung from a newton meter.



The cylinder, of height L , is slowly raised vertically by lifting the newton meter.

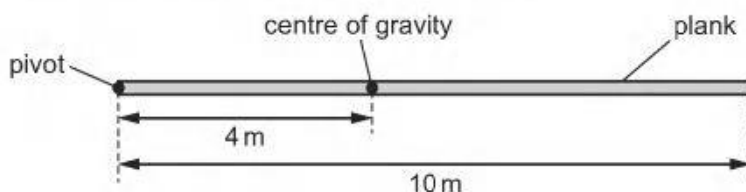
As the base of the cylinder moves from line X in the water to line Y above the surface of the water, the reading R on the newton meter is recorded. The velocity of the cylinder is constant.

Which graph best shows the variation of R with the distance d of the base of the cylinder from line X?



104 - (9702/11_Summer_2022_Q11) - Dynamics

A horizontal wooden plank is pivoted at one end, as shown.



The plank has a mass of 100 kg and a length of 10 m. The centre of gravity of the plank is a distance of 4 m from the pivot.

What is the moment of the weight of the plank about the pivot?

- A $4 \times 10^2 \text{ Nm}$ B $5 \times 10^2 \text{ Nm}$ C $4 \times 10^3 \text{ Nm}$ D $5 \times 10^3 \text{ Nm}$

105 - (9702/12_Summer_2022_Q11) - Dynamics

Two forces form a couple.

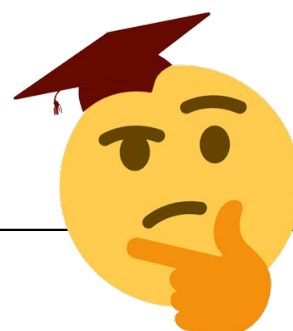
Which statement describes the two forces?

- A They are in the same direction.
B They are perpendicular to each other.
C They have the same magnitude.
D They pass through the same point.

106 - (9702/11_Summer_2022_Q12) - Dynamics

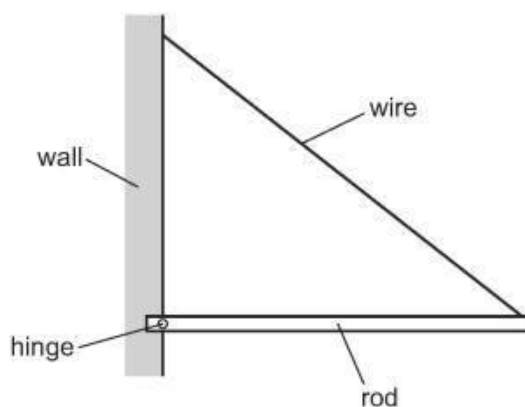
When **must** an object be in equilibrium?

- A when no resultant force acts on the object
B when no resultant force and no resultant torque act on the object
C when no resultant torque acts on the object
D when the upward force on the object is equal and opposite to its weight



107 - (9702/12_Summer_2022_Q12) - Dynamics

A uniform rod is attached by a hinge at one end to a wall. The other end of the rod is supported by a wire so that the rod is horizontal and in equilibrium.



Which arrow shows the direction of the force on the rod from the hinge?

A



B



C



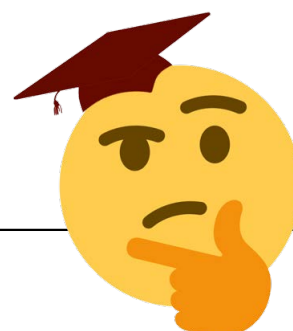
D



108 - (9702/13_Summer_2022_Q12) - Dynamics

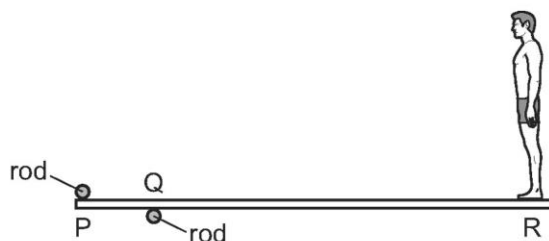
Which statement describes the two forces in a couple?

- A They act in the same direction.
- B They act through the same point.
- C They produce zero resultant force.
- D They produce zero resultant moment.



109 - (9702/11_Summer_2022_Q13) - Dynamics

A uniform diving board is held by two fixed rods at points P and Q. A person stands at end R of the diving board, as shown.



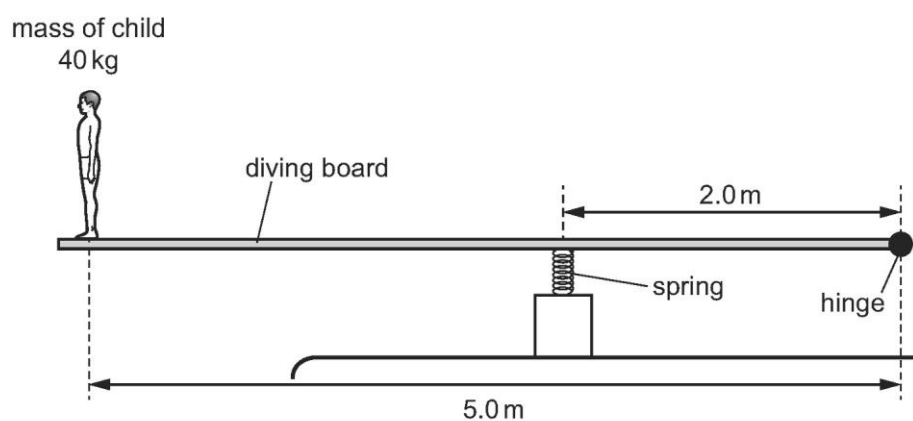
The forces exerted by the rods on the board are vertical. The board remains in equilibrium as the person slowly moves towards point Q from end R.

Which row describes the changes to the magnitudes of the forces exerted by the rods on the board?

	force at P	force at Q
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

110 - (9702/12_Summer_2022_Q13) - Dynamics

A diving board of length 5.0 m is hinged at one end and supported 2.0 m from this end by a spring of spring constant 10 kN m^{-1} . A child of mass 40 kg stands at the far end of the board.



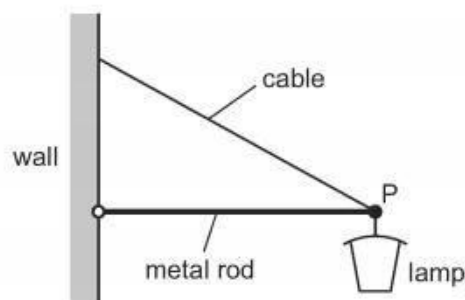
What is the extra compression of the spring caused by the child standing on the end of the board?

- A 1.0 cm B 1.6 cm C 9.8 cm D 16 cm



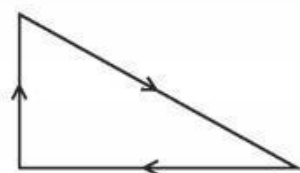
111 - (9702/13_Summer_2022_Q13) - Dynamics

A street lamp is fixed to a wall by a metal rod and a cable.

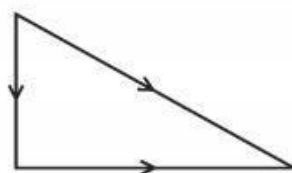


Which vector triangle could represent the forces acting on the end of the rod at point P?

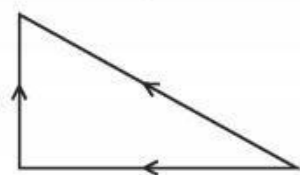
A



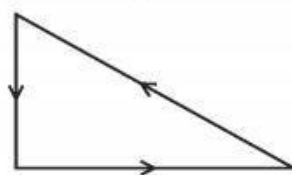
B



C

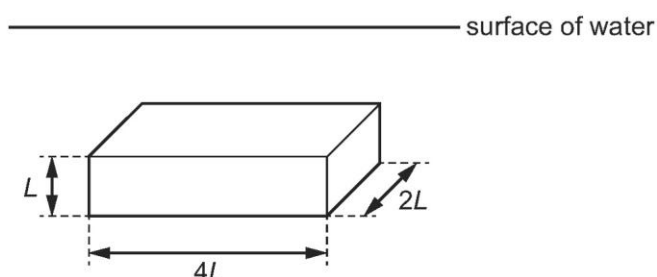


D



112 - (9702/11_Summer_2022_Q14) - Dynamics

A solid block has sides of length L , $2L$ and $4L$. The block is submerged in water of uniform density so that the faces with the largest area are horizontal, as shown.



The upthrust acting on the block is U .

The block is now rotated to a new position so that the faces with the smallest area are horizontal. The block remains fully submerged in the water.

What is the upthrust acting on the block in its new position?

A $\frac{U}{4}$

B U

C $2U$

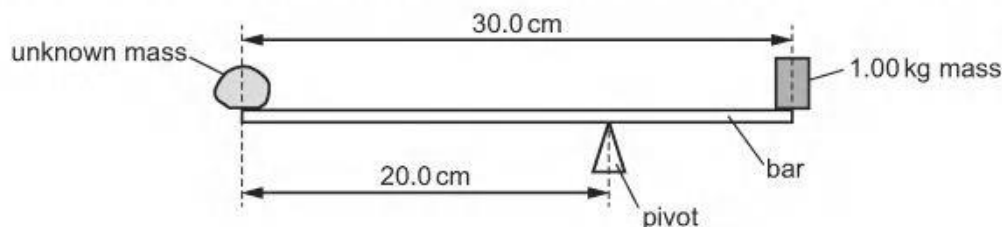
D $4U$



113 - (9702/13_Summer_2022_Q14) - Dynamics

An unknown mass and a 1.00 kg mass are fixed at opposite ends of a bar. The bar has negligible mass and a length of 30.0 cm.

The bar balances when supported by a pivot placed 20.0 cm from the unknown mass, as shown.



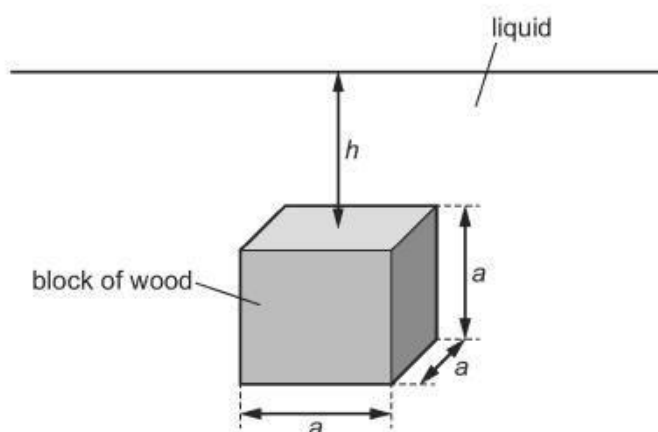
What is the unknown mass?

- A 333 g B 500 g C 667 g D 1000 g

114 - (9702/13_Summer_2022_Q15) - Dynamics

A block of wood of density ρ_w has sides of length a .

The block is immersed in a liquid of density ρ_L . The top surface of the block is at a depth h below the surface of the liquid.



The acceleration of free fall is g .

What is the upthrust acting on the block from the liquid?

- A $\rho_L a^3 g$ B $\rho_w a^3 g$ C $\rho_L h g$ D $\rho_L a g$

115 - (9702/11_Winter_2022_Q7) - Dynamics

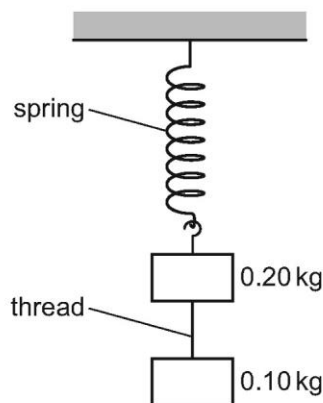
What is the definition of linear momentum?

- A force per unit time
B product of force and time
C product of velocity and mass
D velocity per unit mass



116 - (9702/11_Winter_2022_Q8) - Dynamics

A mass of 0.20 kg is suspended from the lower end of a light spring. A second mass of 0.10 kg is suspended from the first mass by a thread. The arrangement is allowed to come into static equilibrium and then the thread is cut.



Immediately after the thread is cut, what is the upward acceleration of the 0.20 kg mass?

- A 4.9 m s^{-2} B 6.5 m s^{-2} C 9.8 m s^{-2} D 15 m s^{-2}

117 - (9702/12_Winter_2022_Q8) - Dynamics

A constant resultant force F acts on an object of mass m for time t .

What is the change in momentum of the object?

- A $\frac{F}{t}$ B $\frac{Ft}{m}$ C Ft D $\frac{F}{mt}$

118 - (9702/11_Winter_2022_Q9) - Dynamics

A snowflake and a raindrop are in still air. They both fall from rest at the same time and from the same height, far above the ground.

The snowflake and raindrop contain the same mass of water. Assume that there is no evaporation or melting. Also assume that, for a given speed, the drag force acting on the snowflake is greater than the drag force acting on the raindrop.

Which statement about the snowflake and raindrop is correct?

- A The raindrop takes more time than the snowflake to reach terminal velocity.
B The raindrop takes more time than the snowflake to reach the ground.
C They reach the same terminal velocity.
D They take the same amount of time to reach the ground.



119 - (9702/12_Winter_2022_Q9) - Dynamics

The acceleration of free fall on the surface of planet P is one-tenth of that on the surface of planet Q.

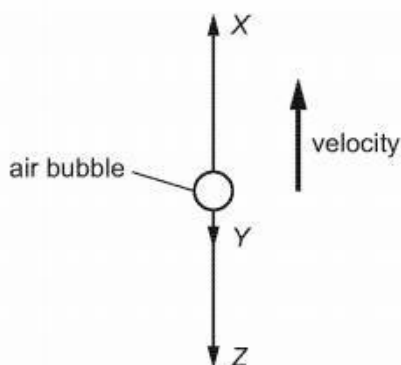
On the surface of P, an object has a mass of 1.0 kg and a weight of 1.0 N.

What are the mass and the weight of the same object on the surface of planet Q?

	mass on Q / kg	weight on Q / N
A	1.0	0.1
B	1.0	10
C	10	10
D	10	100

120 - (9702/13_Winter_2022_Q9) - Dynamics

An air bubble in a tank of water is rising with terminal (constant) velocity. The forces acting on the bubble are X, Y and Z, as shown.



The upthrust on the bubble is X.

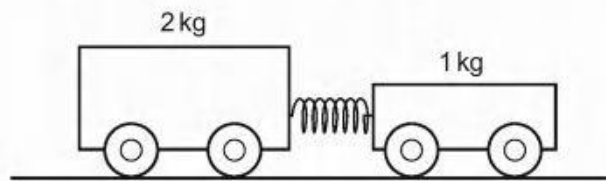
Which statement about the forces is correct?

- A Z is the viscous force on the bubble, Y is the weight of the bubble and $X = Y + Z$.
- B Z is the viscous force on the bubble, Y is the weight of the bubble and $X > Y + Z$.
- C Z is the weight of the bubble, Y is the viscous force on the bubble and $X = Y + Z$.
- D Z is the weight of the bubble, Y is the viscous force on the bubble and $X > Y + Z$.



121 - (9702/11_Winter_2022_Q10) - Dynamics

Two trolleys are held together on a horizontal surface with a compressed spring between them.



When they are released, the trolleys lose contact with the spring. The trolley of mass 2 kg moves to the left at a final speed of 2 m s^{-1} .

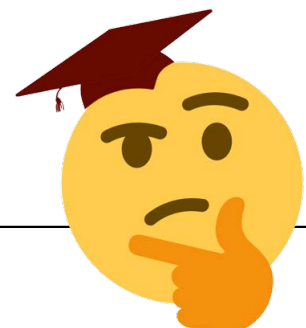
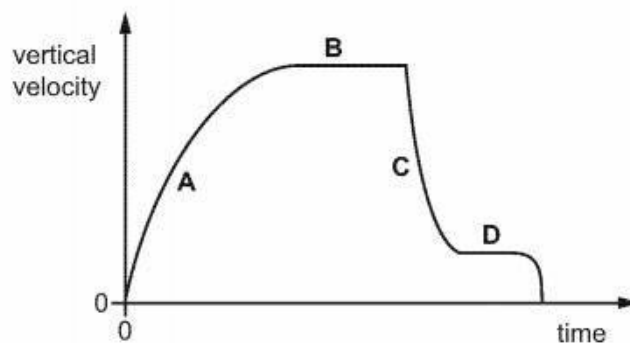
How much elastic potential energy was stored in the spring?

- A 4 J B 6 J C 8 J D 12 J

122 - (9702/12_Winter_2022_Q10) - Dynamics

A parachutist falls from rest from a balloon. The variation with time of the vertical velocity of the parachutist is shown.

In which region is the force due to air resistance much greater than the weight of the parachutist?



123 - (9702/13_Winter_2022_Q10) - Dynamics

Two blocks are at rest on a frictionless horizontal surface. One block is made of wood and the other block is made of steel.

A steel ball is fired horizontally with a speed v at the wooden block. The ball embeds itself in the block, and the ball and block move together after impact.

A second identical steel ball is fired horizontally with speed v at the steel block. The steel ball then rebounds back along its original path with speed $\frac{v}{2}$.



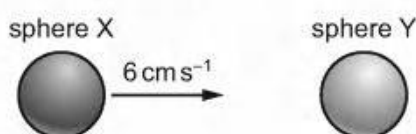
The wooden block and the steel block have equal mass.

Which statement about the blocks immediately after the collisions is correct?

- A Both blocks must travel with the same speed.
- B The steel block must travel faster than the wooden block.
- C The wooden block must travel faster than the steel block.
- D The masses of the blocks and the steel ball are needed to determine which block travels faster.

124 - (9702/12_Winter_2022_Q11) - Dynamics

Two solid spheres form an isolated system. Sphere X moves with speed 6 cm s^{-1} in a straight line directly towards a stationary sphere Y, as shown.



The spheres have a perfectly elastic collision. After the collision, sphere X moves with speed 2 cm s^{-1} in the same direction as before the collision.

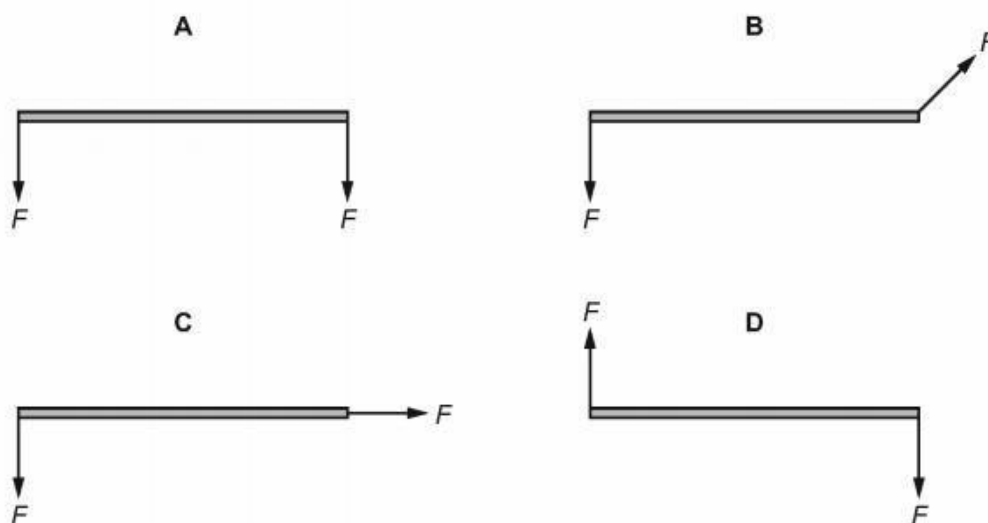
What is the speed of sphere Y?

- A 2 cm s^{-1}
- B 4 cm s^{-1}
- C 6 cm s^{-1}
- D 8 cm s^{-1}



125 - (9702/13_Winter_2022_Q11) - Dynamics

Which diagram shows a couple formed by two forces, each of magnitude F , acting on a rod?



126 - (9702/12_Winter_2022_Q12) - Dynamics

What is **not** a necessary requirement of the forces in a couple?

- A They act in opposite directions.
- B They act along different lines.
- C They have the same magnitude.
- D They produce a resultant force.

127 - (9702/13_Winter_2022_Q12) - Dynamics

A student states that:

'If an object is in equilibrium, the sum of the clockwise moments about a point X is equal to the sum of the anticlockwise moments about a point Y.'

Which condition would make the student's statement correct?

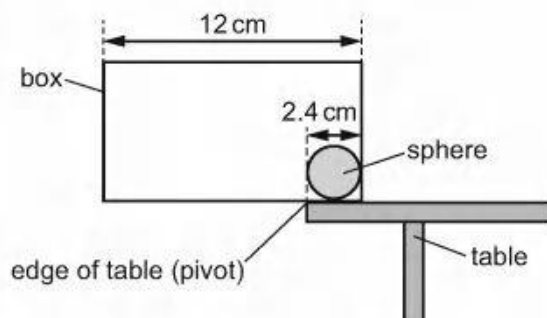
- A Either X or Y is the centre of gravity of the object.
- B Either X or Y is the pivot of the object.
- C X and Y are at opposite ends of the object.
- D X and Y are the same point on the object.



128 - (9702/12_Winter_2022_Q13) - Dynamics

A box of length 12 cm and weight 0.43 N is placed on a horizontal table, with the greater part of its length overhanging the edge of the table. The edge of the table acts as a pivot. The centre of gravity of the box is at its geometric centre.

To balance the box, a uniform sphere of diameter 2.4 cm is placed inside the box, touching one end, as shown.



Assume that the forces acting on the box are in the plane of the diagram.

What is the minimum mass of the sphere that is needed to maintain the system in equilibrium?

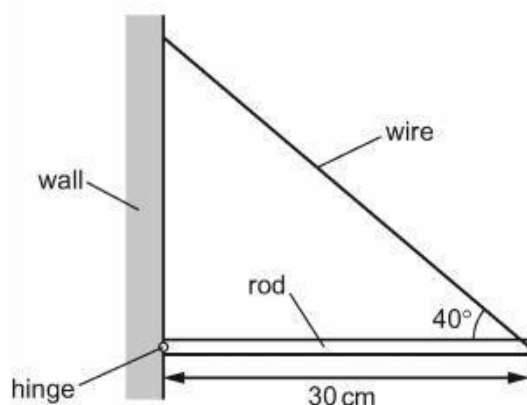
- A 0.066 kg B 0.13 kg C 0.22 kg D 1.3 kg

129 - (9702/13_Winter_2022_Q13) - Dynamics

A uniform rod of length 30 cm and weight 5.2 N is attached to a wall by a hinge at one end.

The other end of the rod is supported by a wire so that the rod is horizontal and in equilibrium.

The wire is at an angle of 40° to the horizontal.



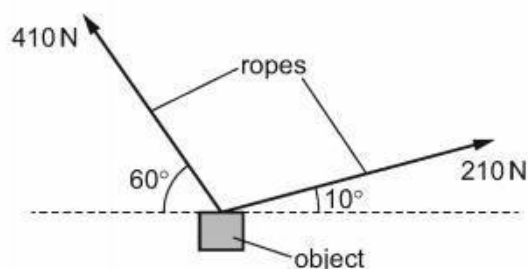
What is the tension in the wire?

- A 3.4 N B 4.0 N C 6.8 N D 8.1 N



130 - (9702/12_Winter_2022_Q14) - Dynamics

An object is suspended by two ropes. One rope has a tension of 410 N at an angle of 60° to the horizontal. The other rope has a tension of 210 N at an angle of 10° to the horizontal.



The object is in equilibrium.

What is the mass of the object?

- A 40 kg B 42 kg C 390 kg D 410 kg

131 - (9702/11_Summer_2023_Q7) - Dynamics

A camera drone of mass 1.20 kg hovers at a fixed point above the ground. The drone has four propellers.

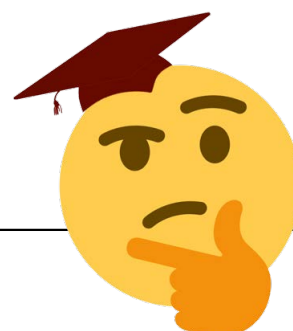


In a time of 1.00 s, each propeller pushes a mass of 0.400 kg of air vertically downwards.

Assume that the air above the propellers is stationary.

What is the speed of the air leaving each propeller?

- A 0.750 m s^{-1} B 3.00 m s^{-1} C 7.36 m s^{-1} D 29.4 m s^{-1}

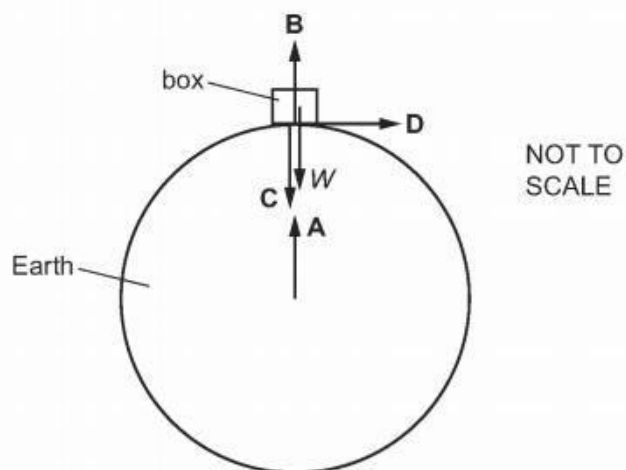


132 - (9702/11_Summer_2023_Q8) - Dynamics

A box rests on the Earth, as shown.

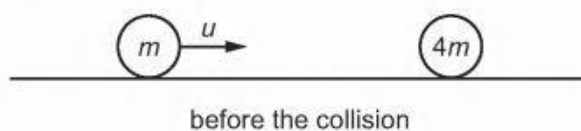
Newton's third law describes how forces of the same type act in pairs. One of the forces of a pair is the weight W of the box.

Which arrow represents the other force of this pair?



133 - (9702/11_Summer_2023_Q10) - Dynamics

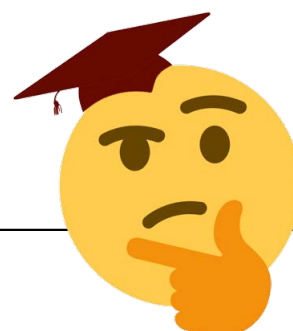
An object of mass m , moving at speed u along a frictionless horizontal surface, collides head-on with a stationary object of mass $4m$.



After the collision, the object of mass m rebounds along its initial path with $\frac{1}{4}$ of its kinetic energy before the collision.

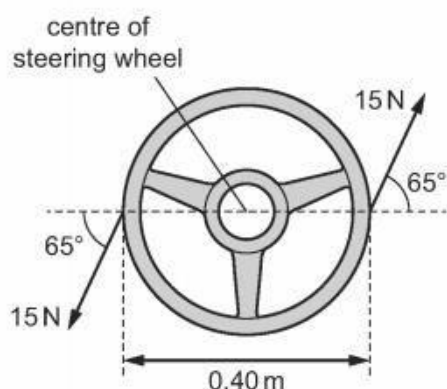
What is the speed of the object of mass $4m$ after the collision?

- A $\frac{u}{8}$ B $\frac{3u}{16}$ C $\frac{5u}{16}$ D $\frac{3u}{8}$



134 - (9702/11_Summer_2023_Q11) - Dynamics

The driver of a car applies two parallel forces to a steering wheel, as shown.



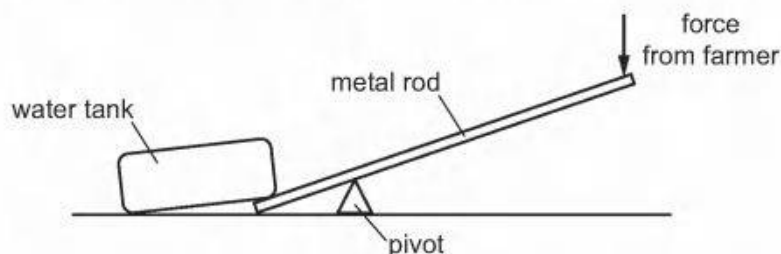
Each force has a magnitude of 15 N and acts in the direction shown. The steering wheel has a diameter of 0.40 m.

What is the torque exerted on the steering wheel?

- A 1.3 Nm B 2.5 Nm C 2.7 Nm D 5.4 Nm

135 - (9702/11_Summer_2023_Q12) - Dynamics

A farmer is trying to lift the corner of a large water tank. She uses a metal rod as a lever.



The vertical force from the farmer is constant and is always applied to the end of the rod.

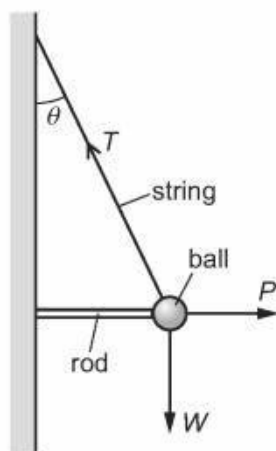
Which change **must** increase the upward force on the water tank?

- A using a longer rod and moving the pivot closer to the tank
B using a longer rod and moving the pivot further away from the tank
C using a shorter rod and moving the pivot closer to the tank
D using a shorter rod and moving the pivot further away from the tank



136 - (9702/11_Summer_2023_Q13) - Dynamics

The diagram shows a ball of weight W hanging in equilibrium from a string.



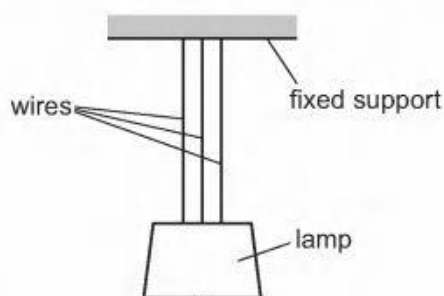
The string is at an angle θ to the vertical. The tension in the string is T . The ball is held away from the wall by a horizontal force P from a metal rod.

Which relationship between the magnitudes of T , P and W is correct?

- A $P = T \cos \theta$ and $W = T \sin \theta$
- B $T = P + W$
- C $T^2 = P^2 + W^2$
- D $W = P \tan \theta$ and $W = T \cos \theta$

137 - (9702/11_Summer_2023_Q18) - Dynamics

A lamp is suspended in equilibrium from a fixed support by three long identical wires.



The weight of the lamp causes each wire to have an extension of 0.40 cm. The height h of the lamp above the floor is measured.

The middle wire suddenly breaks and the lamp falls a small distance as the extensions of the remaining two wires increase. The wires obey Hooke's law.

When the lamp is in equilibrium, the height h of the lamp above the floor is measured again.

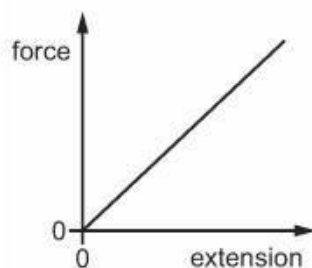
What is the difference between the two values of h ?

- A 0.20 cm
- B 0.27 cm
- C 0.40 cm
- D 0.60 cm



138 - (9702/11_Summer_2023_Q19) - Dynamics

The force–extension graph for a spring is shown.



What represents the work done to extend the spring?

- A the area under the graph
- B the gradient of the graph
- C the reciprocal of the gradient of the graph
- D twice the area under the graph

139 - (9702/12_Summer_2023_Q7) - Dynamics

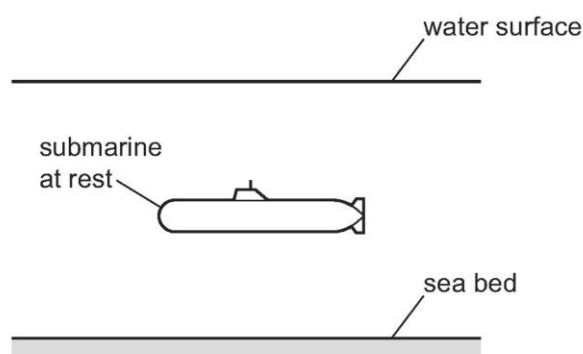
Which statement describes the mass of an object?

- A the force the object experiences due to gravity
- B the momentum of the object before a collision
- C the resistance of the object to changes in motion
- D the weight of the object as measured by a balance



140 - (9702/12_Summer_2023_Q8) - Dynamics

A submarine of total mass 3200 kg is at rest underwater.



The total mass of the submarine is suddenly decreased by 200 kg by pumping water out of the submarine horizontally in a negligible time. The upthrust acting on the submarine is unchanged.

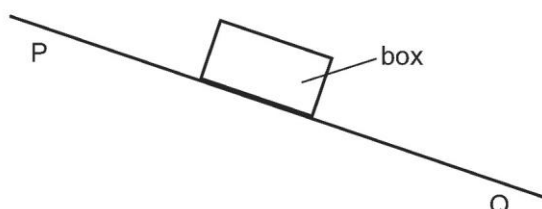
The change in the total weight of the submarine causes it to accelerate vertically upwards.

What is the initial upwards acceleration of the submarine?

- A 0.613 m s^{-2} B 0.654 m s^{-2} C 9.81 m s^{-2} D 10.5 m s^{-2}

141 - (9702/12_Summer_2023_Q9) - Dynamics

A box in air slides with increasing speed down a rough slope from point P to point Q.

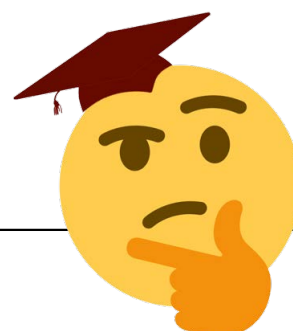


The slope surface exerts a constant frictional force on the box.

As the box moves from P to Q, there are changes to the magnitudes of its acceleration and the total resistive force acting on it.

Which row describes the changes?

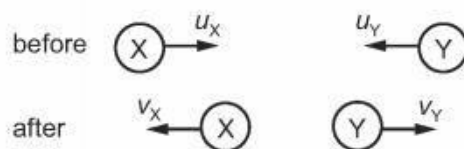
	magnitude of acceleration	magnitude of total resistive force
A	increases	decreases
B	decreases	decreases
C	increases	increases
D	decreases	increases



142 - (9702/12_Summer_2023_Q10) - Dynamics

Two balls, X and Y, approach each other along the same straight line and collide. The collision is perfectly elastic.

Their initial speeds are u_X and u_Y respectively. After the collision they move apart with speeds v_X and v_Y respectively. Their directions are shown.



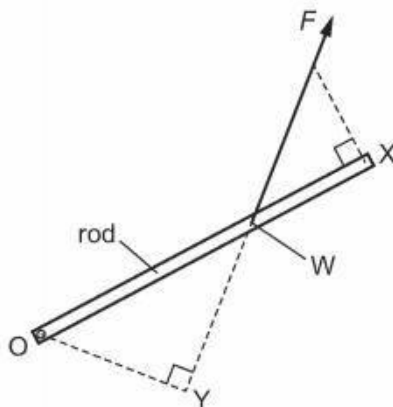
Which equation is correct?

- A $u_X + u_Y = v_X + v_Y$
- B $u_X + u_Y = v_X - v_Y$
- C $u_X - u_Y = v_X + v_Y$
- D $u_X - u_Y = v_X - v_Y$

143 - (9702/12_Summer_2023_Q11) - Dynamics

A rod is pivoted at point O.

A force F is applied to the rod at point W, as shown.



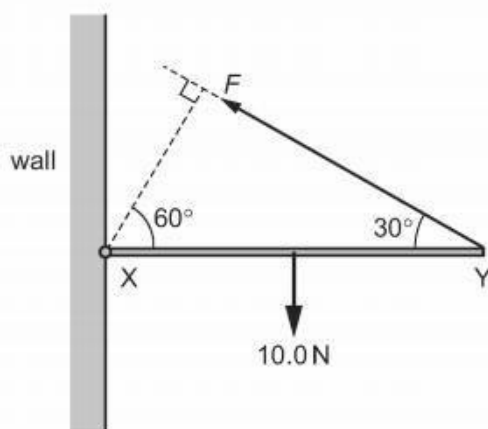
What is the moment of the force F about O?

- A $F \times \text{distance OX}$
- B $F \times \text{distance OY}$
- C $F \times \text{distance WO}$
- D $F \times \text{distance WX}$



144 - (9702/12_Summer_2023_Q12) - Dynamics

A uniform rod XY of weight 10.0 N is freely hinged to a wall at X. It is held horizontal by a force F acting from Y at an angle of 30° to the horizontal, as shown.

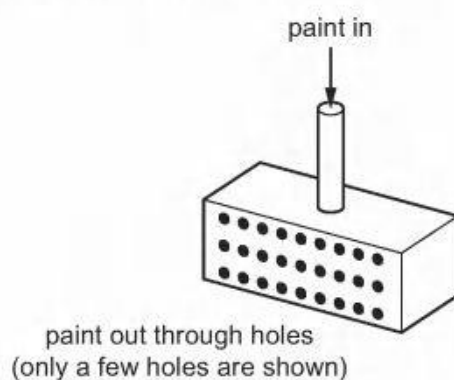


What is the value of F ?

- A 5.0 N B 8.7 N C 10 N D 20 N

145 - (9702/13_Summer_2023_Q7) - Dynamics

A device for spraying paint consists of a box with its faces horizontal and vertical. One of its vertical faces contains small holes. Paint is fed into the box under pressure via a vertical tube and exits through the holes as fine streams moving horizontally.



The paint is ejected at a speed of 2.5 m s^{-1} through 400 holes, each of area 0.4 mm^2 . The density of the paint is 900 kg m^{-3} .

What is the horizontal force required to hold the device stationary as it ejects the paint?

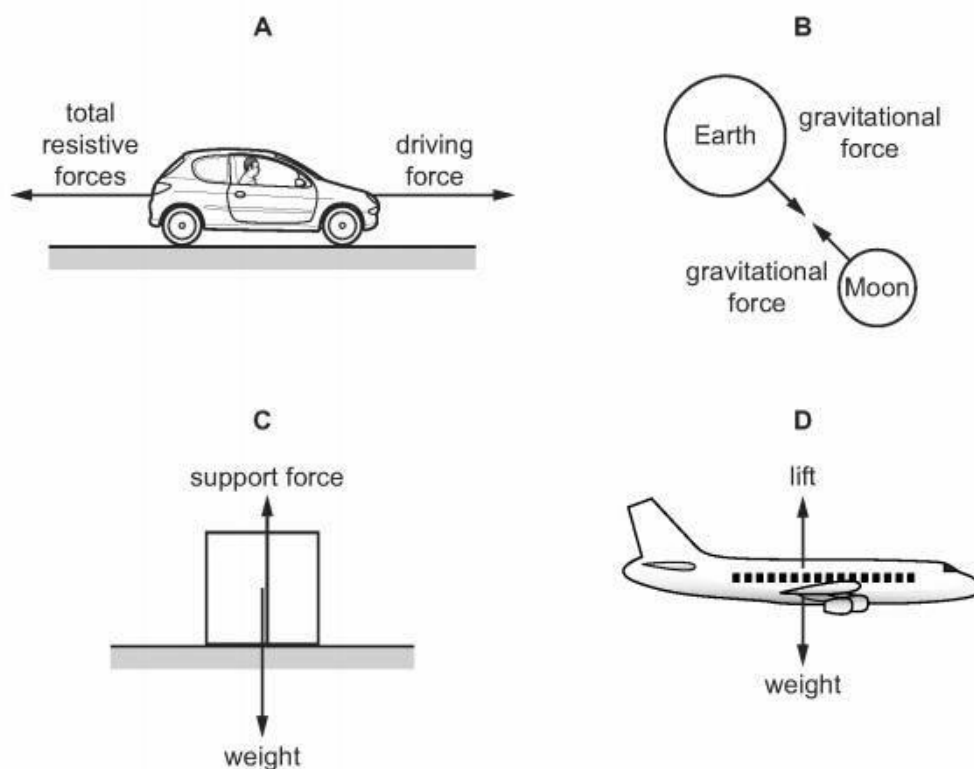
- A 0.36 N B 0.90 N C 2.3 N D 900 N



146 - (9702/13_Summer_2023_Q8) - Dynamics

Each diagram illustrates a pair of forces of equal magnitude.

Which diagram gives an example of a pair of forces that is described by Newton's third law of motion?



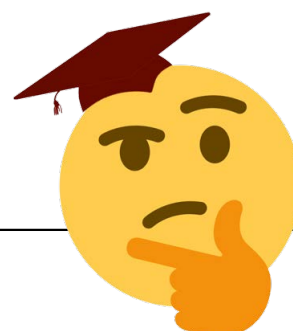
147 - (9702/13_Summer_2023_Q9) - Dynamics

Two balls of identical shape and size but different masses are falling through the same liquid.

The sum of the drag force and upthrust acting on each ball is equal to its weight.

Which statement about the two balls is correct?

- A The heavier ball has a larger acceleration than the lighter ball.
- B The heavier ball has a smaller deceleration than the lighter ball.
- C The heavier ball is falling at the same speed as the lighter ball.
- D The heavier ball is falling at a larger speed than the lighter ball.



148 - (9702/13_Summer_2023_Q10) - Dynamics

A perfectly elastic collision occurs between two objects X and Y. The mass of X is m and the mass of Y is $4m$. Object X travels at speed v before the collision and speed $\frac{3v}{5}$ in the opposite direction after the collision. Object Y is stationary before the collision.



What is the kinetic energy of Y after the collision?

- A $\frac{8}{10}mv^2$ B $\frac{34}{50}mv^2$ C $\frac{16}{50}mv^2$ D $\frac{1}{5}mv^2$

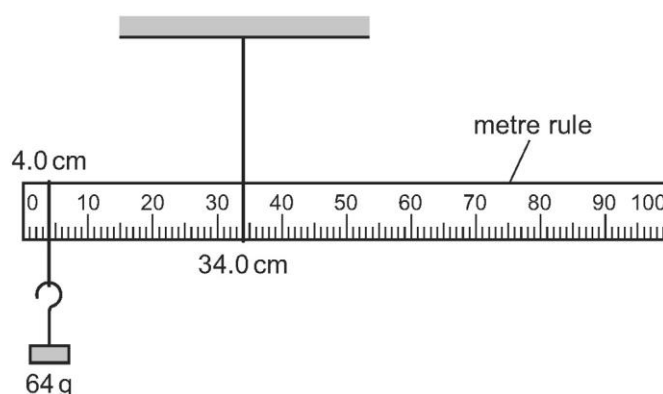
149 - (9702/13_Summer_2023_Q11) - Dynamics

What is **not** a requirement for two forces to act as a couple?

- A The two forces act in opposite directions.
B The two forces act through the same point.
C The two forces combine to produce zero resultant force.
D The two forces have equal magnitude.

150 - (9702/13_Summer_2023_Q12) - Dynamics

A uniform metre rule is pivoted at the 34.0 cm mark, as shown.



The rule balances when a 64 g mass is hung from the 4.0 cm mark.

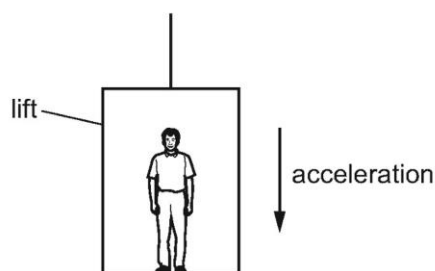
What is the mass of the metre rule?

- A 38 g B 44 g C 120 g D 136 g



151 - (9702/11_Winter_2023_Q7) - Dynamics

A man stands in a lift that is accelerating vertically downwards, as shown.



Which statement describes the force exerted by the man on the floor?

- A It is equal to the weight of the man.
- B It is greater than the force exerted by the floor on the man.
- C It is less than the force exerted by the floor on the man.
- D It is less than the weight of the man.

152 - (9702/11_Winter_2023_Q8) - Dynamics

A ball of mass 200 g is thrown horizontally with a speed of 20 m s^{-1} against a vertical wall.

The ball is in contact with the wall for a time of 0.10 s before rebounding back along its original path with a speed of 10 m s^{-1} .

What is the average force exerted by the wall on the ball during the collision?

- A 20 N B 60 N C 20 kN D 60 kN

153 - (9702/11_Winter_2023_Q9) - Dynamics

In an experiment, a metal ball is dropped into a viscous liquid. The terminal velocity of the ball in the liquid is measured.

The experiment is repeated four times. For each repeat, a change is made to one of the following.

- 1 the density of the metal of the ball
- 2 the height from which the ball is dropped
- 3 the density of the liquid
- 4 the depth of the liquid

Which two changes separately affect the terminal velocity of the ball in the liquid?

- A 1 and 2 B 1 and 3 C 2 and 4 D 3 and 4



154 - (9702/11_Winter_2023_Q10) - Dynamics

Two objects move towards each other along the same straight line.



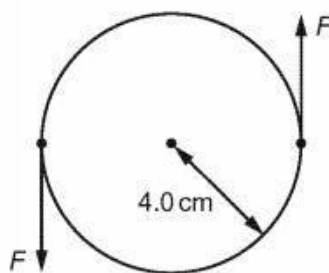
After colliding, the two objects stick together and are stationary.

Which statement **must** be correct?

- A The total kinetic energy of the two objects does not change during the collision.
- B The total momentum of the two objects before the collision is zero.
- C The two objects have equal mass.
- D The two objects have the same speed before the collision.

155 - (9702/11_Winter_2023_Q11) - Dynamics

A minimum torque of 20 N m must be applied to the lid of a jar for it to open. The radius of the lid is 4.0 cm .



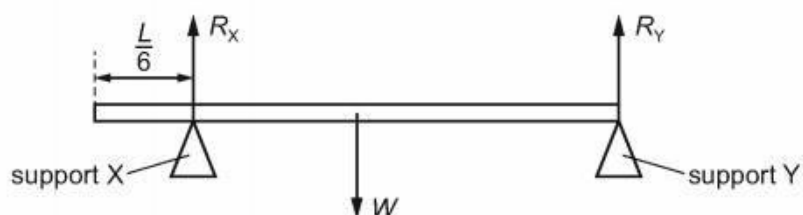
What is the minimum force F that must act on each side of the lid in order to open it?

- A 2.5 N
- B 5.0 N
- C 250 N
- D 500 N



156 - (9702/11_Winter_2023_Q12) - Dynamics

A uniform bar of length L and weight W rests horizontally on two supports X and Y.



Support X exerts a vertical force R_X at a distance of $\frac{L}{6}$ from one end of the bar.

Support Y exerts a vertical force R_Y at the other end of the bar.

The bar is in equilibrium.

What is the ratio $\frac{R_X}{R_Y}$?

A $\frac{3}{2}$

B $\frac{2}{3}$

C $\frac{3}{5}$

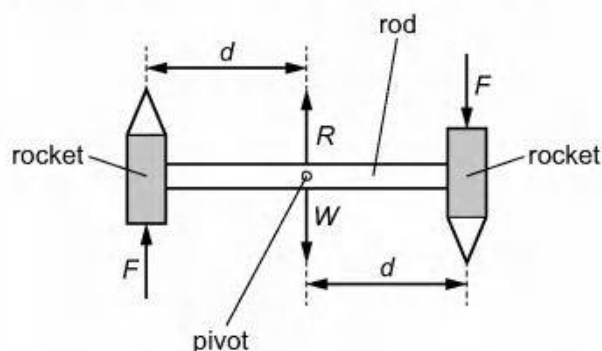
D $\frac{2}{5}$

157 - (9702/11_Winter_2023_Q13) - Dynamics

A type of firework is made by connecting two rockets, facing in opposite directions, to a rod, as shown.

The rod is attached to a frictionless pivot so that the firework can rotate in a vertical plane.

The firework has weight W . The pivot exerts a force R on the rod that is equal and opposite to W .

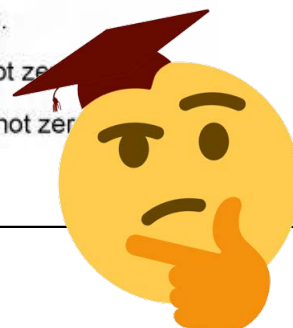


Each rocket exerts a force of magnitude F on the rod at a perpendicular distance d from the pivot. The forces exerted by the rockets are always in opposite directions.

Air resistance is negligible.

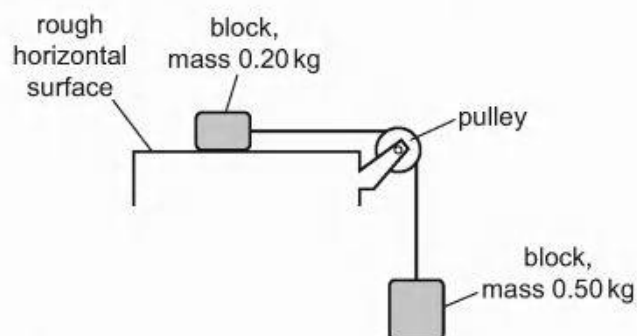
Which statement is correct?

- A The firework is in equilibrium because the resultant force acting on it is zero.
- B The firework is in equilibrium because the resultant torque acting on it is zero.
- C The firework is not in equilibrium because the resultant force acting on it is not zero.
- D The firework is not in equilibrium because the resultant torque acting on it is not zero.



158 - (9702/12_Winter_2023_Q7) - Dynamics

Two blocks, of mass 0.20 kg and 0.50 kg, are connected by a light inextensible string that passes over a frictionless pulley.



The blocks are initially held stationary. The block of mass 0.20 kg rests on a rough horizontal surface.

The block of mass 0.50 kg is suspended in air. Air resistance is negligible.

When the blocks are released, they have an acceleration of magnitude 2.0 m s^{-2} .

What is the magnitude of the frictional force between the block of mass 0.20 kg and the rough surface?

- A 3.5 N B 3.9 N C 4.5 N D 6.3 N

159 - (9702/12_Winter_2023_Q8) - Dynamics

A resultant force causes an object to accelerate.

What is equal to the resultant force?

- A the acceleration of the object per unit mass
B the change in kinetic energy of the object per unit time
C the change in momentum of the object per unit time
D the change in velocity of the object per unit time

160 - (9702/12_Winter_2023_Q9) - Dynamics

An object falls from a stationary helicopter and reaches terminal velocity.

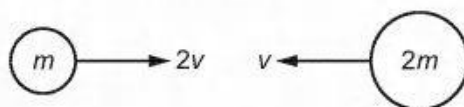
What happens to the acceleration of the object between leaving the helicopter and reaching terminal velocity?

- A It decreases to 9.81 m s^{-2} .
B It decreases to zero.
C It increases to 9.81 m s^{-2} .
D It remains constant at 9.81 m s^{-2} .



161 - (9702/12_Winter_2023_Q10) - Dynamics

Two balls, of masses m and $2m$, travelling in a vacuum with initial velocities $2v$ and v respectively, collide with each other head-on, as shown.



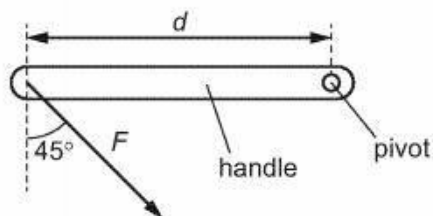
After the collision, the ball of mass m rebounds to the left with velocity v .

What is the loss of kinetic energy in the collision?

- A $\frac{3}{4}mv^2$ B $\frac{3}{2}mv^2$ C $\frac{9}{4}mv^2$ D $\frac{9}{2}mv^2$

162 - (9702/12_Winter_2023_Q11) - Dynamics

A force F is applied at an angle of 45° to a door handle at a distance d from the pivot of the handle, as shown.



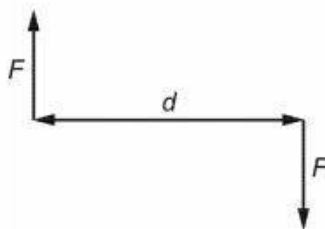
What is the moment of the force about the pivot?

- A $\frac{Fd}{\sqrt{2}}$ B Fd C $Fd\sqrt{2}$ D $2Fd$

163 - (9702/12_Winter_2023_Q12) - Dynamics

A couple consists of two forces, each of magnitude F , that act in opposite directions in the same plane.

The perpendicular distance between the two forces is d .



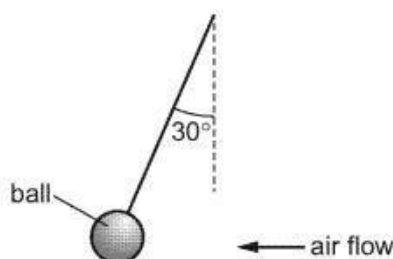
What is the torque of the couple?

- A $\frac{Fd}{2}$ B $\frac{F}{d}$ C Fd D $2Fd$



164 - (9702/12_Winter_2023_Q13) - Dynamics

The diagram shows an experiment to determine the force exerted on a ball by a horizontal air flow.



The ball is suspended by a light string and weighs 0.15 N .

The deflection of the string from vertical is 30° . The ball is in equilibrium.

What is the force on the ball from the air flow?

- A 0.075 N B 0.087 N C 0.26 N D 0.30 N

165 - (9702/13_Winter_2023_Q7) - Dynamics

Which statement about mass is correct?

- A Mass has a magnitude and a direction.
B Mass resists changes in motion.
C The greater the mass of an object, the greater its acceleration when falling in a vacuum.
D The mass of an object depends on its location.

166 - (9702/13_Winter_2023_Q8) - Dynamics

A snooker ball has a mass of 200 g . It hits the cushion of a snooker table and rebounds along its original path.

The ball arrives at the cushion with a speed of 14.0 m s^{-1} and then leaves it with a speed of 7.0 m s^{-1} . The ball and the cushion are in contact for a time of 0.60 s .

What is the average force exerted on the ball by the cushion?

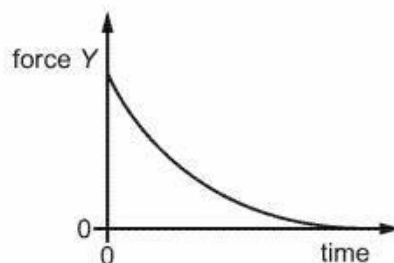
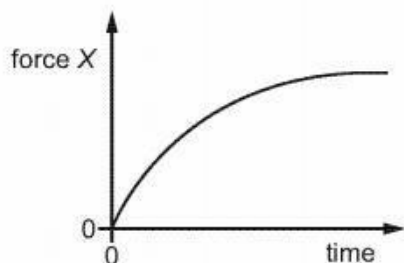
- A 1.4 N B 2.3 N C 4.2 N D 7.0 N



167 - (9702/13_Winter_2023_Q9) - Dynamics

A ball falls from rest through air and eventually reaches a constant velocity.

For this fall, forces X and Y vary with time as shown.



What could be forces X and Y ?

	force X	force Y
A	air resistance	resultant force
B	air resistance	weight
C	upthrust	resultant force
D	upthrust	weight

168 - (9702/13_Winter_2023_Q10) - Dynamics

An object X of mass 0.30 kg is travelling in a straight line at a constant velocity of 3.0 m s^{-1} on a horizontal frictionless surface. Object X collides with a stationary object Y of mass 0.50 kg .

After the collision, X moves with a velocity of 2.0 m s^{-1} at an angle of 60° to its direction before the collision. Object Y moves with a velocity v at an angle of 41° to the direction of X before the collision, as shown.



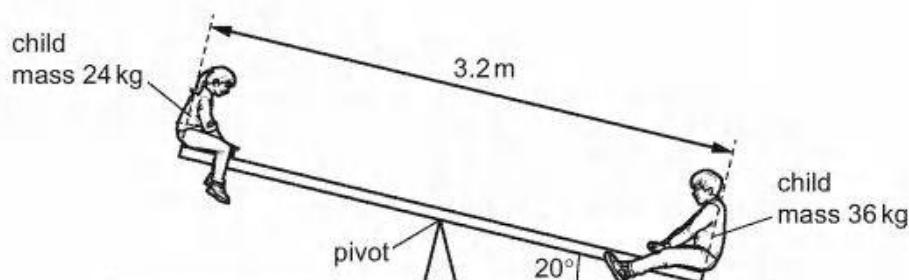
What is the value of v ?

- A 0.80 m s^{-1} B 1.2 m s^{-1} C 1.6 m s^{-1} D 1.8 m s^{-1}



169 - (9702/13_Winter_2023_Q11) - Dynamics

A uniform rigid beam of length 3.2 m is pivoted at its centre. Two children sit at the opposite ends of the beam, as shown.



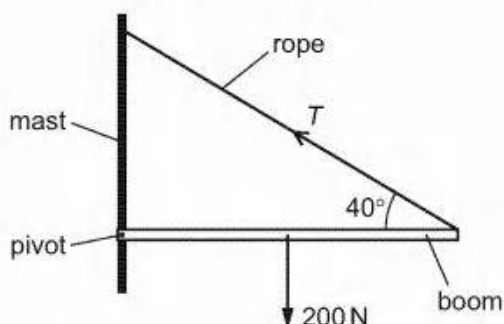
One child has a mass of 24 kg. The other child has a mass of 36 kg. The heavier child causes one end of the beam to permanently rest on the ground, so that the beam makes an angle of 20° to the horizontal ground.

What is the moment of the weight of the 24 kg child about the pivot?

- A 72 Nm B 130 Nm C 350 Nm D 380 Nm

170 - (9702/13_Winter_2023_Q12) - Dynamics

Two parts of a sailing boat are the mast and the boom. The mast is a vertical rigid beam and the boom is a horizontal rigid beam. One end of the boom is attached to the mast by a pivot. The other end of the boom is connected to the mast by a rope, as shown.



The rope is at an angle of 40° to the horizontal and exerts a tension force T on the boom. The weight of the boom is 200 N. The mass of the boom is uniformly distributed along its length. The boom is in equilibrium.

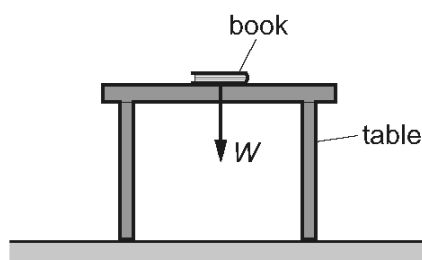
What is the magnitude of T ?

- A 130 N B 160 N C 260 N D 310 N



1 - (9702/12_Summer_2017_Q9) - Forces, Density & Pressure

A book of weight W is at rest on a table. A student attempts to state Newton's third law of motion by saying that 'action equals reaction'.

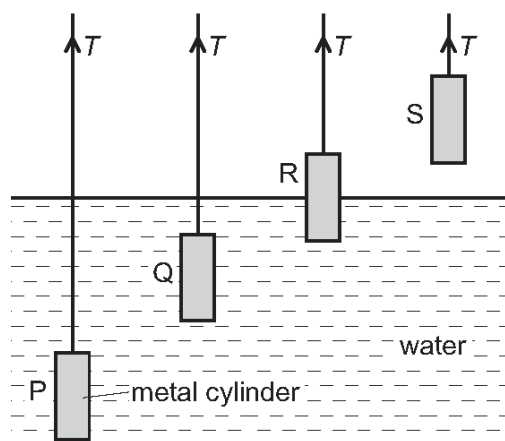


If the weight of the book is the 'action' force, what is the 'reaction' force?

- A** the force W acting downwards on the Earth from the table
- B** the force W acting upwards on the book from the table
- C** the force W acting upwards on the Earth from the book
- D** the force W acting upwards on the table from the floor

2 - (9702/12_Summer_2017_Q10) - Forces, Density & Pressure

A metal cylinder is suspended vertically in equilibrium by a cord. The diagram shows the cylinder in four different positions P, Q, R and S.



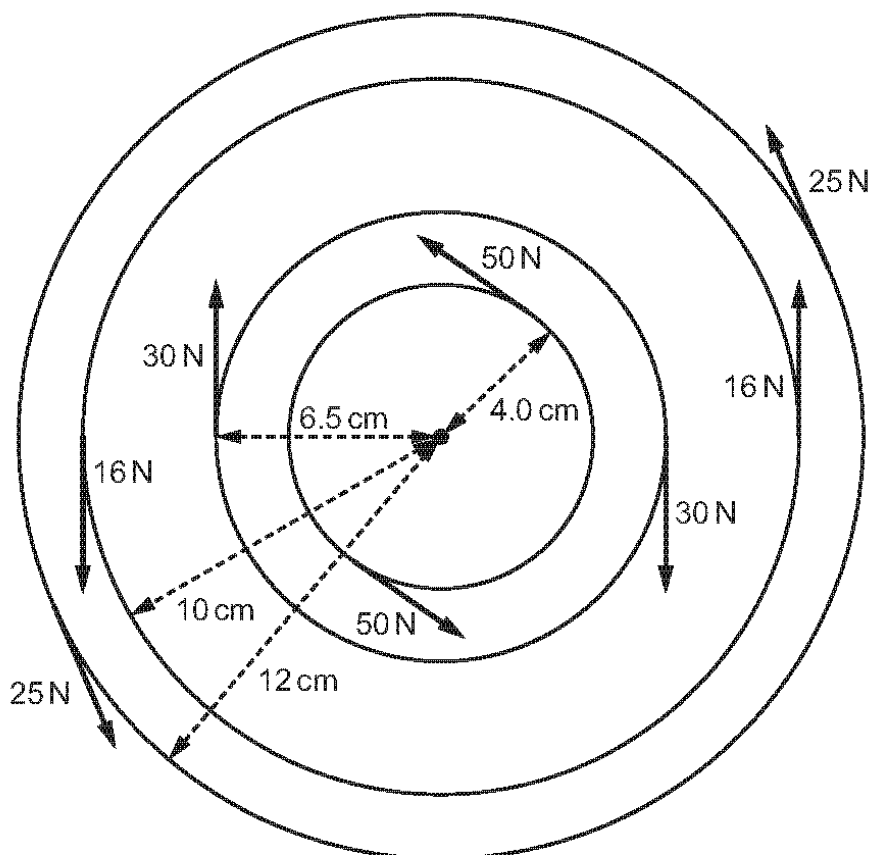
Which statement explains the variation of the tension T in the cord?

- A** At P and at Q, the tension T in the cord is the same because the difference in pressure between the top and bottom of the cylinder is the same.
- B** At Q, the tension T in the cord is less than at P because, at smaller depth, liquid pressure is smaller.
- C** At R, the tension T in the cord is less than at P because atmospheric pressure is less than water pressure.
- D** At S, the tension T in the cord is greater than at P because atmospheric pressure exerts no force on the top or bottom of the cylinder.



3 - (9702/12_Summer_2017_Q11) - Forces, Density & Pressure

In a machine, many couples act on a rotating object as shown.

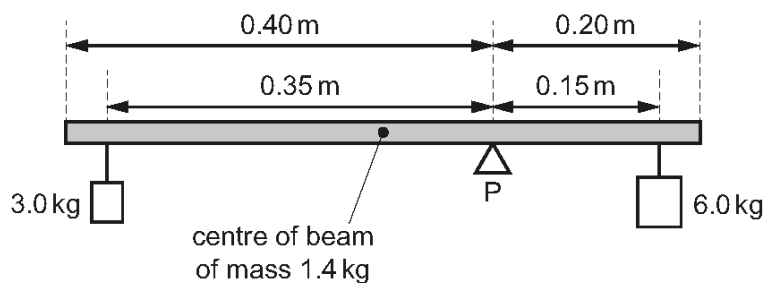


What is the resultant torque acting on the rotating object?

- A** 4.7 Nm **B** 8.6 Nm **C** 9.3 Nm **D** 17.1 Nm

4 - (9702/13_Summer_2017_Q11) - Forces, Density & Pressure

A uniform beam of mass 1.4 kg is pivoted at P as shown. The beam has a length of 0.60 m and P is 0.20 m from one end. Loads of 3.0 kg and 6.0 kg are suspended 0.35 m and 0.15 m from the pivot as shown.



What is the torque that must be applied to the beam in order to maintain it in equilibrium?

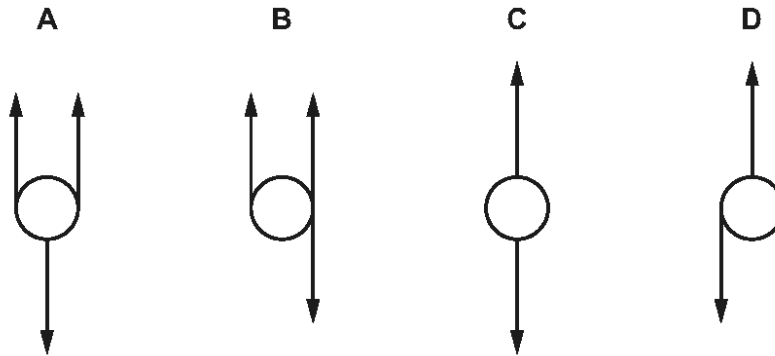
- A** 0.010 Nm **B** 0.10 Nm **C** 0.29 Nm **D** 2.8 Nm



5 - (9702/11_Summer_2017_Q12) - Forces, Density & Pressure

A sphere is acted upon by various forces, all of the same magnitude.

Which system of forces provides a resultant torque but zero resultant force on the sphere?

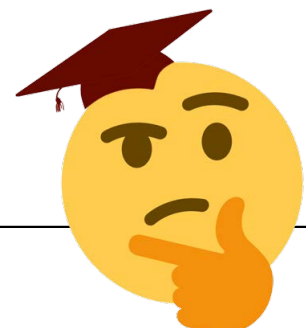
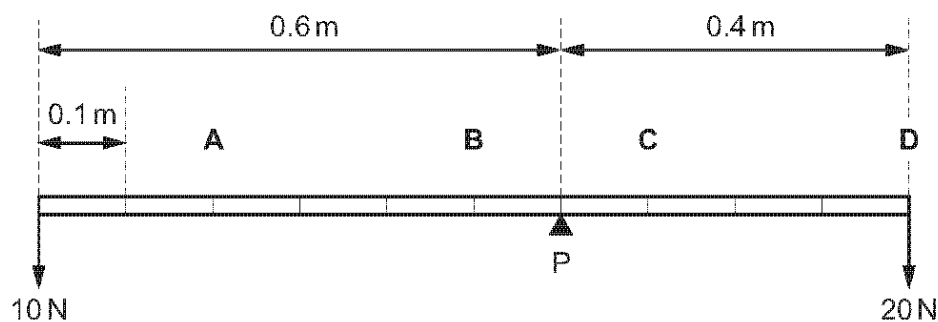


6 - (9702/12_Summer_2017_Q12) - Forces, Density & Pressure

A uniform beam is pivoted at P as shown. Weights of 10 N and 20 N are attached to its ends.

The length of the beam is marked at 0.1 m intervals. The weight of the beam is 100 N.

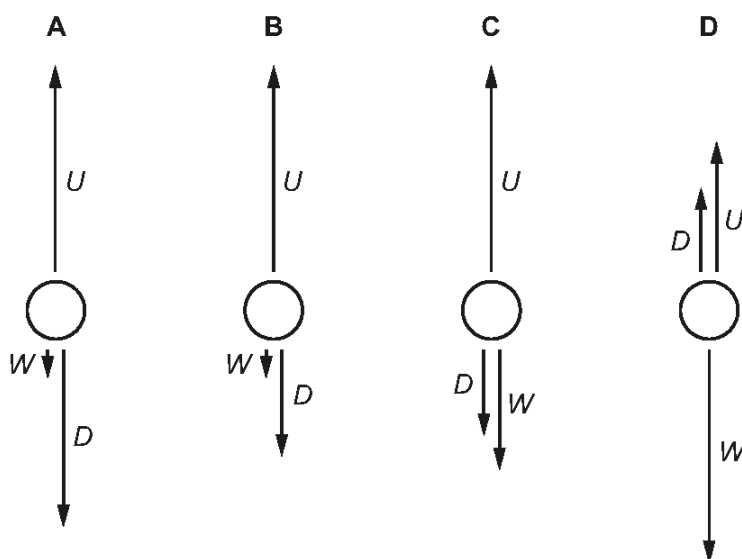
At which point should a further weight of 20 N be attached to achieve equilibrium?



7 - (9702/13_Summer_2017_Q12) - Forces, Density & Pressure

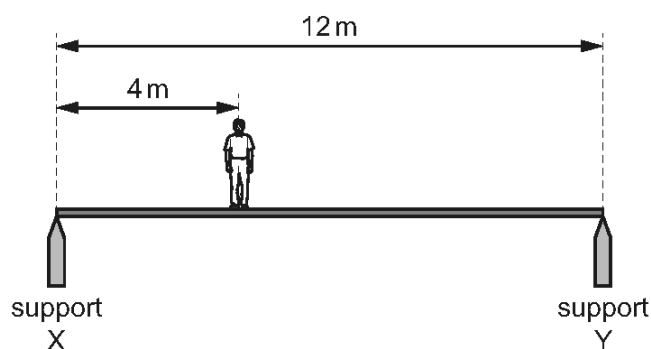
An air bubble is rising through a liquid at a constant speed. The forces on it are the upthrust U , the viscous drag D and its weight W .

Which diagram shows the directions and relative sizes of the forces?



8 - (9702/11_Summer_2017_Q13) - Forces, Density & Pressure

A uniform horizontal footbridge is 12 m long and weighs 4000 N. It rests on two supports X and Y as shown.



A man of weight 600 N is a distance of 4 m from support X.

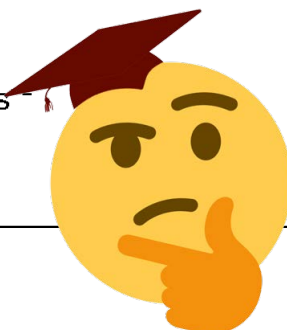
What is the upward force on the footbridge from support X?

- A 2200 N B 2300 N C 2400 N D 2600 N

9 - (9702/12_Summer_2017_Q13) - Physical Quantities & Units, Forces, Density & Pressure

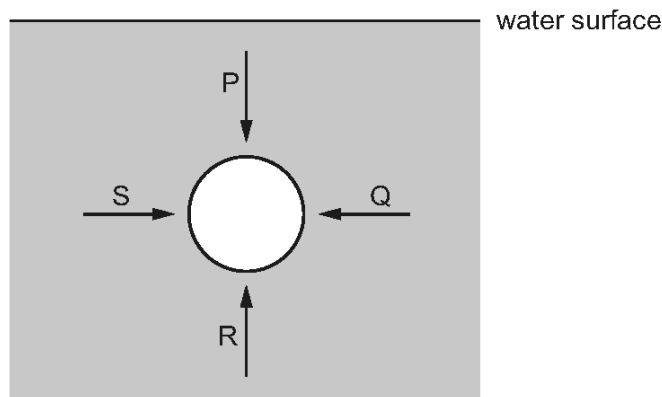
What are the SI base units of the quantity $\frac{\text{pressure}}{\text{density}}$?

- A s^{-2} B $\text{kg}^2 \text{s}^{-2}$ C $\text{kg}^2 \text{m}^2 \text{s}^{-2}$ D $\text{m}^2 \text{s}^{-2}$



10 - (9702/13_Summer_2017_Q13) - Forces, Density & Pressure

The diagram represents a sphere under water. P, Q, R and S are forces acting on the sphere due to the pressure of the water.



Each force acts perpendicularly to the sphere's surface. P and R act in opposite directions vertically. Q and S act in opposite directions horizontally.

Which information about the magnitudes of the forces is correct?

- A** $P < R$ and $S = Q$
- B** $P > R$ and $S = Q$
- C** $P = R$ and $S = Q$ and $P < S$
- D** $P = R$ and $S = Q$ and $P = S$

11 - (9702/11_Summer_2017_Q14) - Forces, Density & Pressure

A metal block has a mass of 750 g. 60% of the mass is magnesium and the remainder is copper.

The density of magnesium is 1.7 g cm^{-3} .

The density of copper is 9.0 g cm^{-3} .

What is the density of the block?

- A** 2.5 g cm^{-3} **B** 4.6 g cm^{-3} **C** 5.4 g cm^{-3} **D** 10.7 g cm^{-3}

12 - (9702/12_Summer_2017_Q16) - Forces, Density & Pressure, Work, Energy & Power

A stone of mass m falls from rest at the top of a cliff of height h into the sea below. Just before hitting the sea the stone has speed v .

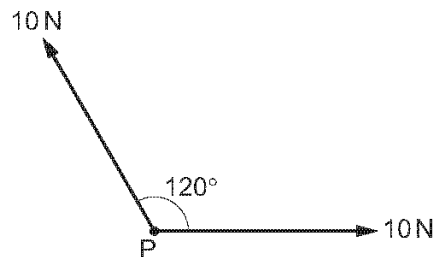
What is the average force of air resistance acting on the stone during its fall?

- A** mg **B** $\frac{m(v^2 - 2gh)}{h}$ **C** $m\left(g - \frac{v^2}{2h}\right)$ **D** $m\left(gh - \frac{v^2}{2}\right)$



13 - (9702/11_Winter_2017_Q2) - Forces, Density & Pressure

Two forces, each of 10 N, act at a point P as shown. The angle between the directions of the forces is 120° .

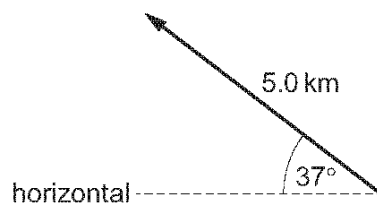


What is the magnitude of the resultant force?

- A 5 N B 10 N C 17 N D 20 N

14 - (9702/12_Winter_2017_Q2) - Kinematics, Forces, Density & Pressure

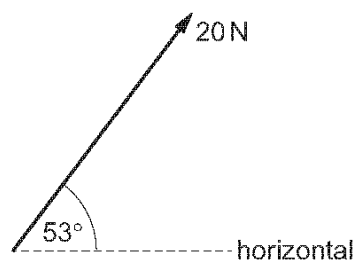
What is the vertical component of this displacement vector?



- A 3.0 km B 3.8 km C 4.0 km D 5.0 km

15 - (9702/13_Winter_2017_Q3) - Forces, Density & Pressure

What is the horizontal component of the force shown?



- A 12 N B 16 N C 20 N D 27 N



16 - (9702/11_Winter_2017_Q8) - Dynamics, Forces, Density & Pressure

The three forces acting on a hot-air balloon that is moving vertically are its weight, the force due to air resistance and the upthrust force.

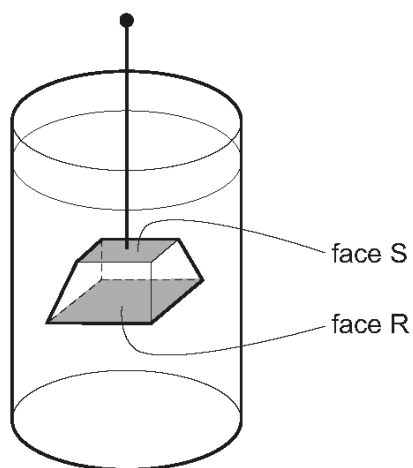
The hot-air balloon descends vertically at constant speed. The force of air resistance on the balloon is F .

Which weight of material must be released from the balloon so that it ascends vertically at the same constant speed?

- A F B $2F$ C $3F$ D $4F$

17 - (9702/12_Winter_2017_Q11) - Forces, Density & Pressure

The diagram shows a block of copper suspended in water.



The block experiences an upthrust from the water.

Which statement is the basis of an explanation for this upthrust?

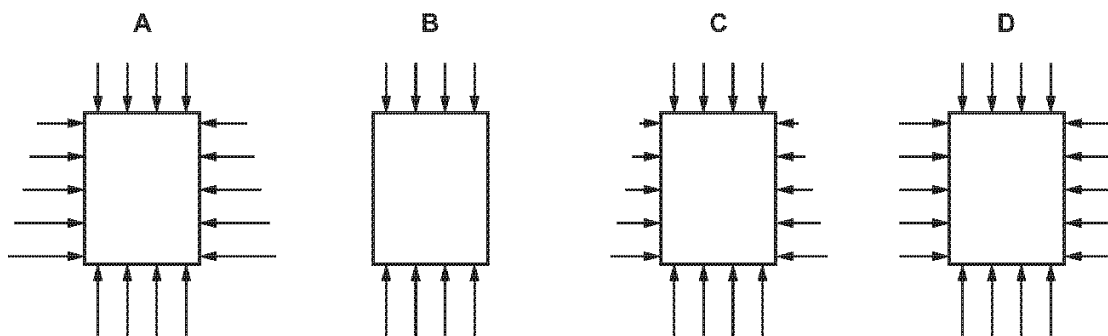
- A Copper is more dense than water.
B The area of face R is greater than the area of face S.
C The density of water increases with depth.
D The pressure of water increases with depth.



18 - (9702/11_Winter_2017_Q12) - Forces, Density & Pressure

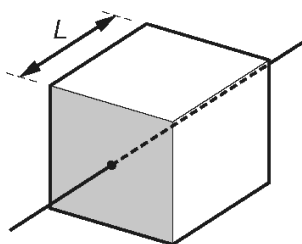
A block is submerged vertically in a liquid. The four diagrams show, to scale, the forces exerted by the liquid on the block.

Which diagram correctly shows a possible situation as viewed from the side?

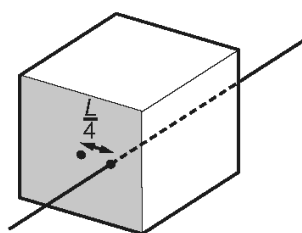


19 - (9702/12_Winter_2017_Q12) - Forces, Density & Pressure

The diagram shows a solid cube with weight W and sides of length L . It is supported at rest by a frictionless spindle that passes through the centres of two opposite vertical faces. One of these faces is shaded.



The spindle is now removed and replaced at a distance $\frac{L}{4}$ to the right of its original position.



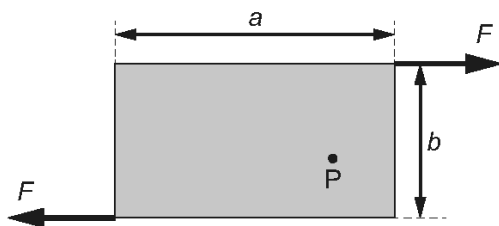
When viewing the shaded face, what is the torque of the couple that will now be needed to keep the cube at rest?

- A $\frac{WL}{4}$ anticlockwise
- B $\frac{WL}{4}$ clockwise
- C $\frac{WL}{2}$ anticlockwise
- D $\frac{WL}{2}$ clockwise



20 - (9702/13_Winter_2017_Q12) - Forces, Density & Pressure

Two forces, each of magnitude F , act along the edges of a rectangular metal plate, as shown.



The plate has length a and width b .

What is the torque about point P ?

A Fa

B Fb

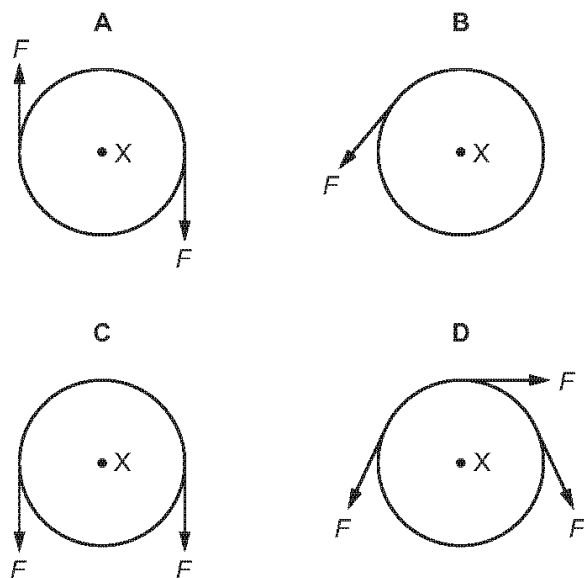
C $2Fa$

D $2Fb$

21 - (9702/11_Winter_2017_Q13) - Forces, Density & Pressure

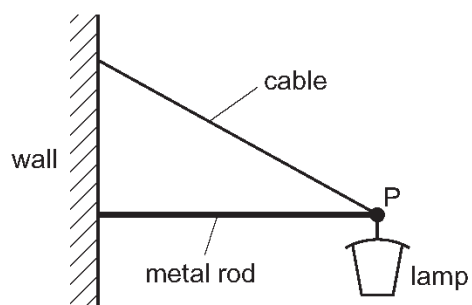
A rigid circular disc of radius r has its centre at X . A number of forces of equal magnitude F act at the edge of the disc. All the forces are in the plane of the disc.

Which arrangement of forces provides a moment of magnitude $2Fr$ about X ?

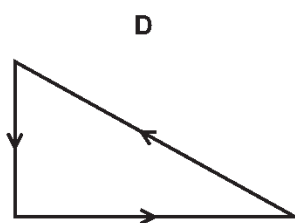
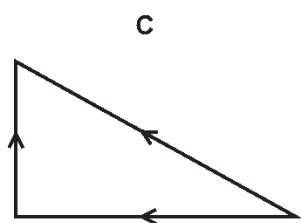
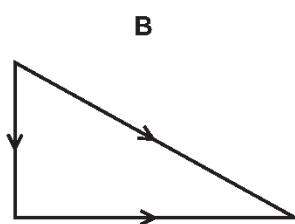
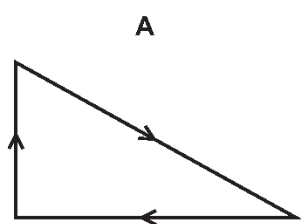


22 - (9702/12_Winter_2017_Q13) - Forces, Density & Pressure

A street lamp is fixed to a wall by a metal rod and a cable.

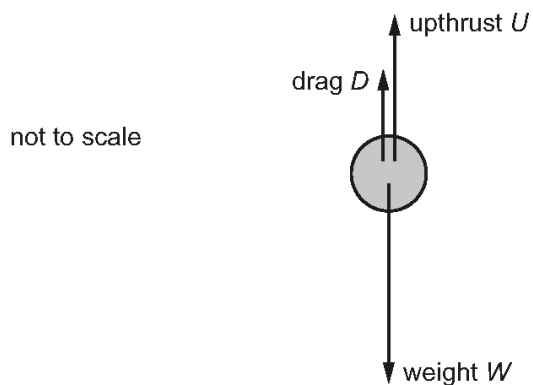


Which vector triangle could represent the forces acting at point P?



23 - (9702/13_Winter_2017_Q13) - Dynamics, Forces, Density & Pressure

A solid sphere falls at constant (terminal) velocity in a liquid. The three forces acting on the sphere are shown in the diagram.



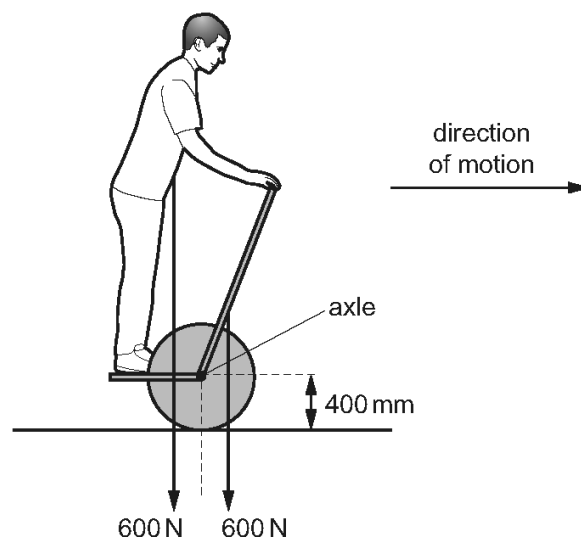
How are the three forces related?

- A $W + D = U$
- B $W > U + D$
- C $W - U = D$
- D $W < D + U$



24 - (9702/11_Winter_2017_Q14) - Forces, Density & Pressure

The diagram shows a motorised vehicle for carrying one person.



The vehicle has two wheels on one axle. The passenger stands on a platform between the wheels.

The weight of the machine is 600 N. Its centre of mass is 200 mm in front of the axle. The wheel radius is 400 mm.

When stationary, a passenger of weight 600 N stands with his centre of mass 200 mm behind the axle to balance the machine.

The motor is now switched on to provide a horizontal force of 90 N at the ground to move the vehicle forwards.

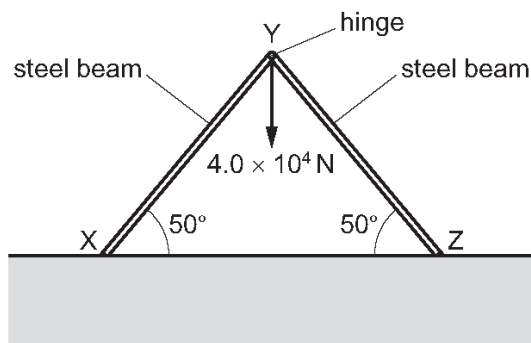
How far and in which direction must the passenger move his centre of mass to maintain balance?

- A 60 mm backwards
- B 60 mm forwards
- C 140 mm backwards
- D 140 mm forwards



25 - (9702/12_Winter_2017_Q14) - Forces, Density & Pressure

Two rigid steel beams XY and YZ are fixed at their lower ends and are hinged at Y. Each beam is inclined at 50° to the horizontal, as shown. A weight of $4.0 \times 10^4 \text{ N}$ hangs from Y. The structure is in equilibrium.



What is the force exerted by each beam on the hinge at Y?

- A $2.6 \times 10^4 \text{ N}$ B $3.1 \times 10^4 \text{ N}$ C $5.2 \times 10^4 \text{ N}$ D $6.2 \times 10^4 \text{ N}$

26 - (9702/13_Winter_2017_Q14) - Forces, Density & Pressure

A thin horizontal plate of area 0.036 m^2 is beneath the surface of a liquid of density 930 kg m^{-3} . The force on one side of the plate due to the pressure of the liquid is 290 N .

What is the depth of the plate beneath the surface of the liquid?

- A 0.88 m B 1.1 m C 1.8 m D 8.7 m

27 - (9702/11_Winter_2017_Q15) - Forces, Density & Pressure

The derivation of the pressure equation $\Delta p = \rho g \Delta h$ uses a number of relationships between quantities.

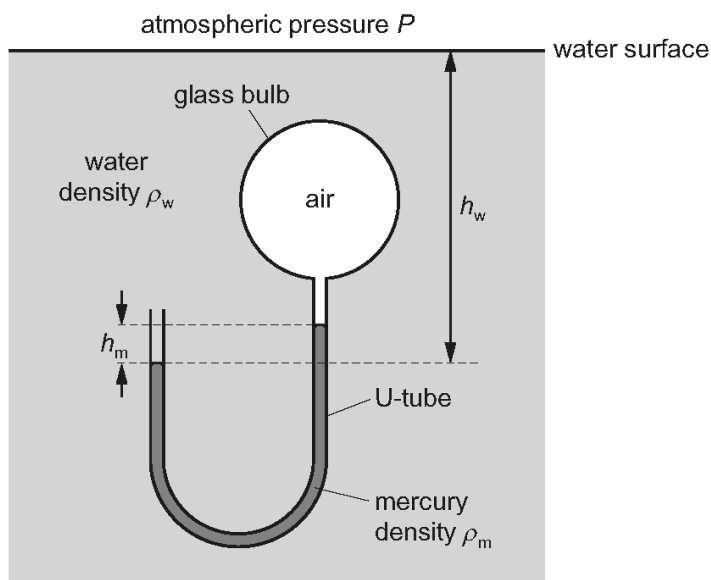
Which relationship is **not** used in the derivation of this equation?

- A density = $\frac{\text{mass}}{\text{volume}}$
B potential energy = mass $\times$ acceleration of free fall $\times$ height
C pressure = $\frac{\text{force}}{\text{area}}$
D weight = mass $\times$ acceleration of free fall



28 - (9702/12_Winter_2017_Q15) - Forces, Density & Pressure

Air is trapped inside a glass bulb which is immersed in water and attached to a U-tube containing mercury. The densities of water and mercury are ρ_w and ρ_m respectively. The surface of the water is open to the atmosphere where atmospheric pressure is P .



The acceleration of free fall is g .

What is the pressure of the air in the glass bulb?

- A $P + g\rho_w h_w + g\rho_m h_m$
- B $P + g\rho_w h_w - g\rho_m h_m$
- C $g\rho_w h_w + g\rho_m h_m$
- D $g\rho_w h_w - g\rho_m h_m$

29 - (9702/11_Winter_2017_Q17) - Forces, Density & Pressure, Work, Energy & Power

A piston in a gas supply pump has an area of 400 cm^2 . The pump moves the gas against a fixed pressure of 3000 Pa .

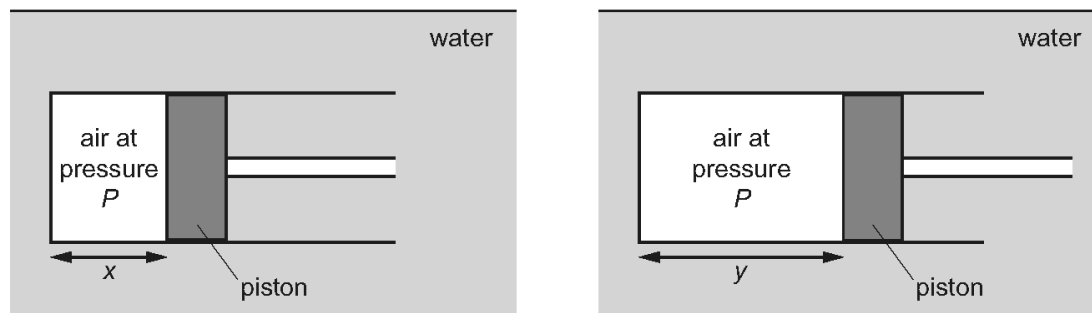
During part of its stroke, the piston moves a distance of 25 cm in one direction. How much work is done by the piston during this movement?

- A 30 J
- B $3.0 \times 10^3\text{ J}$
- C $3.0 \times 10^5\text{ J}$
- D $3.0 \times 10^7\text{ J}$



30 - (9702/13_Winter_2017_Q17) - Forces, Density & Pressure

A horizontal cylinder of cross-sectional area A is fitted with a frictionless piston and contains air at pressure P . It is immersed in hot water and the length of the air column increases from x to y . The pressure P is constant.

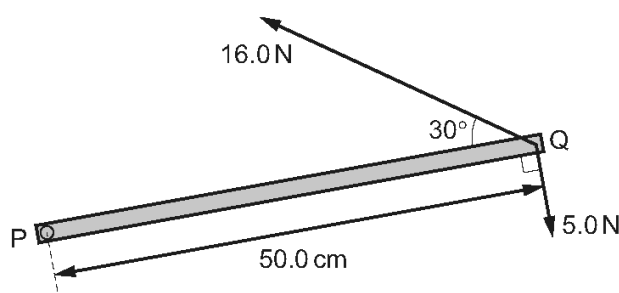


Which equation represents the work done by the trapped air during this process?

- A PAy B $-PAy$ C $PA(y - x)$ D $-PA(y - x)$

31 - (9702/11_Summer_2018_Q10) - Forces, Density & Pressure

A horizontal metal bar PQ of length 50.0 cm is hinged at end P. The diagram shows the metal bar viewed from above.



Two forces of 16.0 N and 5.0 N are in the horizontal plane and act on end Q as shown in the diagram.

What is the total moment about P due to the two forces?

- A 1.5 Nm B 4.4 Nm C 6.5 Nm D 9.4 Nm

32 - (9702/12_Summer_2018_Q10) - Forces, Density & Pressure

The density of water is 1.0 g cm^{-3} and the density of glycerine is 1.3 g cm^{-3} .

Water is added to a measuring cylinder containing 40 cm^3 of glycerine so that the density of the mixture is 1.1 g cm^{-3} . Assume that the mixing process does not change the total volume of the liquid.

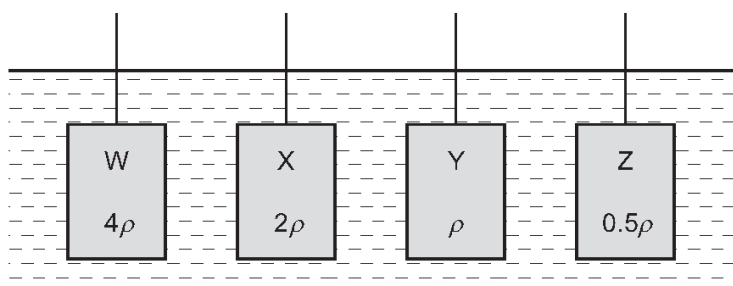
What is the volume of water added?

- A 40 cm^3 B 44 cm^3 C 52 cm^3 D 80 cm^3



33 - (9702/13_Summer_2018_Q10) - Forces, Density & Pressure

Four cuboids with identical lengths, breadths and heights are immersed in water. The cuboids are held at the same depth and in identical orientations by vertical rods, as shown.



Water has density ρ .

Cuboid W is made of material of density 4ρ .

Cuboid X is made of material of density 2ρ .

Cuboid Y is made of material of density ρ .

Cuboid Z is made of material of density 0.5ρ .

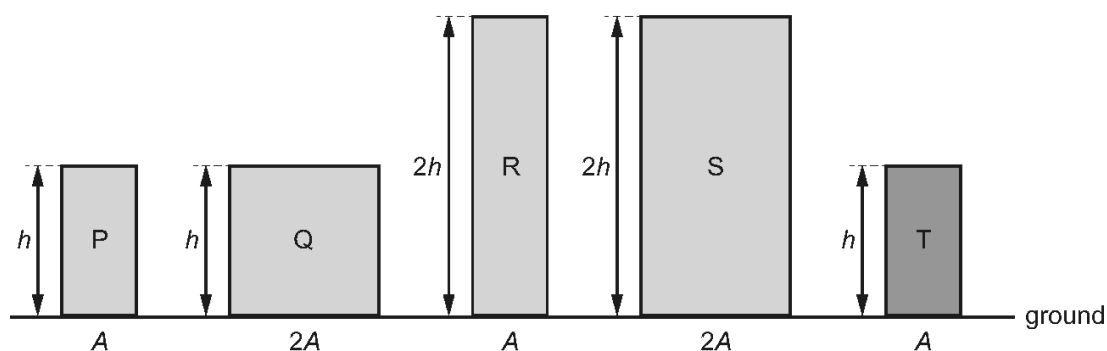
Which statement is correct?

- A The upthrust of the water on each of the cuboids is the same.
- B The upthrust of the water on W is twice the upthrust of the water on X.
- C The upthrust of the water on X is twice the upthrust of the water on W.
- D The upthrust of the water on Y is zero.

34 - (9702/11_Summer_2018_Q11) - Forces, Density & Pressure

Blocks P, Q, R and S are made from material of the same density. Block T is made from a material of twice the density of the material of the other blocks.

The cross-sectional area and height of each of the blocks are shown.



Which two blocks exert the same pressure on the ground?

- A P and T
- B Q and R
- C Q and S
- D S and T



35 - (9702/13_Summer_2018_Q11) - Forces, Density & Pressure

A rectangular block of lead of density $1.13 \times 10^4 \text{ kg m}^{-3}$ has sides of length 12.0 cm, 15.0 cm and 10.0 cm.

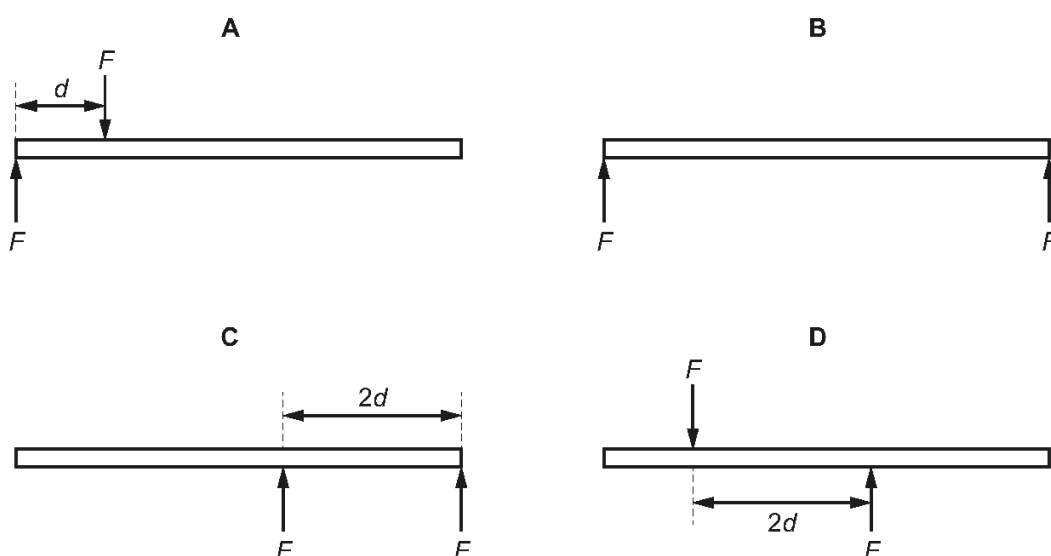
What is the maximum pressure the block can exert when resting on a table?

- A 1.13 kPa B 1.70 kPa C 11.1 kPa D 16.6 kPa

36 - (9702/11_Summer_2018_Q12) - Forces, Density & Pressure

Two parallel forces, each of magnitude F , act on a rod of length $5d$.

Which diagram shows the positions of the two forces that will produce the largest torque on the rod?



37 - (9702/12_Summer_2018_Q12) - Forces, Density & Pressure

A cylindrical block of wood has cross-sectional area A and weight W . It is totally immersed in water with its axis vertical. The block experiences pressures p_t and p_b at its top and bottom surfaces respectively.

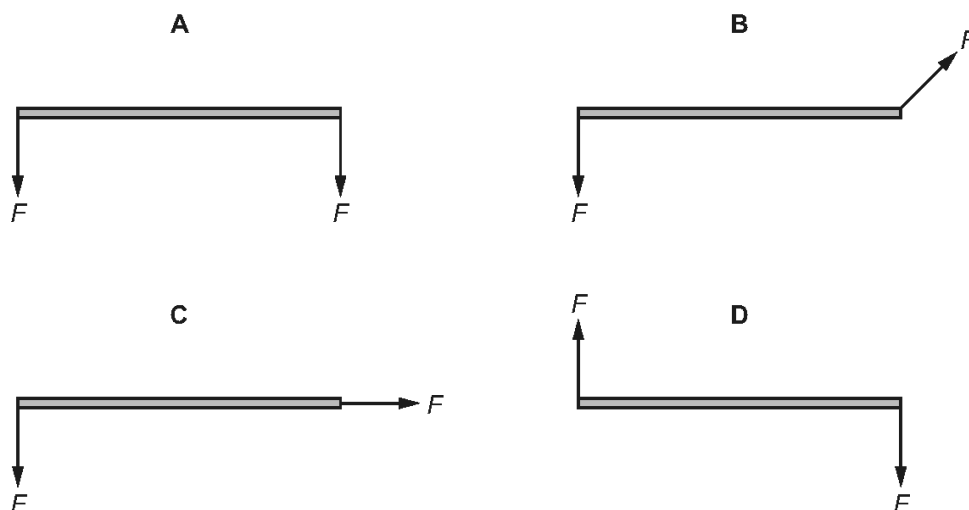
Which expression is equal to the upthrust on the block?

- A $(p_b - p_t)$
B $(p_b - p_t)A$
C $(p_b - p_t)A - W$
D $(p_b - p_t)A + W$



38 - (9702/13_Summer_2018_Q12) - Forces, Density & Pressure

Which diagram shows a couple formed by two forces, each of magnitude F , acting on a rod?



39 - (9702/11_Summer_2018_Q13) - Forces, Density & Pressure

Liquids X and Y are stored in large open tanks. Liquid X has a density of 800 kg m^{-3} and liquid Y has a density of 1200 kg m^{-3} .

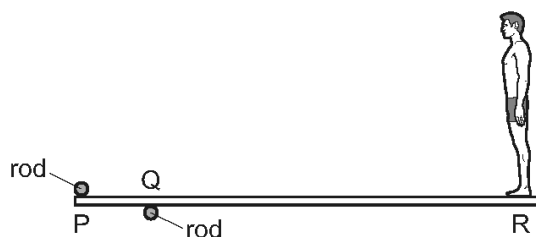
At which depths are the pressures equal?

	depth in liquid X / m	depth in liquid Y / m
A	8	20
B	10	15
C	15	10
D	20	8



40 - (9702/12_Summer_2018_Q13) - Forces, Density & Pressure

A uniform diving-board is held by two fixed rods at points P and Q. A person stands at end R of the diving-board, as shown.



The forces exerted by the rods on the board are vertical. The board remains in equilibrium as the person slowly moves towards point Q from end R.

Which row describes the changes to the forces exerted by the rods on the board?

	force at P	force at Q
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

41 - (9702/13_Summer_2018_Q13) - Forces, Density & Pressure

Full-fat milk is made up of fat-free milk mixed with fat.

A volume of $1.000 \times 10^{-3} \text{ m}^3$ of full-fat milk has a mass of 1.035 kg. It contains 4.00% fat by volume.

The density of fat-free milk is $1.040 \times 10^3 \text{ kg m}^{-3}$.

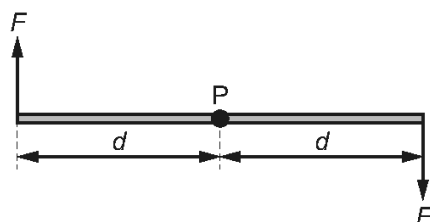
What is the density of fat?

- A $1.25 \times 10^2 \text{ kg m}^{-3}$
- B $9.15 \times 10^2 \text{ kg m}^{-3}$
- C $9.28 \times 10^2 \text{ kg m}^{-3}$
- D $1.16 \times 10^3 \text{ kg m}^{-3}$



42 - (9702/12_Summer_2018_Q14) - Forces, Density & Pressure

Two forces, each of magnitude F , act in opposite directions on a rod.



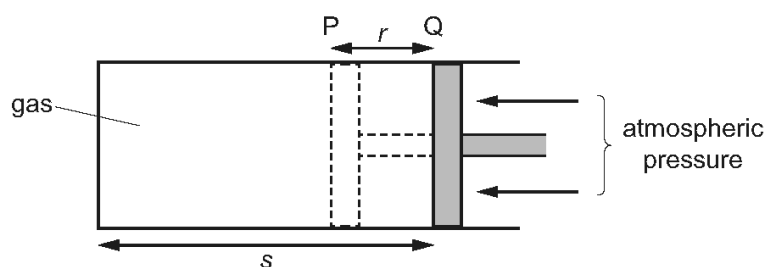
Each force acts on the rod at a distance d from the pivot P.

What is the torque of this couple about P?

- A 0 B $F \times d$ C $2F \times d$ D $2F \times 2d$

43 - (9702/13_Summer_2018_Q14) - Forces, Density & Pressure

Gas is trapped inside a cylinder by a piston of cross-sectional area A . The piston is **not** frictionless.



The gas is heated and this causes it to expand, pushing back the piston through distance r from position P to position Q. The length of the gas column is then s .

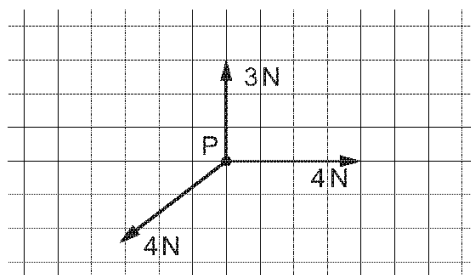
Which expression represents the amount of work done by the gas against the atmosphere during this expansion?

- A (atmospheric pressure) $\times Ar$
B (atmospheric pressure) $\times As$
C (pressure inside the gas) $\times Ar$
D (pressure inside the gas) $\times As$



44 - (9702/12_Summer_2018_Q15) - Dynamics, Forces, Density & Pressure

The vector diagram shows three coplanar forces acting on an object at P.



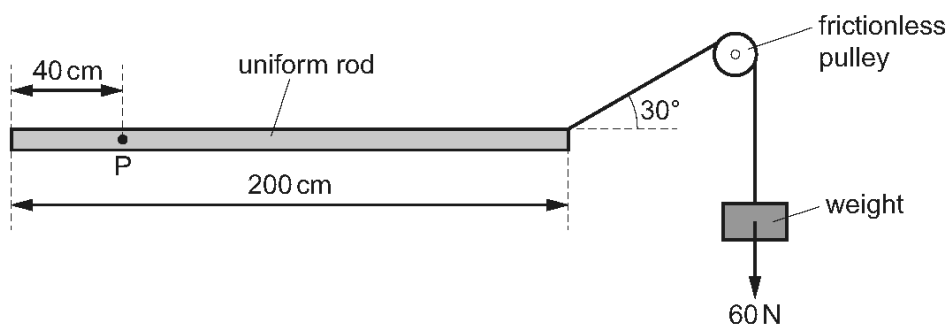
The magnitude of the resultant of these three forces is 1 N.

What is the direction of this resultant force?



45 - (9702/11_Winter_2018_Q11) - Forces, Density & Pressure

A uniform rod of length 200 cm is freely pivoted at point P. The rod is held horizontally in equilibrium by a 60 N weight that is attached to the rod by a string passing over a frictionless pulley.



What is the weight of the rod?

A 30 N

B 60 N

C 80 N

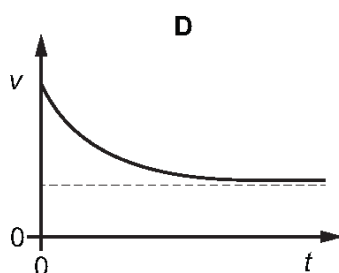
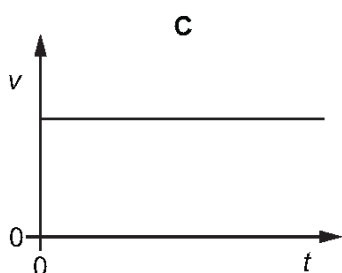
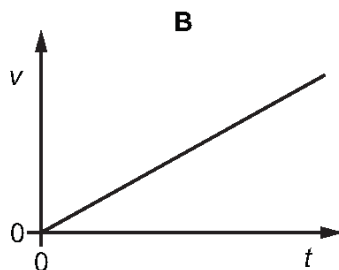
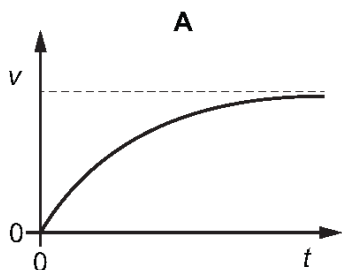
D 140 N



46 - (9702/13_Winter_2018_Q11) - Dynamics, Forces, Density & Pressure

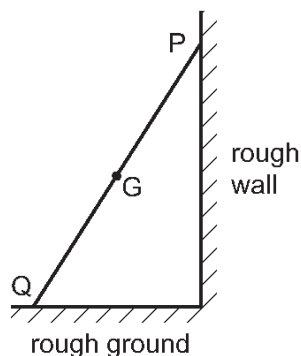
A rigid, hollow sphere is immersed deep in water and released from rest. It experiences an upthrust which propels it towards the surface of the water.

Which graph best shows the variation with time t of its upward velocity v ?



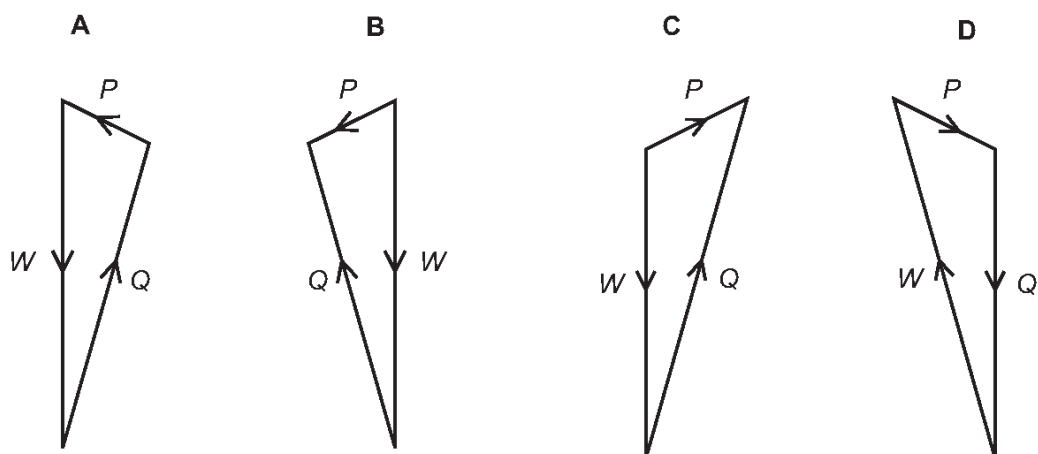
47 - (9702/11_Winter_2018_Q12) - Forces, Density & Pressure

A ladder rests in equilibrium on rough ground against a rough wall.



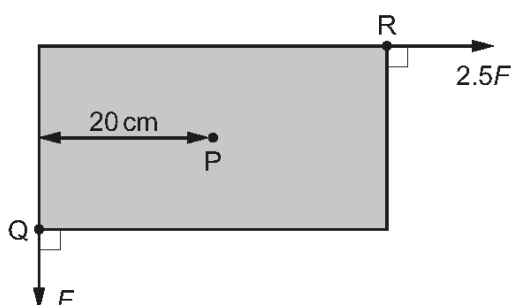
The weight W of the ladder acts through the centre of gravity G . Forces also act on the ladder at P and at Q . These forces are P and Q respectively.

Which vector triangle represents the forces on the ladder?



48 - (9702/12_Winter_2018_Q12) - Forces, Density & Pressure

A uniform rectangular board is supported by a frictionless pivot at its centre point P .



Two forces act in the plane of the board. Force F acts at corner Q and force $2.5F$ acts at corner R . The perpendicular distance between the line of action of force F and point P is 20 cm. The board is in equilibrium.

What is the area of the board?

- A 160 cm^2 B 320 cm^2 C 640 cm^2 D 1600 cm^2

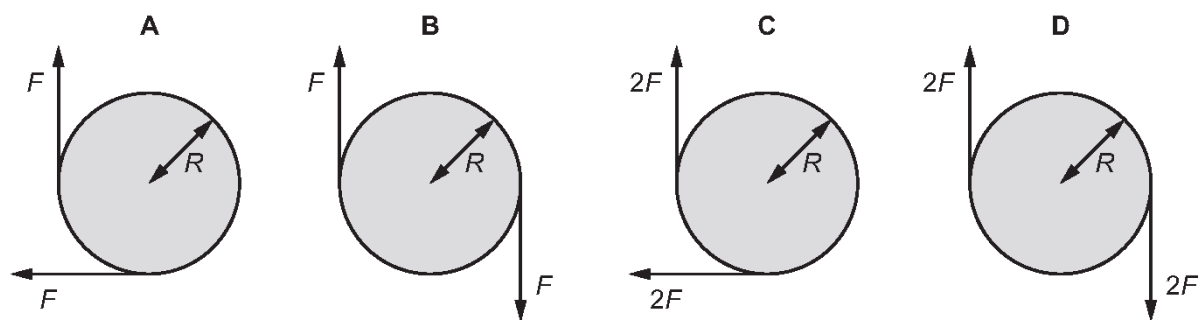


49 - (9702/13_Winter_2018_Q12) - Forces, Density & Pressure

A flat metal disc has radius R .

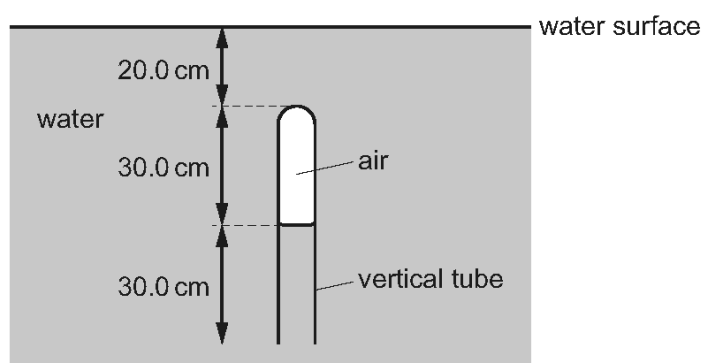
Forces of magnitude F are applied tangentially at the edge of the disc. The forces are in the plane of the disc.

Which arrangement of forces produces only a torque of magnitude $2FR$?



50 - (9702/11_Winter_2018_Q13) - Forces, Density & Pressure

A vertical tube, closed at one end, is immersed in water. A column of air is trapped inside the tube.



The density of water is 1000 kg m^{-3} .

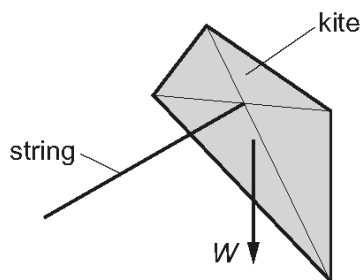
What is the difference between the pressure of the air in the tube and the atmospheric pressure?

- A 1960 Pa B 2940 Pa C 4910 Pa D 7850 Pa



51 - (9702/12_Winter_2018_Q13) - Forces, Density & Pressure

A kite is in equilibrium at the end of a string, as shown.



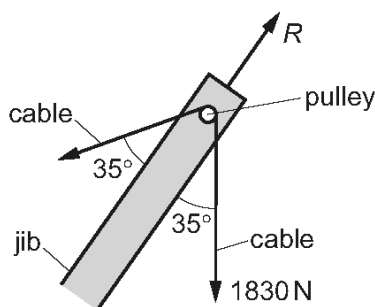
The kite has three forces acting on it: the weight W , the tension T in the string, and the force F from the wind.

Which vector diagram represents the forces acting on the kite?



52 - (9702/13_Winter_2018_Q13) - Forces, Density & Pressure

The diagram shows the jib of a crane at an angle of 35° to the vertical. A cable passes over a frictionless pulley and carries a load of 1830 N.



The force R that the pulley exerts on the cable is in line with the jib. The cable and the pulley are in equilibrium.

What is the value of R ?

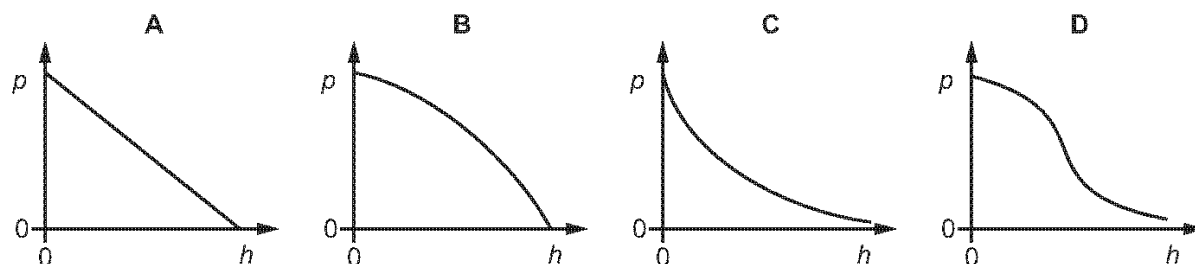
- A 1000 N B 1500 N C 2100 N D 3000 N



53 - (9702/12_Winter_2018_Q14) - Forces, Density & Pressure

The density of the air in the atmosphere decreases as the height h above the surface of the Earth increases.

Which graph best shows the variation with height h of the pressure p of the air?



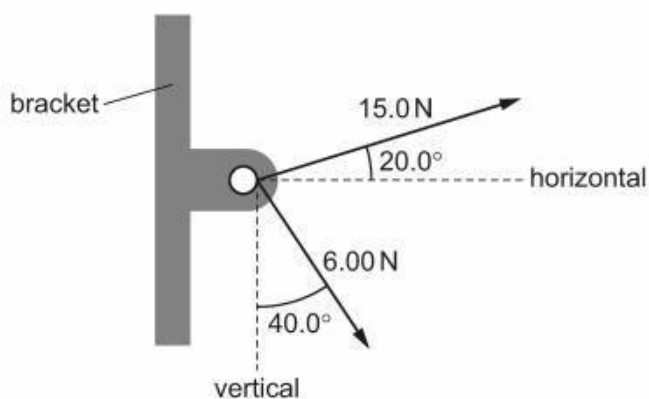
54 - (9702/13_Winter_2018_Q14) - Forces, Density & Pressure

What is a unit for density?

- A Nm^{-3} B gmm^{-1} C kgcm^{-2} D μgmm^{-3}

55 - (9702/12_Summer_2019_Q4) - Forces, Density & Pressure

Two cables are attached to a bracket and exert forces as shown.



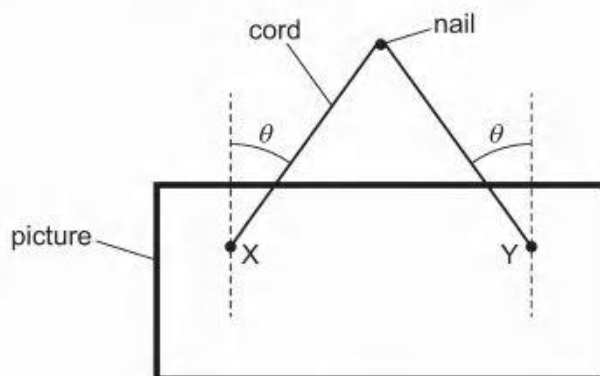
What are the magnitudes of the horizontal and vertical components of the resultant of the two forces?

	horizontal component/N	vertical component/N
A	9.73	0.534
B	9.73	10.2
C	18.0	0.534
D	18.0	10.2



56 - (9702/13_Summer_2019_Q11) - Forces, Density & Pressure

A picture is suspended from a nail by a single cord connected to two points X and Y on the picture. There is negligible friction between the cord and the nail so that the tension in both sides of the cord is the same. The picture hangs symmetrically, as shown.



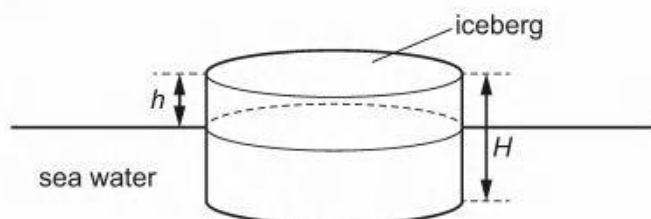
The tension in the cord is T . The angle between the cord and the vertical is θ on both sides.

Which statement is correct?

- A** Increasing the length of the cord, with points X and Y in the same place on the picture, would reduce the tension in the cord.
- B** Moving points X and Y further apart on the picture while keeping the length of the cord constant would reduce the tension in the cord.
- C** Moving points X and Y to the top edge of the picture while keeping their distance apart constant and the length of the cord constant would reduce the tension in the cord.
- D** The weight of the picture is equal to $T \cos \theta$.

57 - (9702/11_Summer_2019_Q12) - Forces, Density & Pressure

A cylindrical iceberg of height H floats in sea water. The top of the iceberg is at height h above the surface of the water.



The density of ice is ρ_i and the density of sea water is ρ_w .

What is the height h of the iceberg above the sea water?

- A** $\left(1 - \frac{\rho_i}{\rho_w}\right)H$ **B** $\left(\frac{\rho_i}{\rho_w} - 1\right)H$ **C** $\frac{\rho_w}{\rho_i}H$ **D** $\frac{\rho_i}{\rho_w}H$



58 - (9702/12_Summer_2019_Q12) - Forces, Density & Pressure

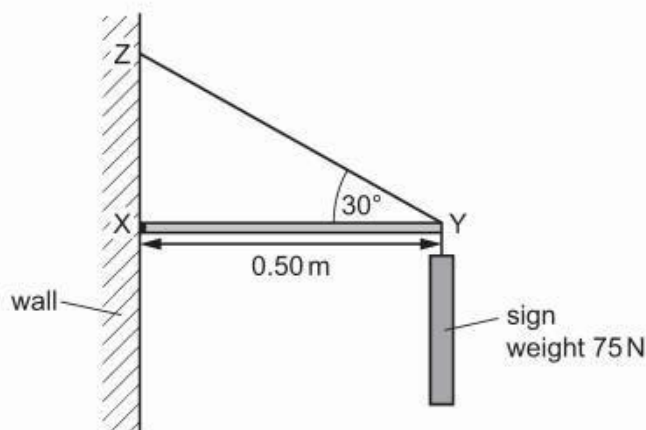
A submarine descends vertically at constant velocity. The three forces acting on the submarine are viscous drag, upthrust and weight.

Which relationship between their magnitudes is correct?

- A weight < drag
- B weight = drag
- C weight < upthrust
- D weight > upthrust

59 - (9702/13_Summer_2019_Q12) - Forces, Density & Pressure

A shop sign weighing 75 N hangs from a frame attached to a vertical wall.



The frame consists of a horizontal rod XY and a rod YZ that is at an angle of 30° to the horizontal. Rod XY is attached to the wall by a hinge at X and has length 0.50 m. Assume that the weights of the rods are negligible.

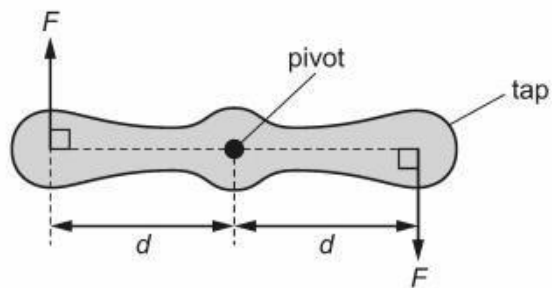
What is the horizontal force exerted by the wall on rod XY?

- A 0 N B 43 N C 130 N D 150 N



60 - (9702/11_Summer_2019_Q13) - Forces, Density & Pressure

A couple is applied to a tap as shown.

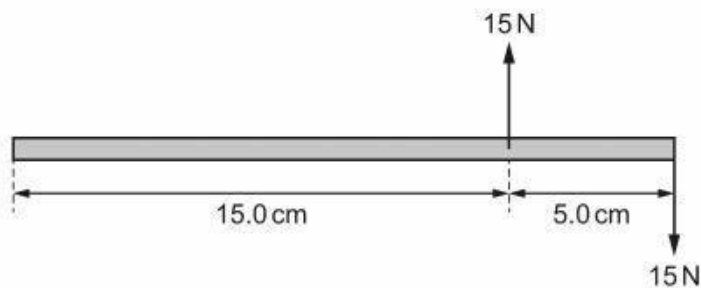


What is the torque of the couple?

- A $\frac{Fd}{2}$ B Fd C $2Fd$ D $4Fd$

61 - (9702/13_Summer_2019_Q13) - Forces, Density & Pressure

What is the torque of the couple shown?

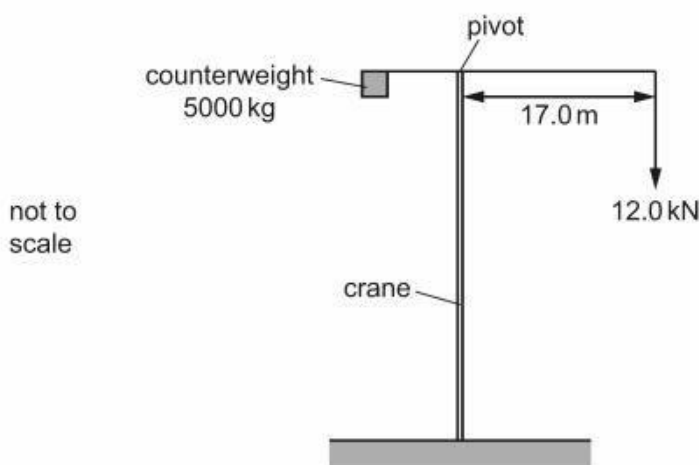


- A 0.75 Nm B 1.50 Nm C 3.00 Nm D 5.25 Nm



62 - (9702/11_Summer_2019_Q14) - Forces, Density & Pressure

A crane uses a counterweight to stop it from toppling over when lifting a load, as shown.



The counterweight has a mass of 5000 kg. The crane is required to lift a load of 12.0 kN and the horizontal distance from the pivot to the load is 17.0 m.

How far from the pivot should the centre of gravity of the counterweight be positioned in order to keep the crane in equilibrium?

- A 0.0408 m B 0.240 m C 4.16 m D 40.8 m

63 - (9702/13_Summer_2019_Q14) - Forces, Density & Pressure

Water has a density of 1.0 g cm^{-3} .

Glycerine has a density of 1.3 g cm^{-3} .

A student measures out a volume of 40 cm^3 of glycerine into a container.

The student adds water to the container to make a mixture of water and glycerine. Assume that the total volume of water and glycerine does not change when the two liquids are mixed.

Which volume of water needs to be added to make a mixture of density 1.1 g cm^{-3} ?

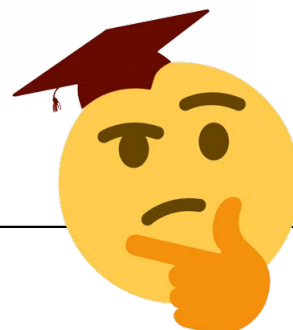
- A 4.0 cm^3 B 8.0 cm^3 C 34 cm^3 D 80 cm^3

64 - (9702/11_Summer_2019_Q15) - Forces, Density & Pressure

Three parallel forces act on an object. As a result of these forces, the object is in equilibrium.

What **must** be correct for these forces?

- A They all act along the same line.
B They all have the same magnitude.
C They do **not** all act along the same line.
D They do **not** all have the same magnitude.



65 - (9702/12_Summer_2019_Q15) - Forces, Density & Pressure

A volume of 1.5 m^3 of water is mixed with 0.50 m^3 of alcohol. The density of water is 1000 kg m^{-3} and the density of alcohol is 800 kg m^{-3} .

The volume of the mixture is 2.0 m^3 .

What is the density of the mixture?

- A 850 kg m^{-3} B 900 kg m^{-3} C 940 kg m^{-3} D 950 kg m^{-3}

66 - (9702/11_Summer_2019_Q16) - Forces, Density & Pressure

An empty glass beaker has a mass of 103 g. When filled with water, it has a total mass of 361 g. When filled with cooking oil, it has a total mass of 351 g.

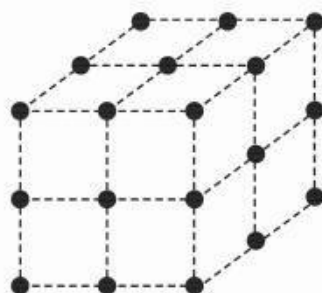
The density of water is 1.00 g cm^{-3} .

What is the density of the cooking oil?

- A 0.961 g cm^{-3} B 0.972 g cm^{-3} C 1.03 g cm^{-3} D 1.04 g cm^{-3}

67 - (9702/12_Summer_2019_Q21) - Forces, Density & Pressure

The diagram shows the arrangement of atoms in a particular crystal.



Each atom is at the corner of a cube.

The mass of each atom is $3.5 \times 10^{-25} \text{ kg}$. The density of the crystal is $9.2 \times 10^3 \text{ kg m}^{-3}$.

What is the shortest distance between the centres of two adjacent atoms?

- A $3.8 \times 10^{-29} \text{ m}$
B $6.2 \times 10^{-15} \text{ m}$
C $3.4 \times 10^{-10} \text{ m}$
D $3.0 \times 10^{-9} \text{ m}$



68 - (9702/13_Winter_2019_Q10) - Forces, Density & Pressure

A solid sphere, which is less dense than water, is held completely immersed in water a few metres below the surface. The density of the water is uniform.

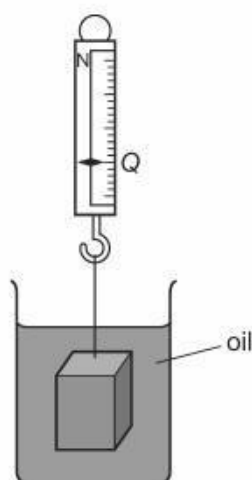
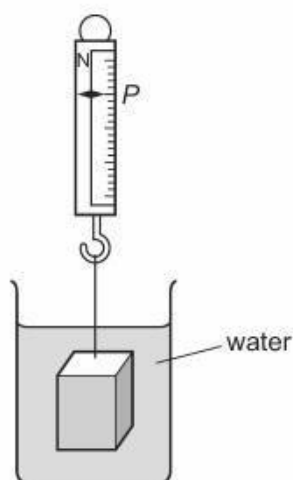
The sphere is released. Immediately after release, the sphere rises.

Which row correctly describes the changes in the upthrust on the sphere and the resultant force on the sphere?

	upthrust on the sphere	resultant force on the sphere
A	constant	increasing
B	constant	decreasing
C	decreasing	increasing
D	decreasing	decreasing

69 - (9702/11_Winter_2019_Q11) - Forces, Density & Pressure

An object of weight W is suspended from a newton meter. When the object is completely immersed in water, the newton meter reads P . When the object is completely immersed in oil, the newton meter reads Q .



What is the ratio $\frac{\text{density of oil}}{\text{density of water}}$?

A $\frac{W-P}{Q-P}$

B $\frac{Q-P}{W-P}$

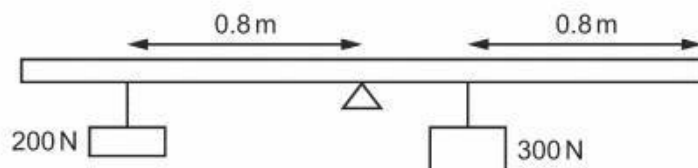
C $\frac{W-P}{W-Q}$

D $\frac{W-Q}{W-P}$



70 - (9702/12_Winter_2019_Q11) - Forces, Density & Pressure

A rigid uniform bar of length 2.4 m is pivoted horizontally at its midpoint.



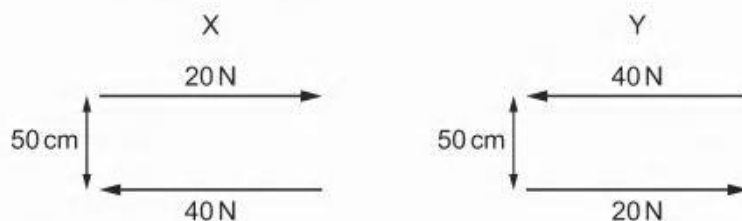
Weights are hung from two points on the bar as shown in the diagram. To maintain equilibrium, a couple is applied to the bar.

What is the torque and direction of this couple?

- A 40 N m clockwise
- B 40 N m anticlockwise
- C 80 N m clockwise
- D 80 N m anticlockwise

71 - (9702/13_Winter_2019_Q11) - Forces, Density & Pressure

The diagram shows two pairs X and Y of parallel forces.



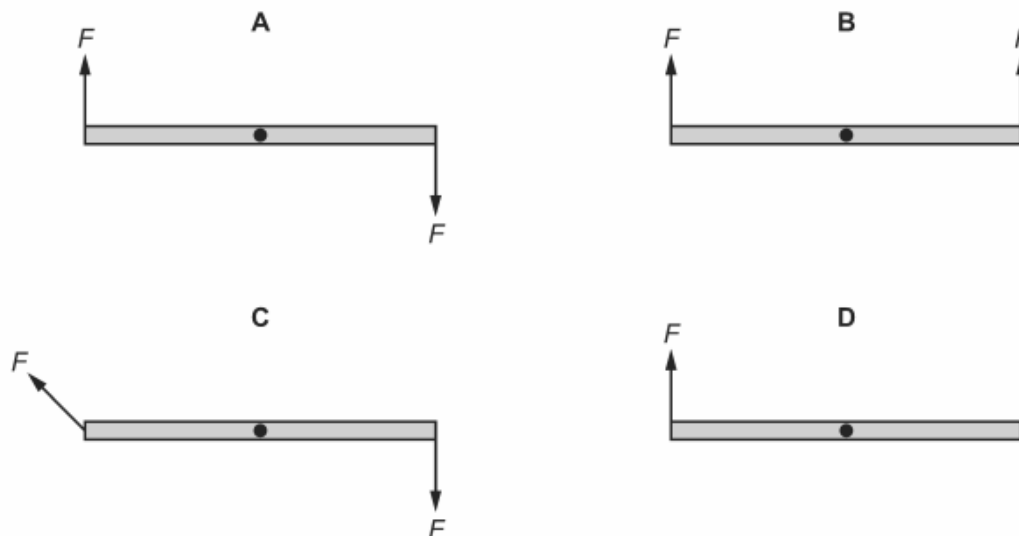
Which statement is correct?

- A X is equivalent to a clockwise torque of 10 N m and a force of 20 N to the left.
- B X is equivalent to a clockwise torque of 20 N m only.
- C Y is equivalent to an anticlockwise torque of 30 N m and a force of 20 N to the left.
- D Y is equivalent to an anticlockwise torque of 30 N m only.



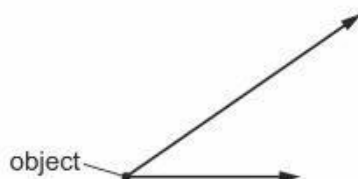
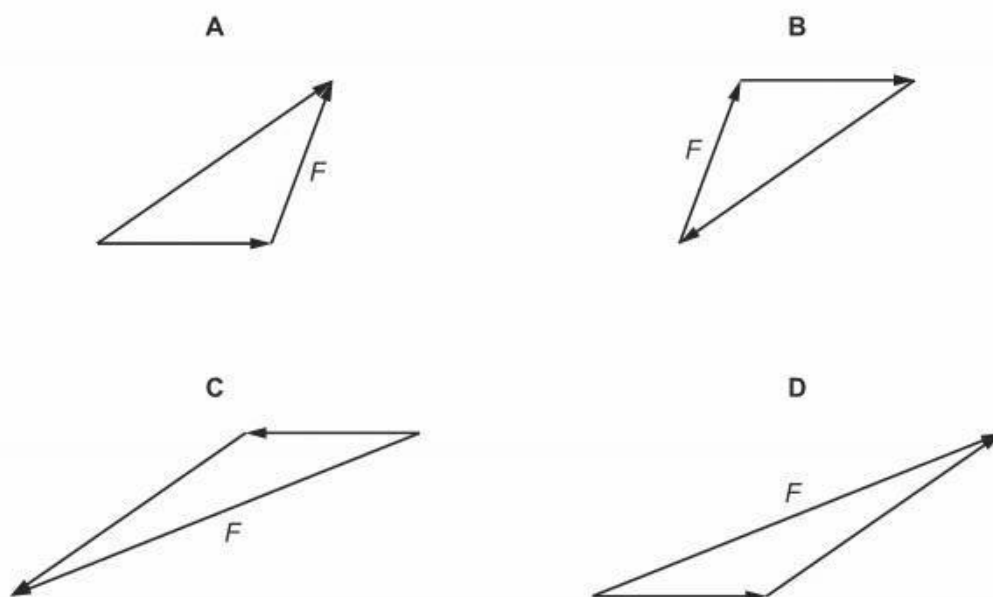
72 - (9702/11_Winter_2019_Q12) - Forces, Density & Pressure

Which diagram shows a couple?



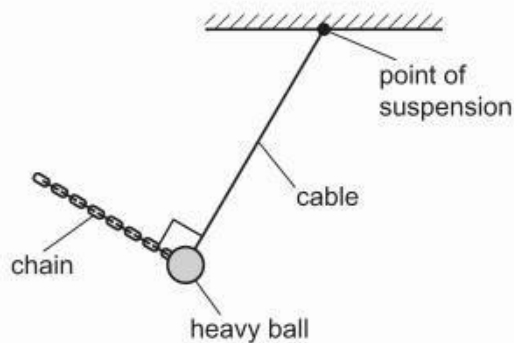
73 - (9702/12_Winter_2019_Q12) - Forces, Density & Pressure

Two coplanar forces act on an object as shown.

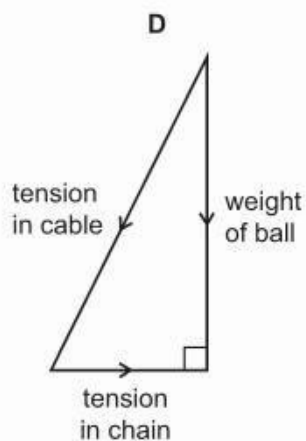
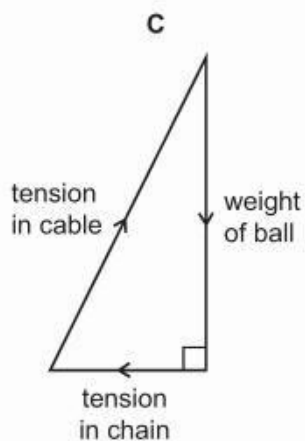
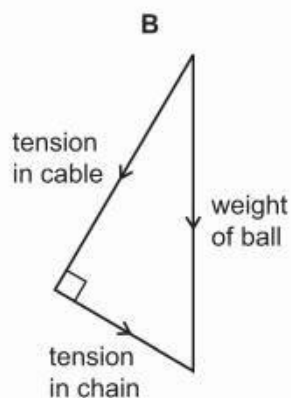
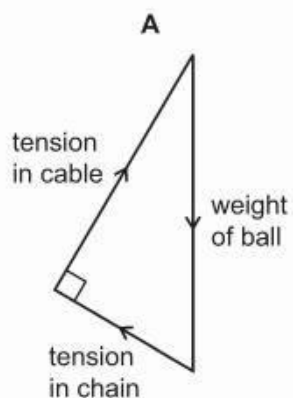
Which diagram shows the resultant F of these two forces?

74 - (9702/13_Winter_2019_Q12) - Forces, Density & Pressure

A heavy ball hanging from a cable is held in equilibrium by a chain, as shown.

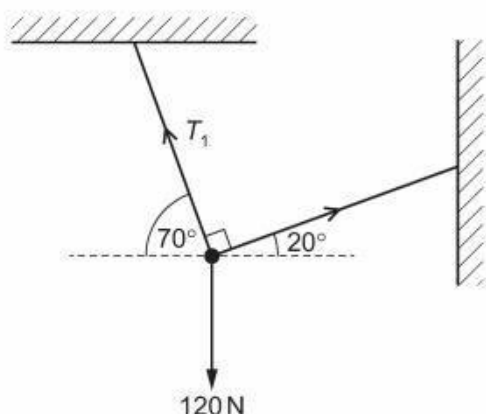


Which vector diagram shows the three forces acting on the ball?



75 - (9702/11_Winter_2019_Q13) - Dynamics, Forces, Density & Pressure

An object of weight 120 N is supported in equilibrium by two strings as shown.



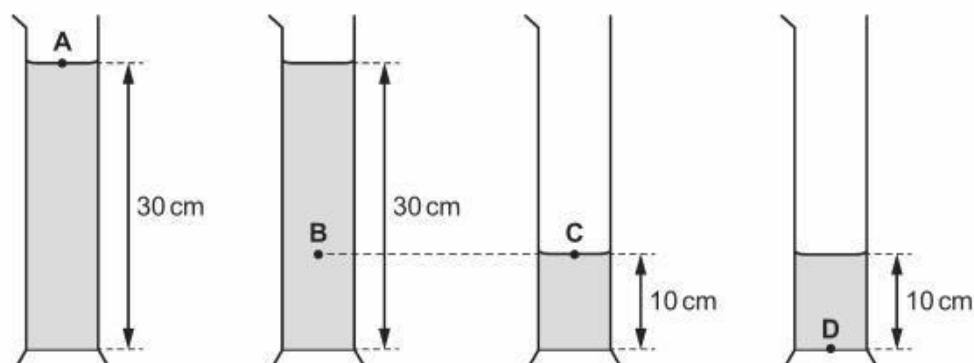
What is the tension T_1 in the left-hand string?

- A 41 N B 77 N C 113 N D 128 N

76 - (9702/12_Winter_2019_Q13) - Forces, Density & Pressure

Four measuring cylinders are filled with the same liquid to the heights shown.

At which position is the pressure the greatest?



77 - (9702/13_Winter_2019_Q13) - Forces, Density & Pressure

At sea level, atmospheric pressure is 100 kPa and the density of air is 1.3 kg m^{-3} .

Assume that the density of air decreases linearly with height above sea level.

What is an estimate of the total height of the atmosphere based on this information?

- A 7.8 km B 16 km C 77 km D 150 km



78 - (9702/11_Winter_2019_Q14) - Forces, Density & Pressure

In a large container in an oil refinery, three oils of different densities are mixed. No chemical activity occurs.

The mixture consists of:

1200 kg of oil of density 1100 kg m^{-3}

1500 kg of oil of density 860 kg m^{-3}

4000 kg of oil of density 910 kg m^{-3} .

What is the density of the mixture?

- A 927 kg m^{-3} B 933 kg m^{-3} C 957 kg m^{-3} D 1045 kg m^{-3}

79 - (9702/13_Summer_2020_Q2) - Forces, Density & Pressure

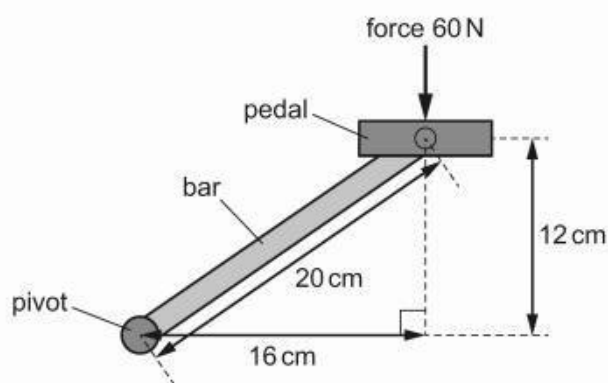
A sample of gas has a mass of $4.8 \mu\text{g}$ and occupies a volume of 1.2 dm^3 .

What is the density of the sample of gas?

- A $4.0 \times 10^{-3} \text{ kg m}^{-3}$
B $4.0 \times 10^{-5} \text{ kg m}^{-3}$
C $4.0 \times 10^{-6} \text{ kg m}^{-3}$
D $4.0 \times 10^{-8} \text{ kg m}^{-3}$

80 - (9702/12_Summer_2020_Q11) - Forces, Density & Pressure

A bicycle pedal is connected to a pivot by a metal bar, as shown.



The force on the pedal is 60 N downwards.

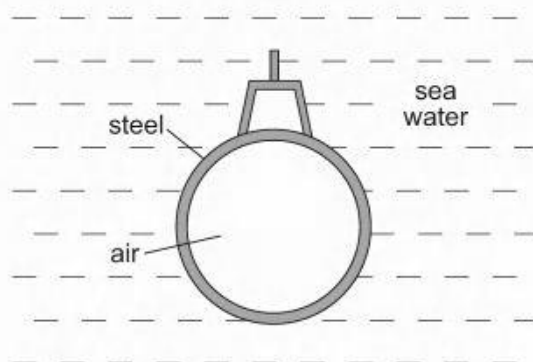
What is the moment of this force about the pivot?

- A 7.2 Nm B 9.6 Nm C 12 Nm D 1200 Nm



81 - (9702/13_Summer_2020_Q11) - Forces, Density & Pressure

A submarine is in equilibrium in a fully submerged position.



What causes the upthrust on the submarine?

- A The air in the submarine is less dense than sea water.
- B There is a difference in water pressure acting on the top and on the bottom of the submarine.
- C The sea water exerts a greater upward force on the submarine than the weight of the steel.
- D The submarine displaces its own volume of sea water.

82 - (9702/11_Summer_2020_Q12) - Forces, Density & Pressure

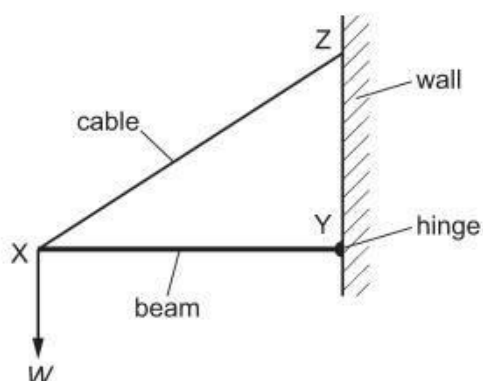
Which statement best describes a couple?

- A a pair of forces of equal magnitude acting in opposite directions which produce rotational motion but not translational motion
- B a pair of forces of equal magnitude acting in opposite directions which produce translational motion but not rotational motion
- C a pair of forces of equal magnitude acting in the same direction which produce rotational motion but not translational motion
- D a pair of forces of equal magnitude acting in the same direction which produce translational motion but not rotational motion



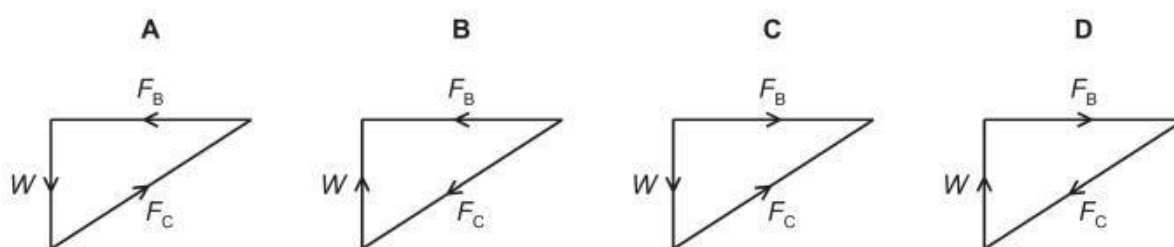
83 - (9702/12_Summer_2020_Q12) - Forces, Density & Pressure

A thin horizontal beam XY is freely hinged at point Y to a vertical wall. The beam is held stationary by a cable XZ which is attached to the wall at point Z.



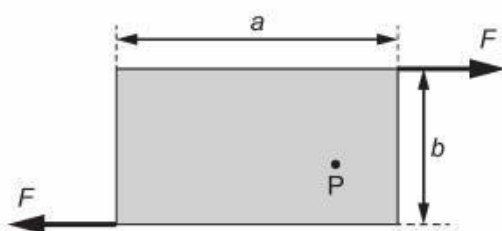
The beam supports a weight W at point X. The forces in the cable and the beam are F_C and F_B respectively.

Which vector triangle represents the forces acting on point X?



84 - (9702/13_Summer_2020_Q12) - Forces, Density & Pressure

Two forces, each of magnitude F , act along the edges of a rectangular metal plate, as shown.



The plate has length a and width b .

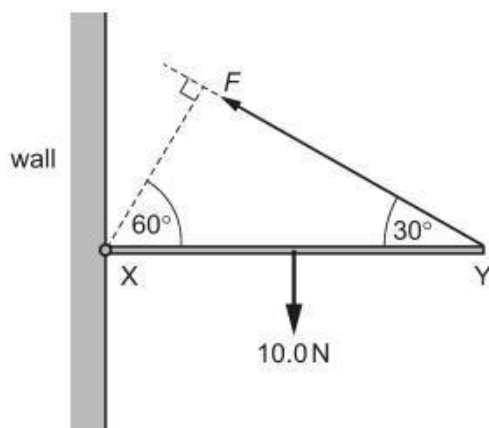
What is the torque about point P?

- A Fa B Fb C $2Fa$ D $2Fb$



85 - (9702/11_Summer_2020_Q13) - Forces, Density & Pressure

A uniform rod XY of weight 10.0 N is freely hinged to a wall at X. It is held horizontal by a force F acting from Y at an angle of 30° to the horizontal, as shown.

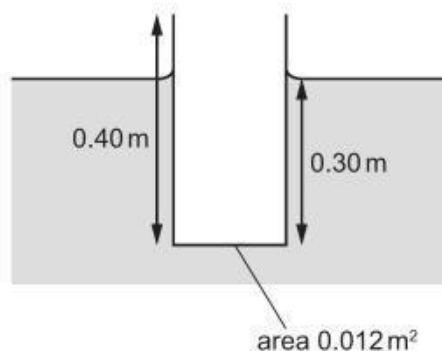


What is the value of F ?

- A 5.0 N B 8.7 N C 10.0 N D 20.0 N

86 - (9702/12_Summer_2020_Q13) - Forces, Density & Pressure

A pipe, open at one end, floats in a liquid as shown.



The cross-sectional area of the pipe is 0.012 m^2 . The weight of the pipe is 32 N.

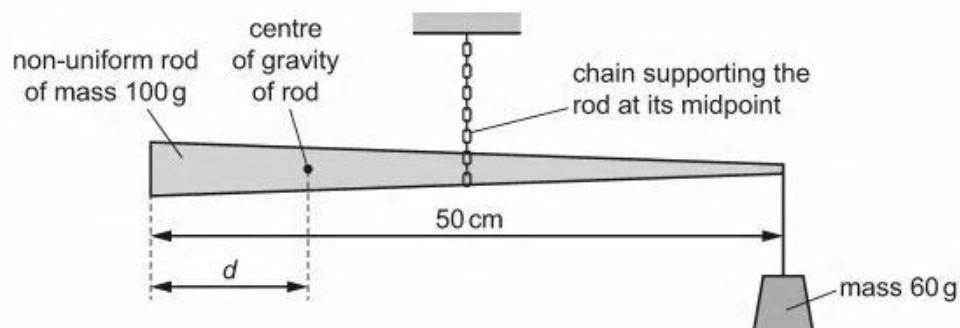
What is the density of the liquid?

- A 680 kg m^{-3} B 910 kg m^{-3} C 6700 kg m^{-3} D 8900 kg m^{-3}



87 - (9702/13_Summer_2020_Q13) - Forces, Density & Pressure

A non-uniform rod has a mass of 100 g and a length of 50 cm. It is supported by a chain at its midpoint. The rod is held in equilibrium by having a mass of 60 g suspended from its right-hand end, as shown.



The centre of gravity of the rod is a distance d from its left-hand end.

What is the value of d ?

- A** 10 cm **B** 15 cm **C** 25 cm **D** 40 cm



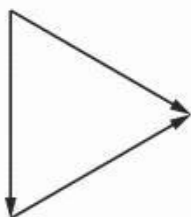
88 - (9702/11_Summer_2020_Q14) - Forces, Density & Pressure

Four combinations of vectors are shown, each representing all the forces acting on an object. The forces all act in the same plane.

The object is in equilibrium.

Which combination of vectors could represent the forces acting on the object?

A



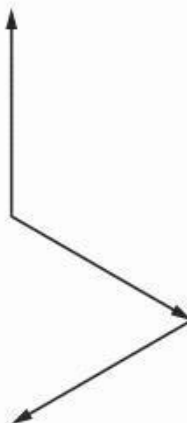
B



C

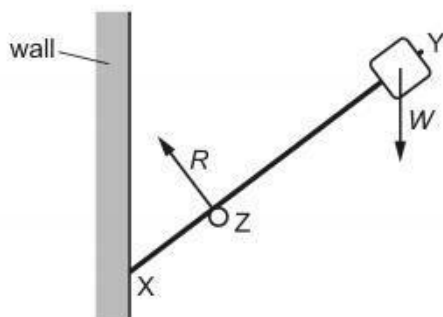


D



89 - (9702/13_Summer_2020_Q14) - Forces, Density & Pressure

A light rigid rod XY has an object of weight W fixed at one end. The rod is in equilibrium, resting on a support at Z and a vertical wall at X. The support exerts a force R on the rod as shown. The diagram shows the directions, but not the magnitudes, of the forces R and W .



What is the direction of the force on the rod at X?



90 - (9702/11_Summer_2020_Q15) - Forces, Density & Pressure

A rectangular metal bar exerts a pressure of $15\,200\text{ Pa}$ on the horizontal surface on which it rests.

The height of the metal bar is 80 cm .

What is the density of the metal?

- A 190 kg m^{-3}
- B 1900 kg m^{-3}
- C $19\,000\text{ kg m}^{-3}$
- D $190\,000\text{ kg m}^{-3}$

91 - (9702/13_Summer_2020_Q15) - Forces, Density & Pressure

Liquid Q has twice the density of liquid R.

At depth x in liquid R, the pressure due to the liquid is 4 kPa .

At which depth in liquid Q is the pressure due to the liquid 7 kPa ?

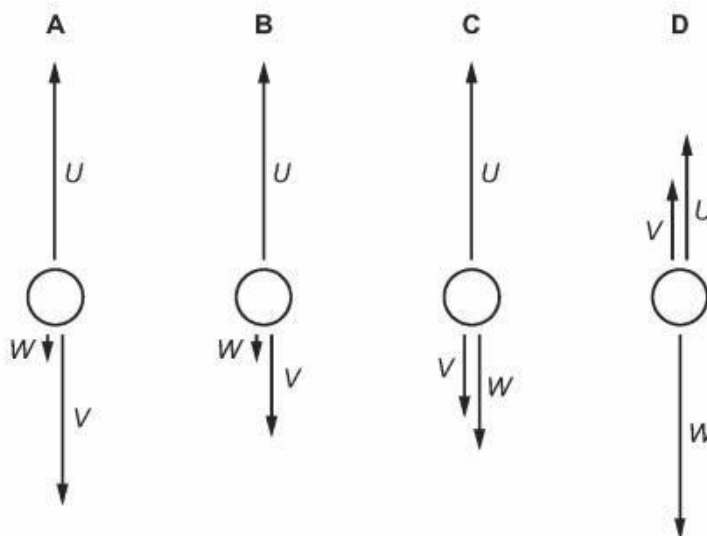
- A $\frac{2x}{7}$
- B $\frac{7x}{8}$
- C $\frac{8x}{7}$
- D $\frac{7x}{2}$



92 - (9702/13_Winter_2020_Q11) - Forces, Density & Pressure

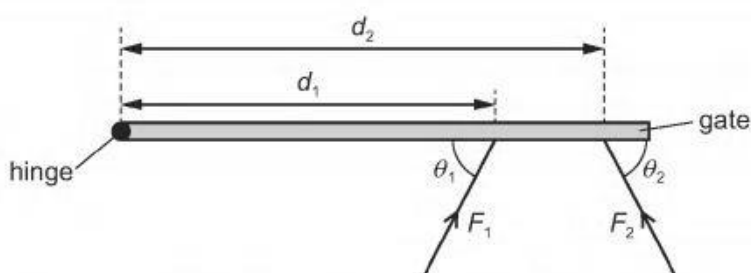
An air bubble is rising through a liquid at a constant speed. The forces on it are the upthrust U , the viscous drag V and its weight W .

Which diagram shows the directions and relative sizes of the forces?



93 - (9702/11_Winter_2020_Q12) - Forces, Density & Pressure

Two people push a vertical gate to open it. The forces exerted by the people on the gate are shown.



One person is distance d_1 from the gate's hinge and pushes with horizontal force F_1 at angle θ_1 to the gate.

The other person is at distance d_2 from the hinge and pushes with horizontal force F_2 at an angle θ_2 to the gate.

What is the total moment about the hinge due to forces F_1 and F_2 ?

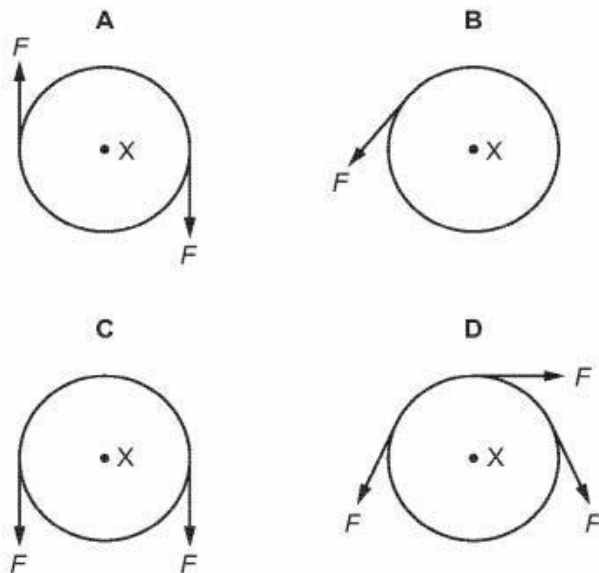
- A $(d_1 \times F_1 \cos \theta_1) + (d_2 \times F_2 \cos \theta_2)$
- B $(d_1 \times F_1 \sin \theta_1) + (d_2 \times F_2 \sin \theta_2)$
- C $(d_1 \times F_1 \cos \theta_1) - (d_2 \times F_2 \cos \theta_2)$
- D $(d_1 \times F_1 \sin \theta_1) - (d_2 \times F_2 \sin \theta_2)$



94 - (9702/12_Winter_2020_Q12) - Forces, Density & Pressure

A rigid circular disc of radius r has its centre at X . A number of forces of equal magnitude F act at the edge of the disc. All the forces are in the plane of the disc.

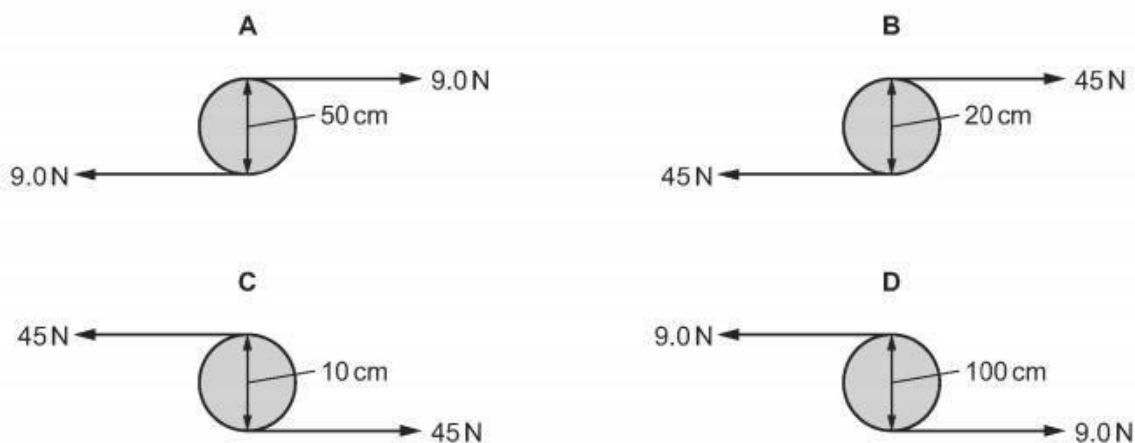
Which arrangement of forces provides a total moment of magnitude $2Fr$ about X ?



95 - (9702/13_Winter_2020_Q12) - Forces, Density & Pressure

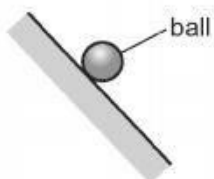
A couple applies a clockwise torque of 9.0 N m to a circular disc.

Which diagram shows this couple?

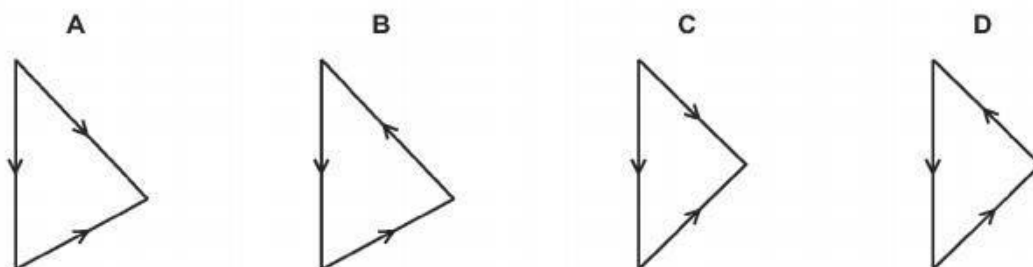


96 - (9702/11_Winter_2020_Q13) - Forces, Density & Pressure

A ball is rolling down a slope at a constant speed. The three forces acting on the ball are its weight, the contact force normal to the slope and friction.

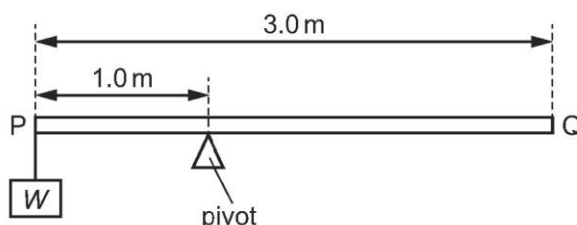


Which diagram could represent these three forces?



97 - (9702/12_Winter_2020_Q13) - Forces, Density & Pressure

The diagram shows a uniform beam PQ. The length of the beam is 3.0 m and its weight is 50 N. The beam is supported on a pivot 1.0 m from end P. A load of weight W is hung from end P. The beam is in equilibrium.



What is the value of W ?

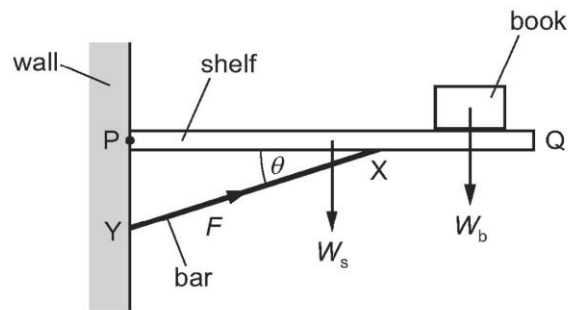
- A 25 N B 50 N C 75 N D 100 N



98 - (9702/13_Winter_2020_Q13) - Forces, Density & Pressure

A shelf PQ is attached to a vertical wall at P and supports a book.

The shelf is held horizontal by a rigid bar XY, as shown.



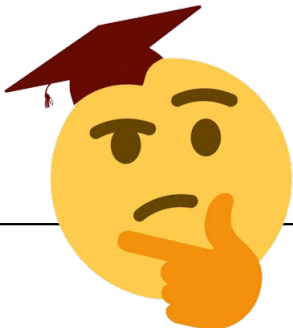
The weight of the shelf is W_s and the weight of the book is W_b .

The bar is at an angle θ to the shelf and exerts a force F on the shelf.

The shelf is in equilibrium.

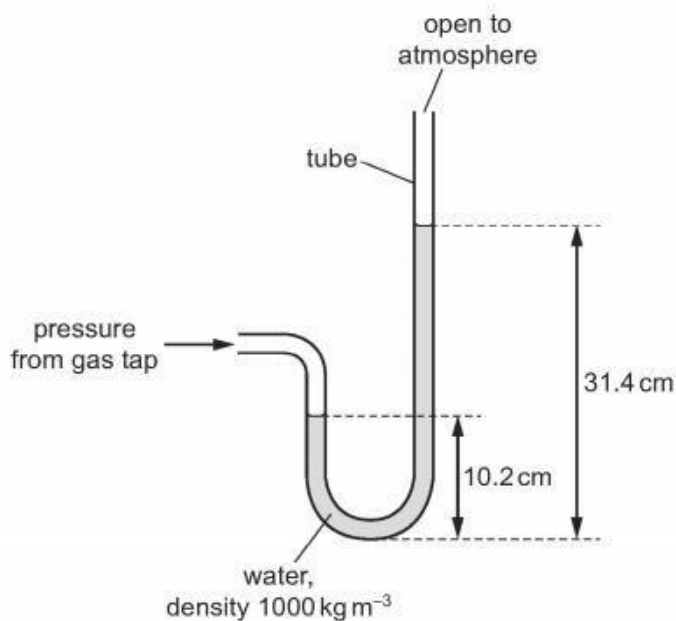
What are the magnitudes of the horizontal and the vertical components of the force of the wall on the shelf at P?

	horizontal component	vertical component
A	$F \cos \theta$	$(W_s + W_b - F \cos \theta)$
B	$F \cos \theta$	$(W_s + W_b - F \sin \theta)$
C	$F \sin \theta$	$(W_s + W_b - F \cos \theta)$
D	$F \sin \theta$	$(W_s + W_b - F \sin \theta)$



99 - (9702/11_Winter_2020_Q14) - Forces, Density & Pressure

One end of a U-shaped tube is attached to a gas tap, with its other end open to the atmosphere. It contains water of density 1000 kg m^{-3} and the heights of both sides of the water column are shown.



The atmospheric pressure is 101 kPa.

What is the pressure of the gas from the gas tap?

- A 99 kPa B 100 kPa C 102 kPa D 103 kPa

100 - (9702/12_Winter_2020_Q14) - Forces, Density & Pressure

In a high-wire circus act, a man of mass 85 kg is standing at rest at the midpoint of the wire.



The wire on either side of the man is at an angle of 20° to the horizontal.

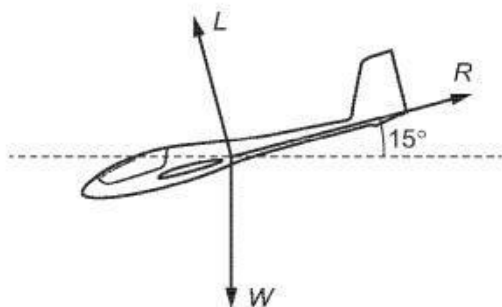
What is the tension T in the wire?

- A 0.44 kN B 0.89 kN C 1.2 kN D 2.4 kN

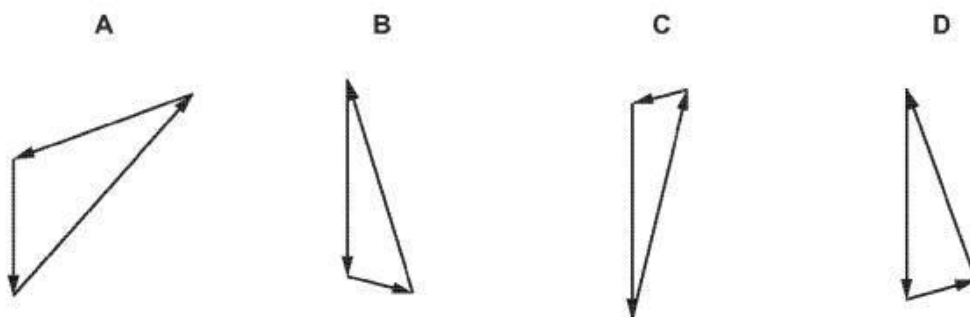


101 - (9702/13_Winter_2020_Q14) - Forces, Density & Pressure

A glider is descending at constant speed at an angle of 15° to the horizontal. The diagram shows the directions of the lift L , air resistance R and weight W acting on the glider.

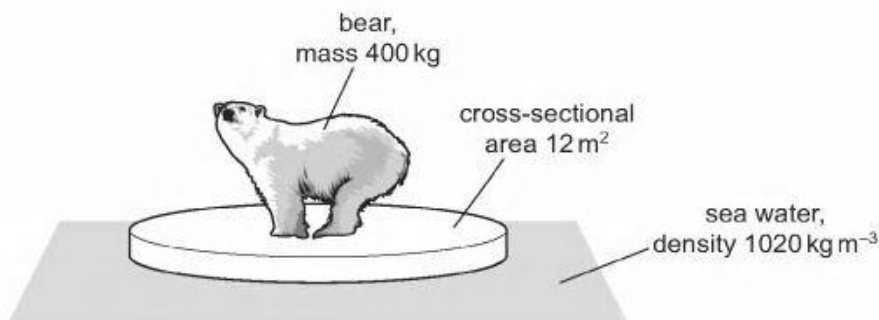


Which vector triangle could represent the forces acting on the glider?

**102** - (9702/12_Winter_2020_Q15) - Forces, Density & Pressure

A cylindrical block of ice of cross-sectional area 12 m^2 is floating, partially submerged, in the sea.

The density of the sea water is 1020 kg m^{-3} . A polar bear of mass 400 kg steps onto the block of ice.



The block of ice sinks a vertical distance d .

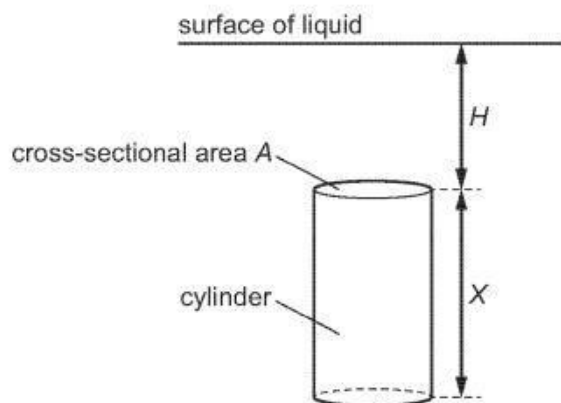
What is the value of d ?

- A 3.3 mm B 3.3 cm C 0.32 m D 3.1 m



103 - (9702/13_Winter_2020_Q15) - Forces, Density & Pressure

A solid cylinder of density ρ_c , cross-sectional area A and length X is submerged in a liquid of density ρ_L . The upper face of the cylinder is at a depth H below the surface of the liquid, as shown.



The acceleration of free fall is g .

Which expression gives the magnitude of the upthrust force acting on the cylinder?

- A $\rho_c A H g$ B $\rho_c A X g$ C $\rho_L A H g$ D $\rho_L A X g$

104 - (9702/11_Summer_2021_Q1) - Dynamics, Forces, Density & Pressure

What is a reasonable estimate of the volume of an adult person?

- A 0.10 m^3 B 0.50 m^3 C 1.0 m^3 D 2.0 m^3

105 - (9702/12_Summer_2021_Q2) - Forces, Density & Pressure

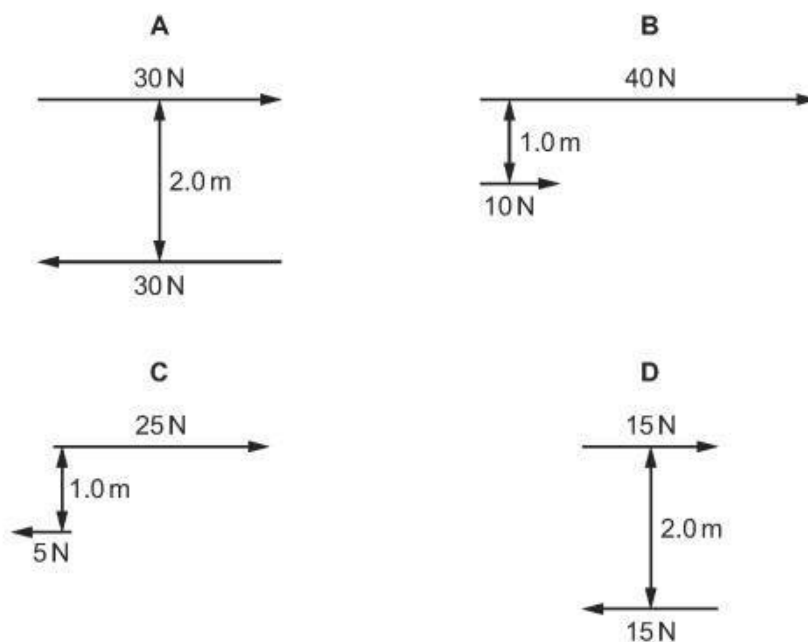
Which quantity could have units of N m V^{-1} ?

- A acceleration
B charge
C current
D resistance



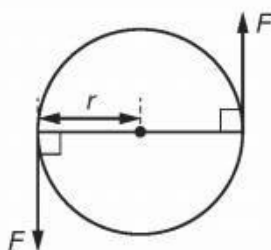
106 - (9702/11_Summer_2021_Q12) - Forces, Density & Pressure

Which pair of forces forms a couple with a torque of 30 N m?



107 - (9702/12_Summer_2021_Q12) - Forces, Density & Pressure

A disc of radius r is acted upon by two opposite forces, each of magnitude F . The forces form a couple, as shown.



What is the torque of this couple?

- A $\frac{1}{2} Fr$ B Fr C $2Fr$ D $4Fr$

108 - (9702/13_Summer_2021_Q12) - Forces, Density & Pressure

What is a couple?

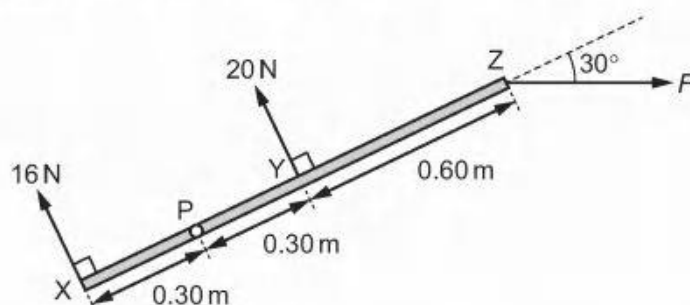
- A a pair of equal forces acting in the same direction but along different lines
B a pair of forces that are equal and opposite but acting along different lines
C a pair of forces that produce no resultant force and no resultant moment
D a pair of unequal forces acting in opposite directions but along the same line



109 - (9702/11_Summer_2021_Q13) - Forces, Density & Pressure

A uniform rigid bar XZ with negligible mass is 1.20 m long. The bar is pivoted at point P. Three coplanar forces act on the bar as shown. Forces of 16 N and 20 N act perpendicularly to the bar at points X and Y respectively. Force F acts at point Z at an angle of 30° to the axis of the bar.

The distances along the bar of the pivot and of the forces are shown.



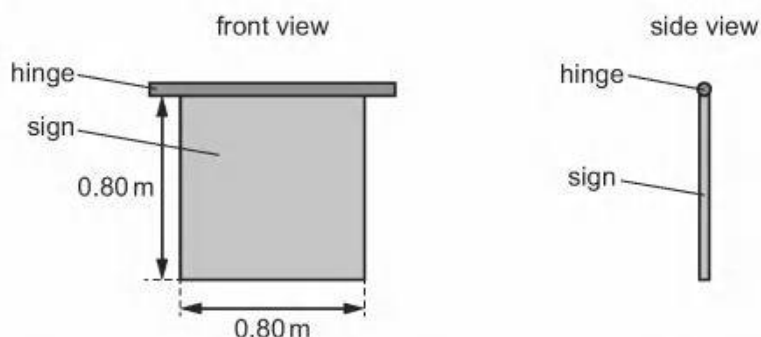
The bar experiences a resultant moment about P of 6.0 N m in a clockwise direction.

What is the magnitude of F ?

- A 9.2 N B 11 N C 16 N D 24 N

110 - (9702/12_Summer_2021_Q13) - Forces, Density & Pressure

A uniform square sign of weight 40 N is suspended vertically from its top edge by a horizontal hinge, as shown.



The hinge is not frictionless. When the sign is displaced from the vertical by an external force and then released, it does not return to the vertical position.

The maximum torque exerted by the hinge on the sign is 6.0 N m. The sign is displaced by 90° so that it is horizontal and then gradually released.

At which angle to the vertical does the sign hang after release?

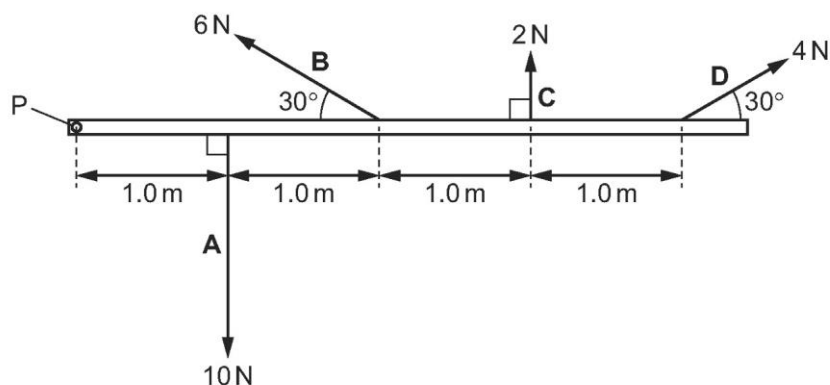
- A 11° B 22° C 68° D 79°



111 - (9702/13_Summer_2021_Q13) - Forces, Density & Pressure

Four coplanar forces act on a rigid rod, as shown. The rod is hinged at P.

Which force produces the greatest moment about point P?



112 - (9702/11_Summer_2021_Q14) - Forces, Density & Pressure

Water of depth 9.0 cm is covered by oil of depth 5.0 cm in a measuring cylinder.

The density of the water is 1000 kg m^{-3} and the density of the oil is 800 kg m^{-3} .

What is the total pressure exerted on the base of the measuring cylinder due to the oil and water?

- A 390 Pa B 880 Pa C 1200 Pa D 1300 Pa

113 - (9702/12_Summer_2021_Q14) - Forces, Density & Pressure

Each foot of an elephant has a circular cross-section with a circumference of 1.4 m. The elephant has a mass of 5400 kg.

The elephant is standing still with all four feet on the ground. Assume the pressure under each foot is the same.

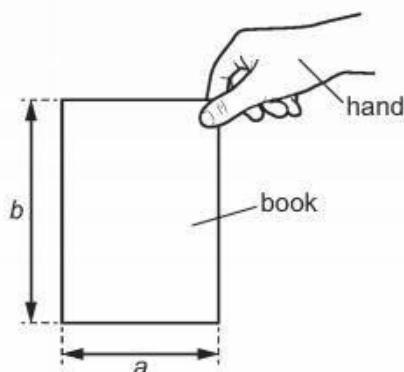
What is the approximate pressure exerted on the ground by each of the elephant's feet?

- A 8.7 kPa B 35 kPa C 85 kPa D 340 kPa



114 - (9702/13_Summer_2021_Q14) - Forces, Density & Pressure

A book of weight W has a rectangular shape and is of uniform thickness. The book is held in a vertical plane so that the longer sides of the book are vertical, as shown.



Which expression gives the approximate torque exerted by the hand on the book?

- A $\frac{Wa}{2}$ clockwise
- B $\frac{Wb}{2}$ anticlockwise
- C Wa clockwise
- D Wb anticlockwise

115 - (9702/13_Summer_2021_Q15) - Forces, Density & Pressure

The derivation of the pressure equation $\Delta p = \rho g \Delta h$ uses a number of relationships between quantities.

Which relationship is **not** used in the derivation of this equation?

- A density = $\frac{\text{mass}}{\text{volume}}$
- B potential energy = mass $\times$ acceleration of free fall $\times$ height
- C pressure = $\frac{\text{force}}{\text{area}}$
- D weight = mass $\times$ acceleration of free fall

116 - (9702/11_Winter_2021_Q10) - Forces, Density & Pressure

A ball of mass 0.16 kg is travelling horizontally at a speed of 20 m s^{-1} .

It collides with a wall and rebounds with a speed of 15 m s^{-1} along its original path. The ball is in contact with the wall for a time of 1.0 ms .

What is the average force exerted by the wall on the ball?

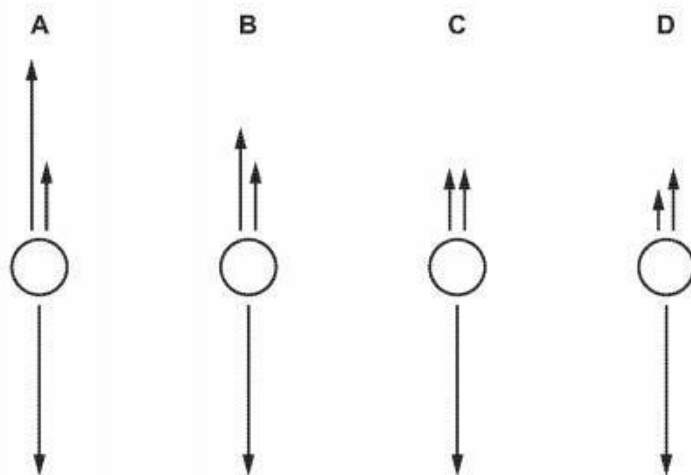
- A 800 N
- B 2400 N
- C 3200 N
- D 5600 N



117 - (9702/13_Winter_2021_Q11) - Forces, Density & Pressure

A spherical object falls through water at a constant speed. Three forces act on the object.

Which diagram, showing these three forces to scale, is correct?



118 - (9702/13_Winter_2021_Q12) - Forces, Density & Pressure

Two forces act as a couple.

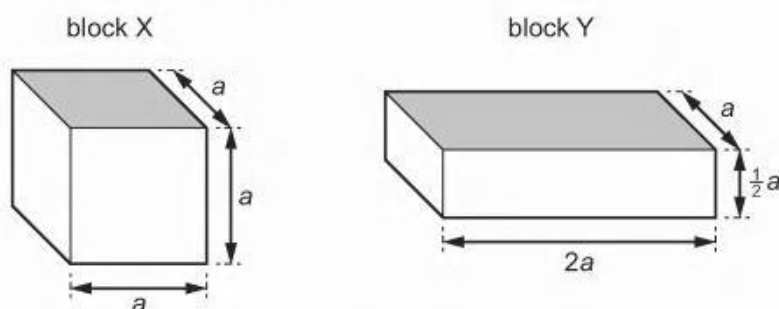
Which statement about the two forces must **not** be correct?

- A They act along the same straight line.
- B They act in opposite directions.
- C They are the same type of force.
- D They have the same magnitude.



119 - (9702/13_Winter_2021_Q15) - Forces, Density & Pressure

The diagram shows two blocks X and Y.



Block X has sides of length a . When block X is placed in a liquid of density ρ with the shaded face level with the liquid surface, it experiences an upthrust U .

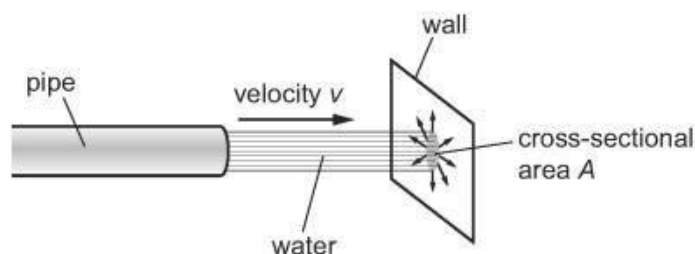
Block Y has horizontal sides of length a and $2a$ and height $\frac{1}{2}a$. Block Y is placed in a liquid of density 2ρ , also with the shaded face level with the liquid surface.

What is the upthrust on block Y?

- A $\frac{1}{2}U$ B U C $2U$ D $4U$

120 - (9702/11_Summer_2022_Q8) - Forces, Density & Pressure

Water flows out of a pipe and hits a wall.



When the jet of water hits the wall, it has horizontal velocity v and cross-sectional area A .

The density of the water is ρ . The water does not rebound from the wall.

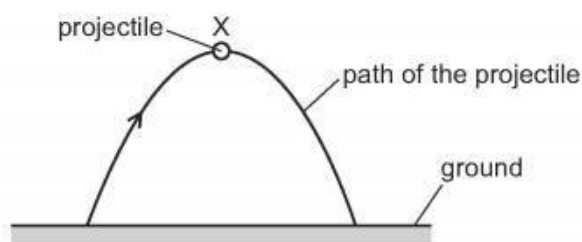
What is the force exerted on the wall by the water?

- A $\frac{\rho v}{A}$ B $\frac{\rho v^2}{A}$ C $\rho A v$ D $\rho A v^2$



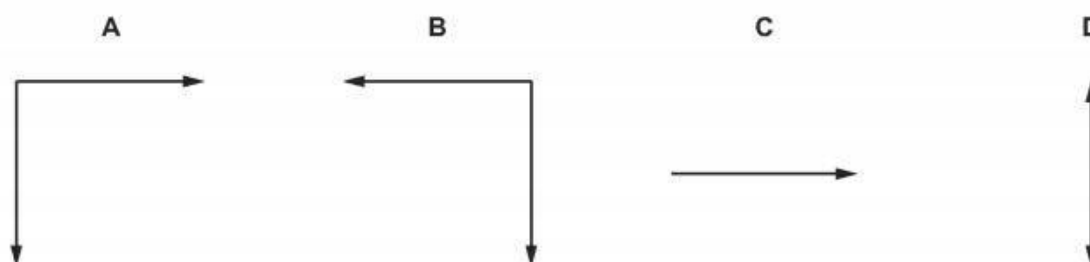
121 - (9702/11_Summer_2022_Q9) - Forces, Density & Pressure

A projectile is launched at an angle above horizontal ground and travels through the air.



The projectile reaches its maximum height at position X. Assume that no upthrust acts on the projectile.

Which diagram shows the **directions** of the force or forces acting on the projectile at position X?



122 - (9702/11_Summer_2022_Q10) - Forces, Density & Pressure

What is a statement of the principle of conservation of momentum?

- A A force is equal to the rate of change of momentum of the object upon which it acts.
- B In a perfectly elastic collision, the relative momentum of the objects before impact is equal to their relative momentum after impact.
- C The momentum of an object is the product of the mass of the object and its velocity.
- D The total momentum of a system of interacting objects remains constant, providing no resultant external force acts on the system.

123 - (9702/12_Summer_2022_Q14) - Forces, Density & Pressure

A granite rock at the surface of the Earth has density ρ . The rock is transported to the surface of another planet.

The acceleration of free fall on the surface of the other planet is twice that on the surface of the Earth.

What is the density of the rock on the other planet?

- A 0.5ρ B ρ C 2ρ D 4ρ



124 - (9702/11_Summer_2022_Q15) - Forces, Density & Pressure

In a large container in an oil refinery, three oils of different densities are mixed. No chemical activity occurs.

The mixture consists of:

1200 kg of oil of density 1100 kg m^{-3}

1500 kg of oil of density 860 kg m^{-3}

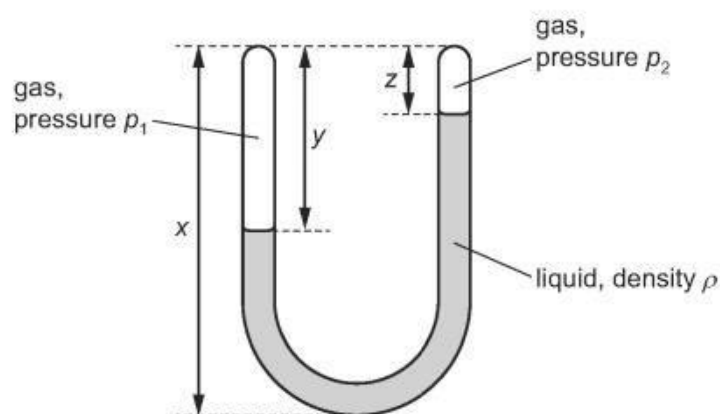
4000 kg of oil of density 910 kg m^{-3} .

What is the density of the mixture?

- A 927 kg m^{-3} B 933 kg m^{-3} C 957 kg m^{-3} D 1045 kg m^{-3}

125 - (9702/12_Summer_2022_Q15) - Forces, Density & Pressure

A closed U-shaped tube contains a stationary liquid of density ρ . One side of the tube contains a gas at pressure p_1 and the other side contains a gas at pressure p_2 , as shown.



The acceleration of free fall is g .

Which equation is correct?

- A $p_1 = \rho g y$
B $p_2 = \rho g(x - z)$
C $p_1 - p_2 = \rho g(y - z)$
D $p_1 + p_2 = \rho g x$



126 - (9702/13_Summer_2022_Q16) - Forces, Density & Pressure

A technical article about diesel engines expresses the energy available from diesel fuel both as 41.8 MJ kg^{-1} and as 34.9 GJ m^{-3} .

What is the density of diesel fuel?

- A $8.35 \times 10^2 \text{ kg m}^{-3}$
- B $1.20 \times 10^3 \text{ kg m}^{-3}$
- C $8.35 \times 10^5 \text{ kg m}^{-3}$
- D $1.20 \times 10^6 \text{ kg m}^{-3}$

127 - (9702/11_Summer_2022_Q19) - Forces, Density & Pressure

Two wires, P and Q, are made from the same metal and hang vertically from a steel girder.

Wire Q has half the length and twice the diameter of wire P.

Identical masses are attached to the bottom of each wire. Both wires obey Hooke's law as they are stretched by the weight of the masses.

What is the ratio $\frac{\text{extension of wire P}}{\text{extension of wire Q}}$?

- A $\frac{8}{1}$
- B $\frac{4}{1}$
- C $\frac{1}{1}$
- D $\frac{1}{2}$

128 - (9702/11_Summer_2022_Q20) - Forces, Density & Pressure

Which statement about elastic and plastic deformation **must** be correct?

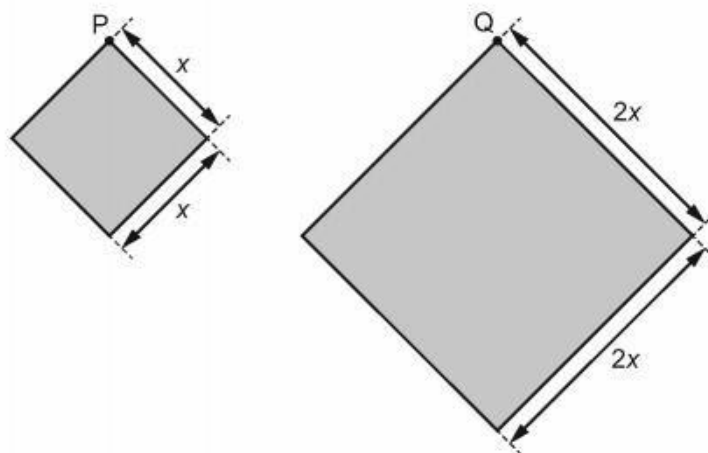
- A Elastic deformation and plastic deformation are proportional to the applied force.
- B Elastic deformation and plastic deformation cause no change in volume.
- C Elastic deformation causes heating of the material but plastic deformation does not.
- D Elastic deformation is reversible but plastic deformation is not.



129 - (9702/11_Winter_2022_Q11) - Forces, Density & Pressure

A square board, of side length x , hangs freely from a nail P, as shown.

The board has uniform thickness and is made from material of uniform density.



A second square board, of side length $2x$, is made of the same material and has the same thickness as the original board. This second board is then hung from a nail Q. Nails P and Q are at the same height.

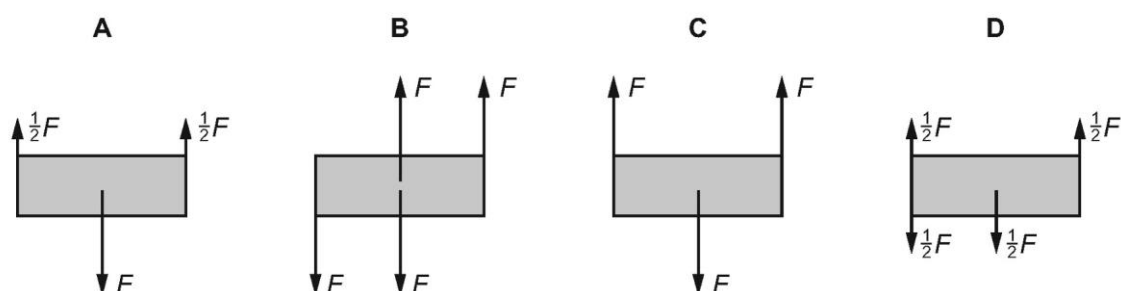
What is the vertical distance between the positions of the centres of gravity of the two boards?

- A 0 B $\frac{x}{\sqrt{2}}$ C x D $x\sqrt{2}$

130 - (9702/11_Winter_2022_Q12) - Forces, Density & Pressure

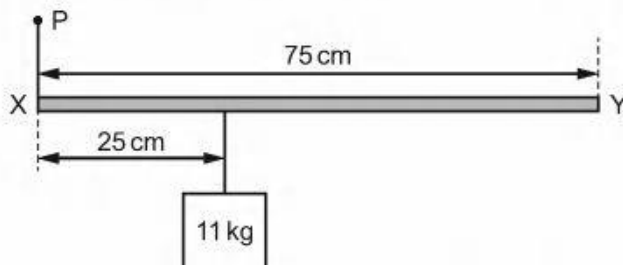
Forces are applied to a rigid object. The forces all act in the same plane.

In which diagram is the object in equilibrium?



131 - (9702/11_Winter_2022_Q13) - Forces, Density & Pressure

A rigid rod XY has negligible mass and length 75 cm. The rod is suspended from a fixed point P by a string attached to end X. An object of mass 11 kg is suspended by a string that is attached to the rod at a distance of 25 cm from end X, as shown.



Which vertically upward force acting on end Y of the rod would hold the rod horizontally in equilibrium?

- A 3.7 N B 33 N C 36 N D 320 N

132 - (9702/11_Winter_2022_Q14) - Forces, Density & Pressure

The density of water is 1.0 g cm^{-3} and the density of glycerine is 1.3 g cm^{-3} .

Water is added to a measuring cylinder containing 40 cm^3 of glycerine so that the density of the mixture is 1.1 g cm^{-3} . Assume that the mixing process does not change the total volume of the liquid.

What is the volume of water added?

- A 40 cm^3 B 44 cm^3 C 52 cm^3 D 80 cm^3

133 - (9702/13_Winter_2022_Q14) - Forces, Density & Pressure

Water is pumped through a nozzle at the end of a hose. The nozzle has a circular cross-section of diameter 50 mm. A mass of 100 kg of water takes a time of 2.0 s to move through the nozzle. The density of water is 1000 kg m^{-3} .

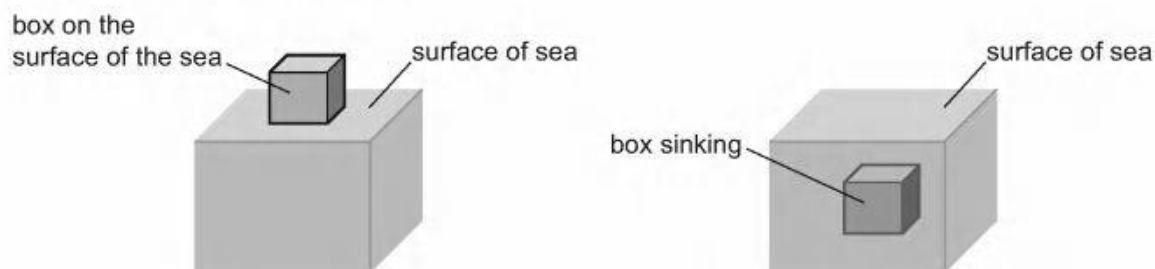
What is the speed of the water in the nozzle?

- A 6.4 m s^{-1} B 13 m s^{-1} C 25 m s^{-1} D 51 m s^{-1}



134 - (9702/11_Winter_2022_Q15) - Forces, Density & Pressure

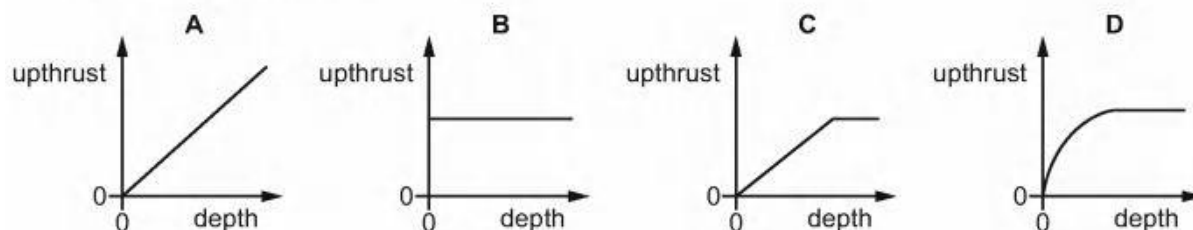
A box, in the shape of a cube, falls from a ship into the sea. The box lands with its lower face level with the surface of the sea.



The box begins to sink, becomes totally submerged and then sinks deeper into the sea.

As the box sinks, its lower face is always parallel to the surface of the sea.

Which graph best represents the variation of the upthrust acting on the box with the depth of its lower face below the surface of the sea?



135 - (9702/12_Winter_2022_Q15) - Forces, Density & Pressure

A solid cube is floating in equilibrium in liquid mercury. The cube is made of iron of density 7900 kg m^{-3} .

The cube floats with 42% of its volume above the surface of the mercury.

What is the density of the mercury?

- A 3300 kg m^{-3}
- B 4600 kg m^{-3}
- C 14000 kg m^{-3}
- D 19000 kg m^{-3}



136 - (9702/13_Winter_2022_Q15) - Forces, Density & Pressure

A solid wooden cube rests on a horizontal surface.

What gives the pressure exerted by the weight of the cube on the horizontal surface?

- A the product of the acceleration of free fall and the density of the cube
- B the product of the acceleration of free fall, the density and the side length of the cube
- C the product of the acceleration of free fall, the density and the area of one face of the cube
- D the product of the acceleration of free fall, the density and the volume of the cube

137 - (9702/12_Winter_2022_Q16) - Forces, Density & Pressure

The diagram shows two vessels, P and Q, both with sides inclined at 45° to the horizontal.



Vessel P tapers outwards and vessel Q tapers inwards, as shown.

Both vessels contain a liquid. The depth of the liquid in the vessels is the same. The liquid in vessel P is twice as dense as the liquid in vessel Q.

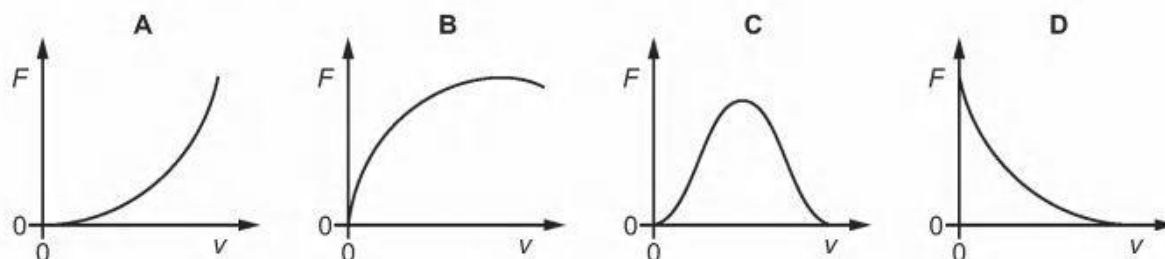
What is the ratio $\frac{\text{pressure due to the liquid on the base of P}}{\text{pressure due to the liquid on the base of Q}}$?

- A $\frac{2}{1}$
- B $\frac{\sqrt{2}}{1}$
- C $\frac{1}{\sqrt{2}}$
- D $\frac{1}{2}$

138 - (9702/11_Summer_2023_Q9) - Forces, Density & Pressure

A small ball is held at the surface of liquid oil in a container. The ball is released from rest and falls through the oil. The ball has velocity v . A viscous (drag) force F acts on the ball.

Which graph could show the variation with v of F ?



139 - (9702/11_Summer_2023_Q14) - Forces, Density & Pressure

Which expression for pressure is correct?

- A force per unit area
- B force per unit volume
- C mass per unit area
- D mass per unit volume

140 - (9702/11_Summer_2023_Q15) - Forces, Density & Pressure

A ball has a mass of 0.50 kg and a volume of $1.3 \times 10^{-3} \text{ m}^3$. The ball is floating in equilibrium on still water. The two forces that act on the ball are its weight and the upthrust due to the water.

The density of the water is $1.0 \times 10^3 \text{ kg m}^{-3}$.

What is the percentage of the volume of the ball above the surface of the water?

- A 3.9%
- B 38%
- C 62%
- D 96%

141 - (9702/12_Summer_2023_Q13) - Forces, Density & Pressure

Two solid cubes X and Y are made of material of the same density. Cube X has twice the mass of cube Y.

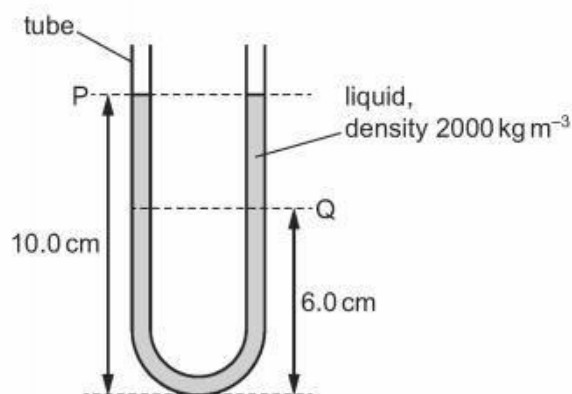
Cube X has sides of length x . Cube Y has sides of length y .

What is the ratio $\frac{x}{y}$?

- A 1.26
- B 1.41
- C 2.00
- D 8.00

142 - (9702/12_Summer_2023_Q14) - Forces, Density & Pressure

A U-shaped glass tube contains liquid of density 2000 kg m^{-3} , as shown.



What is the difference in pressure due to the liquid between levels P and Q?

- A 780 Pa
- B 1200 Pa
- C 1600 Pa
- D 2000 Pa



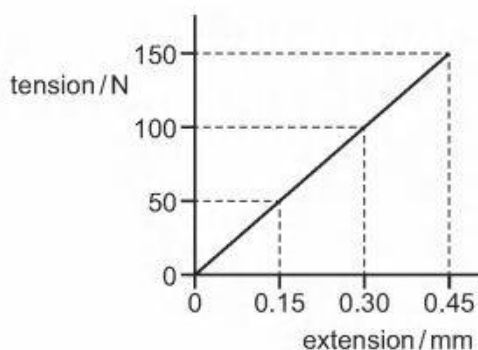
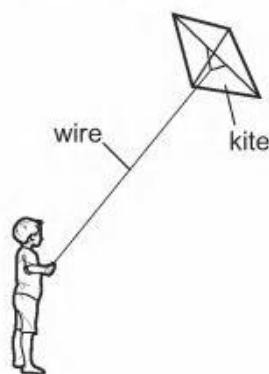
143 - (9702/12_Summer_2023_Q18) - Forces, Density & Pressure

What is meant by the spring constant of a spring?

- A extension per unit force
- B $\frac{1}{2} \times \text{force} \times \text{extension}$
- C force $\times$ extension
- D force per unit extension

144 - (9702/12_Summer_2023_Q19) - Forces, Density & Pressure

A child holds a thin metal wire that is attached to a kite. The graph shows how the extension of the wire varies with its tension.



A gust of wind increases the tension from 100 N to 150 N.

What is the change in the elastic potential energy of the wire caused by the gust of wind?

- A 3.8 mJ
- B 19 mJ
- C 34 mJ
- D 38 mJ

145 - (9702/13_Summer_2023_Q13) - Forces, Density & Pressure

A volume of 1.5 m^3 of water is mixed with 0.50 m^3 of alcohol. The density of water is 1000 kg m^{-3} and the density of alcohol is 800 kg m^{-3} .

The volume of the mixture is 2.0 m^3 .

What is the density of the mixture?

- A 850 kg m^{-3}
- B 900 kg m^{-3}
- C 940 kg m^{-3}
- D 950 kg m^{-3}



146 - (9702/13_Summer_2023_Q18) - Forces, Density & Pressure

A metal wire has length 5.2 m and diameter 1.0 mm. The metal has Young modulus 360 GPa.

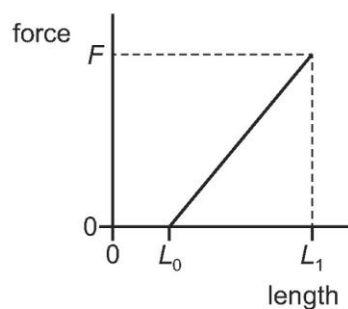
The wire is fixed at one end and a force is applied to the other end. The force extends the wire by 7.2 mm. The wire obeys Hooke's law.

What is the force applied to the wire?

- A $1.2 \times 10^2 \text{ N}$
- B $3.9 \times 10^2 \text{ N}$
- C $5.0 \times 10^2 \text{ N}$
- D $1.6 \times 10^3 \text{ N}$

147 - (9702/13_Summer_2023_Q19) - Forces, Density & Pressure

The graph shows how the length of a spring varies with the force applied to it.



The spring has unstretched length L_0 . When a force F is applied, the spring has length L_1 .

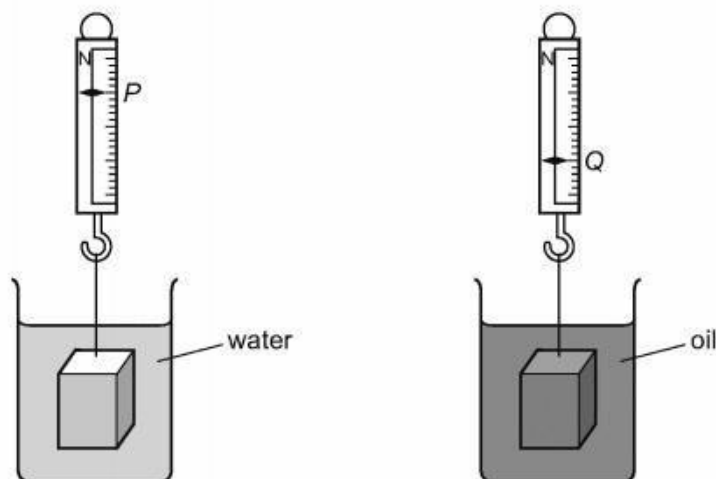
What is the work done in stretching the spring to length L_1 ?

- A $\frac{1}{2}FL_1$
- B $\frac{1}{2}F(L_1 - L_0)$
- C FL_1
- D $F(L_1 - L_0)$



148 - (9702/11_Winter_2023_Q14) - Forces, Density & Pressure

An object of weight W is suspended from a newton meter. When the object is completely immersed in water, the newton meter reads P . When the object is completely immersed in oil, the newton meter reads Q .



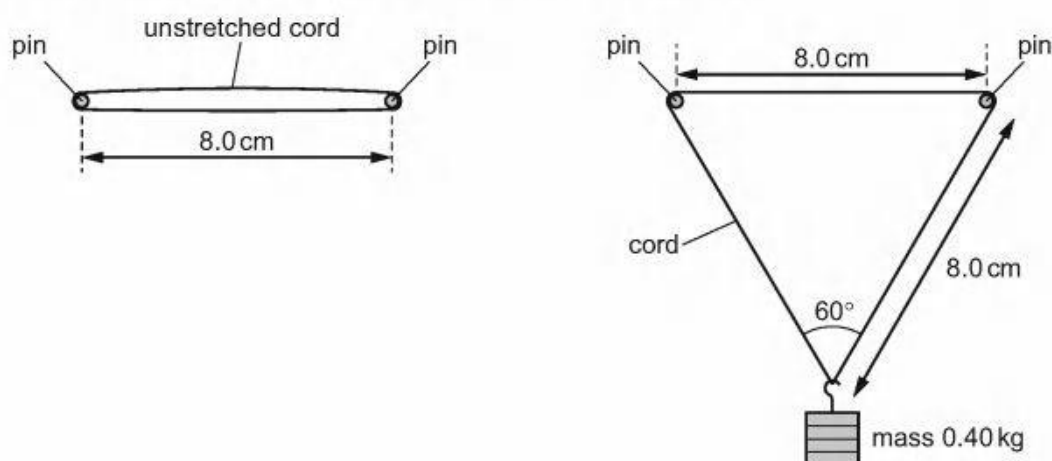
What is the ratio $\frac{\text{density of oil}}{\text{density of water}}$?

- A $\frac{W-P}{Q-P}$ B $\frac{Q-P}{W-P}$ C $\frac{W-P}{W-Q}$ D $\frac{W-Q}{W-P}$

149 - (9702/11_Winter_2023_Q18) - Forces, Density & Pressure

An elastic cord of unstretched total length 16.0 cm and cross-sectional area $2.0 \times 10^{-6} \text{ m}^2$ is held horizontally by two smooth pins a distance 8.0 cm apart.

The cord obeys Hooke's law. A load of mass 0.40 kg is suspended centrally on the cord. The angle between the two sides of the cord supporting the load is 60° .



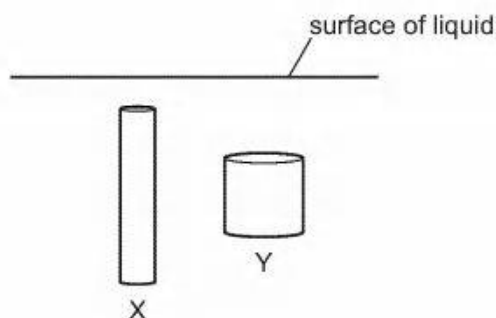
What is the Young modulus of the cord material?

- A $5.7 \times 10^5 \text{ Pa}$ B $1.1 \times 10^6 \text{ Pa}$ C $2.3 \times 10^6 \text{ Pa}$ D $3.9 \times 10^6 \text{ Pa}$



150 - (9702/12_Winter_2023_Q14) - Forces, Density & Pressure

Two solid cylindrical objects X and Y are held fully submerged in a liquid, as shown.



The objects have the same volume. The density of the material of Y is twice the density of the material of X. Both objects are stationary.

Which statement is correct?

- A The force due to the liquid acting on the top surface of X is greater than that acting on the top surface of Y.
- B The pressure difference due to the liquid between the top and bottom surfaces of X is the same as that for Y.
- C The upthrust acting on X is the same as the upthrust acting on Y.
- D The weight of X is the same as the weight of Y.

151 - (9702/13_Winter_2023_Q13) - Forces, Density & Pressure

Full-fat milk is made up of fat-free milk mixed with fat.

A volume of $1.000 \times 10^{-3} \text{ m}^3$ of full-fat milk has a mass of 1.035 kg. It contains 4.00% fat by volume.

The density of fat-free milk is $1.040 \times 10^3 \text{ kg m}^{-3}$.

What is the density of fat?

- A $1.25 \times 10^2 \text{ kg m}^{-3}$
- B $9.15 \times 10^2 \text{ kg m}^{-3}$
- C $9.28 \times 10^2 \text{ kg m}^{-3}$
- D $1.16 \times 10^3 \text{ kg m}^{-3}$

152 - (9702/13_Winter_2023_Q14) - Forces, Density & Pressure

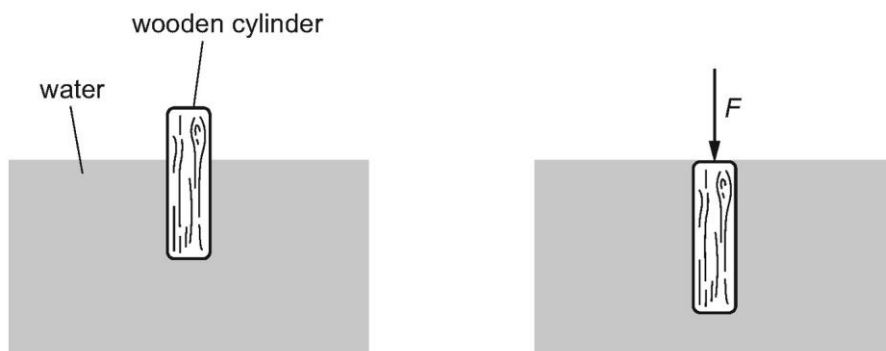
Which expression for pressure is correct?

- A force per unit area
- B mass per unit area
- C mass per unit volume
- D weight per unit volume



153 - (9702/13_Winter_2023_Q15) - Forces, Density & Pressure

A wooden cylinder floats partially submerged in a bath of water. A force F is applied to the cylinder until it is just fully submerged.



Which statement is **not** correct?

- A Some of the water gains gravitational potential energy.
- B The cylinder loses gravitational potential energy.
- C Work is done by force F on the cylinder.
- D Work is done by the upthrust on the cylinder.



1 - (9702/12_Summer_2017_Q14) - Dynamics, Work, Energy & Power

Which quantities are conserved in an inelastic collision?

	kinetic energy	total energy	linear momentum
A	conserved	not conserved	conserved
B	conserved	not conserved	not conserved
C	not conserved	conserved	conserved
D	not conserved	conserved	not conserved

2 - (9702/13_Summer_2017_Q14) - Work, Energy & Power

The first column in the table gives four examples of work being done. The second column gives more detail of the action.

Which row is **not** correct?

	example	detail
A	a girl dives from a diving board into a swimming pool	work is done by the girl against the gravitational field as she falls
B	a man pushes a car along a level road	work is done by the man against friction
C	an electron is accelerated towards a positively charged plate	work is done on the electron by the electric field of the plate
D	a piston is pushed outwards as a gas expands	work is done on the atmosphere by the gas

3 - (9702/11_Summer_2017_Q15) - Work, Energy & Power

A man climbs slowly at a steady speed to the top of a ladder.

What is the **main** energy transfer taking place for the man as he climbs?

- A** chemical potential to gravitational potential
- B** chemical potential to kinetic
- C** kinetic to gravitational potential
- D** thermal (heat) to kinetic



4 - (9702/12_Summer_2017_Q15) - Work, Energy & Power

A cyclist is travelling at a constant speed up a hill. The frictional force resisting the cyclist's motion is 8.0 N.

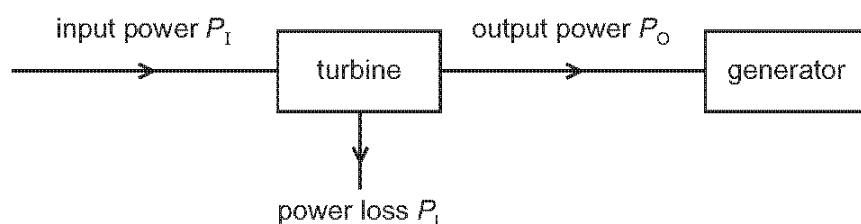
The cyclist uses 450 J of energy to travel a distance of 20 m.

What is the increase in the gravitational potential energy of the cyclist?

- A** 160 J **B** 290 J **C** 440 J **D** 610 J

5 - (9702/13_Summer_2017_Q15) - Work, Energy & Power

A steam turbine is used to drive a generator. The input power to the turbine is P_I and the output power is P_O . The power loss in the turbine is P_L , as shown below.



What is the efficiency of the turbine?

- A** $\frac{P_L}{P_O}$ **B** $\frac{P_I}{P_O}$ **C** $\frac{P_L}{P_I}$ **D** $\frac{P_O}{P_I}$

6 - (9702/11_Summer_2017_Q16) - Work, Energy & Power

During an interval of time, fuel supplies energy X to a car.

Some of this energy is converted into kinetic energy as the car accelerates.

The rest of the energy Y is lost as thermal energy.

What is the efficiency of the car?

- A** $\frac{X}{X-Y}$ **B** $\frac{Y}{X-Y}$ **C** $\frac{X-Y}{X}$ **D** $\frac{X-Y}{Y}$

7 - (9702/12_Summer_2017_Q16) - Forces, Density & Pressure, Work, Energy & Power

A stone of mass m falls from rest at the top of a cliff of height h into the sea below. Just before hitting the sea the stone has speed v .

What is the average force of air resistance acting on the stone during its fall?

- A** mg **B** $\frac{m(v^2 - 2gh)}{h}$ **C** $m\left(g - \frac{v^2}{2h}\right)$ **D** $m\left(gh - \frac{v^2}{2}\right)$



8 - (9702/11_Summer_2017_Q17) - Work, Energy & Power

A railway engine accelerates a train of total mass 800 tonnes (1 tonne = 1000 kg) from rest to a speed of 50 m s^{-1} .

How much useful work must be done on the train to reach this speed?

- A** $1.0 \times 10^6 \text{ J}$ **B** $2.0 \times 10^6 \text{ J}$ **C** $1.0 \times 10^9 \text{ J}$ **D** $2.0 \times 10^9 \text{ J}$

9 - (9702/12_Summer_2017_Q17) - Work, Energy & Power

A railway engine accelerates a train of total mass 1200 tonnes (1 tonne = 1000 kg) from rest to a speed of 75 m s^{-1} .

How much useful work must be done on the train to reach this speed?

- A** $3.4 \times 10^6 \text{ J}$ **B** $6.8 \times 10^6 \text{ J}$ **C** $3.4 \times 10^9 \text{ J}$ **D** $6.8 \times 10^9 \text{ J}$

10 - (9702/13_Summer_2017_Q17) - Work, Energy & Power

A man has a mass of 80 kg. He ties himself to one end of a rope which passes over a single fixed pulley. He pulls on the other end of the rope to lift himself up at an average speed of 50 cm s^{-1} .

What is the average useful power at which he is working?

- A** 40 W **B** 0.39 kW **C** 4.0 kW **D** 39 kW

11 - (9702/11_Summer_2017_Q18) - Work, Energy & Power

A mass is raised vertically. In time t , the increase in its gravitational potential energy is E_p and the increase in its kinetic energy is E_k .

What is the average power input to the mass?

- A** $(E_p - E_k)t$ **B** $(E_p + E_k)t$ **C** $\frac{E_p - E_k}{t}$ **D** $\frac{E_p + E_k}{t}$



12 - (9702/12_Summer_2017_Q18) - Work, Energy & Power

What is a correct derivation of the equation relating power, force and velocity?

A $\text{power} = \frac{\text{work done}}{\text{time taken}}$ and $\text{work done} = \text{force} \times \text{displacement}$

$$\text{so power} = \frac{\text{force} \times \text{displacement}}{\text{time taken}}$$

$$\text{so power} = \text{force} \times \text{velocity}$$

B $\text{power} = \frac{\text{work done}}{\text{time taken}}$ and $\text{work done} = \text{force} \times \text{distance}$

$$\text{so power} = \frac{\text{force} \times \text{distance}}{\text{time taken}}$$

$$\text{so power} = \text{force} \times \text{velocity}$$

C $\text{power} = \frac{\text{work done}}{\text{time taken}}$ and $\text{work done} = \frac{\text{force}}{\text{displacement}}$

$$\text{so power} = \frac{\text{force}}{\text{displacement}} \times \text{time taken}$$

$$\text{so power} = \frac{\text{force}}{\text{velocity}}$$

D $\text{power} = \frac{\text{work done}}{\text{time taken}}$ and $\text{work done} = \frac{\text{force}}{\text{distance}}$

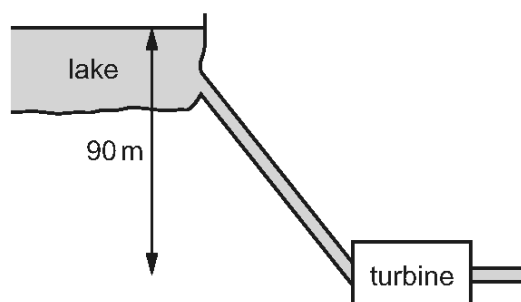
$$\text{so power} = \frac{\text{force}}{\text{distance}} \times \text{time taken}$$

$$\text{so power} = \frac{\text{force}}{\text{velocity}}$$



13 - (9702/11_Summer_2017_Q19) - Work, Energy & Power

Water flows from a lake into a turbine that is a vertical distance of 90 m below the lake, as shown.



The mass flow rate of the water is 2400 kg min^{-1} . The turbine has an efficiency of 75%.

What is the output power of the turbine?

- A** 26 kW **B** 35 kW **C** 1.6 MW **D** 2.1 MW

14 - (9702/13_Winter_2017_Q2) - Work, Energy & Power

The maximum theoretical power P of a wind turbine is given by the equation

$$P = k\rho Av^n$$

where ρ is the density of air, A is the area swept by the turbine blades, v is the speed of the air and k is a constant with no units.

What is the value of n ?

- A** 1 **B** 2 **C** 3 **D** 4

15 - (9702/11_Winter_2017_Q3) - Work, Energy & Power

An ion is accelerated in a vacuum by a series of electrodes. A graph of the power supplied to the ion is plotted against time.

What is represented by the area under the graph between two times?

- A** the average force on the ion
B the change in kinetic energy of the ion
C the change in momentum of the ion
D the change in velocity of the ion



16 - (9702/13_Winter_2017_Q15) - Work, Energy & Power

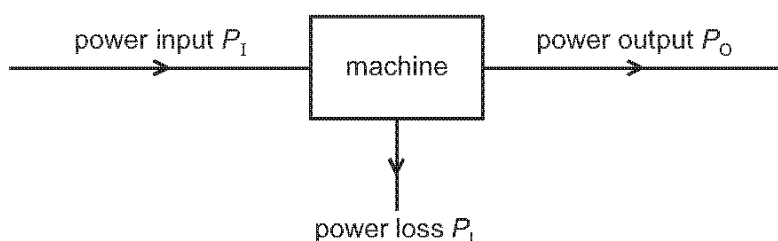
A ball is thrown vertically upwards. Air resistance is negligible.

Which statement is correct?

- A By the principle of conservation of energy, the total energy of the ball is constant throughout its motion.
- B By the principle of conservation of momentum, the momentum of the ball is constant throughout its motion.
- C The kinetic energy of the ball is greatest at the greatest height attained.
- D The potential energy of the ball increases at a constant rate during its ascent.

17 - (9702/11_Winter_2017_Q16) - Work, Energy & Power

Power is transferred through a machine as shown.



What is the efficiency of the machine?

- A $\frac{P_I}{P_O + P_L}$
- B $\frac{P_L}{P_I}$
- C $\frac{P_L}{P_O}$
- D $\frac{P_O}{P_I}$

18 - (9702/13_Winter_2017_Q16) - Work, Energy & Power

A car of total mass 1560 kg is travelling with a constant speed of 32 m s^{-1} . The driving force provided by the car is 680 N. The kinetic energy of the car is 800 kJ and its momentum is 50 000 N s.

Which two items of data could be used to calculate the useful power output of the car?

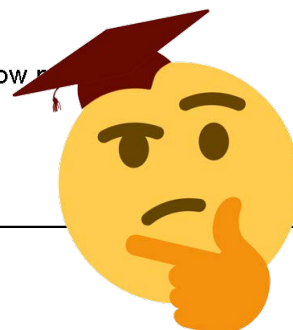
- A driving force and momentum
- B kinetic energy and mass
- C mass and momentum
- D speed and driving force

19 - (9702/11_Winter_2017_Q17) - Forces, Density & Pressure, Work, Energy & Power

A piston in a gas supply pump has an area of 400 cm^2 . The pump moves the gas against a fixed pressure of 3000 Pa.

During part of its stroke, the piston moves a distance of 25 cm in one direction. How much work is done by the piston during this movement?

- A 30 J
- B $3.0 \times 10^3 \text{ J}$
- C $3.0 \times 10^5 \text{ J}$
- D $3.0 \times 10^7 \text{ J}$



20 - (9702/12_Winter_2017_Q18) - Work, Energy & Power

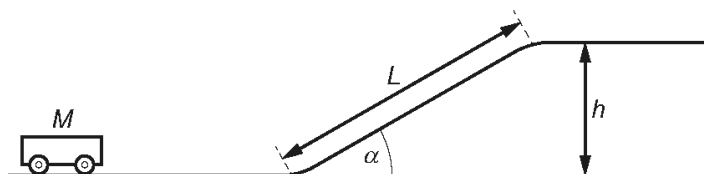
Car X is travelling at half the speed of car Y. Car X has twice the mass of car Y.

Which statement is correct?

- A Car X has half the kinetic energy of car Y.
- B Car X has one quarter of the kinetic energy of car Y.
- C Car X has twice the kinetic energy of car Y.
- D The two cars have the same kinetic energy.

21 - (9702/13_Winter_2017_Q18) - Work, Energy & Power

A trolley rolls along a horizontal surface and then travels up a slope before reaching a second horizontal surface. The slope is of length L . The trolley has mass M . The slope is at an angle α to the horizontal surface. The second horizontal surface is at height h above the first surface.



Assume negligible frictional forces. The acceleration of free fall is known.

In order to determine the minimum initial velocity of the trolley for it to reach the top of the slope, which additional values are needed?

- A h and M B M , L and h C α , L , M D h only

22 - (9702/11_Winter_2017_Q19) - Work, Energy & Power

A turbine at a hydroelectric power station is situated 30m below the level of the surface of a large lake. The water passes through the turbine at a rate of 340 m^3 per minute.

The overall efficiency of the turbine and generator system is 90%.

What is the output power of the power station? (The density of water is 1000 kg m^{-3} .)

- A 0.15MW B 1.5MW C 1.7MW D 90MW

23 - (9702/12_Winter_2017_Q19) - Work, Energy & Power, Current Of Electricity

During refuelling, a petrol car receives 50 litres of fuel in 90 seconds. The petrol has 34 MJ of energy per litre.

For an electric car to receive the same amount of energy in the same time from a 230V supply, what is the minimum current required?

- A 2700A B $8.2 \times 10^4\text{ A}$ C $7.4 \times 10^6\text{ A}$ D $6.6 \times 10^8\text{ A}$



24 - (9702/11_Summer_2018_Q8) - Kinematics, Work, Energy & Power

The momentum of a car of mass m increases from p_1 to p_2 .

What is the increase in the kinetic energy of the car?

- A $\frac{(p_2^2 - p_1^2)}{2m}$ B $\frac{(p_2 - p_1)^2}{2m}$ C $\frac{p_2 - p_1}{2m}$ D $\frac{p_1 - p_2}{2m}$

25 - (9702/12_Summer_2018_Q9) - Kinematics, Work, Energy & Power

An elastic collision occurs between two bodies X and Y. The mass of body X is m and the mass of body Y is $4m$. Body X travels at speed v before the collision and speed $\frac{3v}{5}$ in the opposite direction after the collision. Body Y is stationary before the collision.



What is the kinetic energy of body Y after the collision?

- A $\frac{8}{10}mv^2$ B $\frac{34}{50}mv^2$ C $\frac{16}{50}mv^2$ D $\frac{1}{5}mv^2$

26 - (9702/11_Summer_2018_Q14) - Work, Energy & Power

A train of mass $3.3 \times 10^6 \text{ kg}$ is moving at a constant speed up a slope inclined at an angle of 0.64° to the horizontal. The engine of the train is producing a useful output power of 14 MW.

Assume that there are no frictional forces opposing the motion of the train.

What is the speed of the train?

- A 0.43 ms^{-1} B 4.2 ms^{-1} C 39 ms^{-1} D 380 ms^{-1}

27 - (9702/11_Summer_2018_Q15) - Work, Energy & Power

A cannon-ball of mass 3.50 kg is fired at a speed of 22.0 ms^{-1} from a gun on a ship at a height of 6.00 m above sea level.

The total energy of the cannon-ball is the sum of the gravitational potential energy relative to the surface of the sea and the kinetic energy.

What is the total energy of the cannon-ball as it leaves the gun?

- A 206 J B 641 J C 847 J D 1050 J



28 - (9702/13_Summer_2018_Q15) - *Work, Energy & Power*

Water from a reservoir is fed to the turbine of a hydroelectric system at a rate of 510 kg s^{-1} . The reservoir is 280 m above the level of the turbine.

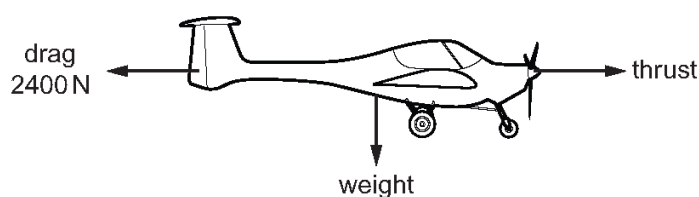
The electrical output from the generator driven by the turbine is a current of 205 A at a potential difference of 5800 V.

What is the efficiency of the system?

- A 8.3% B 12% C 83% D 85%

29 - (9702/11_Summer_2018_Q16) - *Kinematics, Work, Energy & Power*

An aircraft travels at a constant velocity of 90 m s^{-1} in horizontal flight. The diagram shows some of the forces acting on the aircraft.



The mass of the aircraft is 2000 kg.

What is the power produced by the thrust force?

- A $1.8 \times 10^5\text{ W}$ B $2.2 \times 10^5\text{ W}$ C $1.8 \times 10^6\text{ W}$ D $2.0 \times 10^6\text{ W}$

30 - (9702/12_Summer_2018_Q16) - *Work, Energy & Power, Current Of Electricity*

In 'normal driving conditions', an electric car has a range of 150 km. This uses all of the 200 MJ of energy stored in its batteries.

With the batteries initially fully charged, the car is driven 100 km in 'normal driving conditions'. The batteries are then recharged from a household electrical supply delivering a constant current of 13.0 A at a potential difference of 230 V.

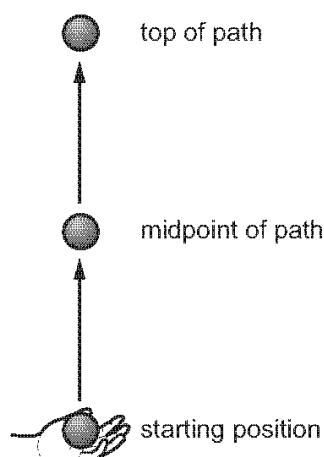
What is the minimum time required to recharge the batteries?

- A 0.95 hours
B 12.4 hours
C 18.6 hours
D 27.9 hours



31 - (9702/13_Summer_2018_Q16) - Work, Energy & Power

A ball is thrown vertically up into the air. It rises to the top of its path before beginning to fall vertically downwards.



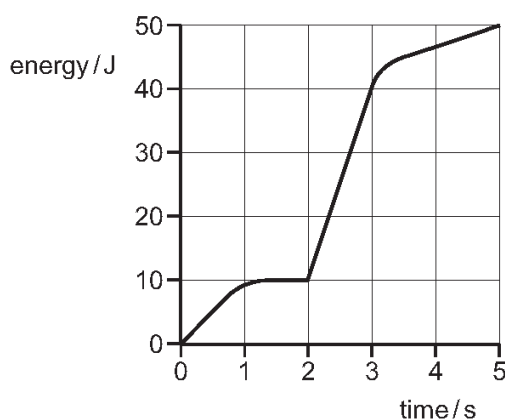
Assume that the gravitational potential energy of the ball is zero at its starting position.

Which statement about the ball is **not** correct?

- A As it rises, its kinetic energy is transferred to gravitational potential energy.
- B At the midpoint of its path, its gravitational potential energy is equal to its initial kinetic energy.
- C At the top of its path, its kinetic energy is zero.
- D At the top of its path, its total energy is less than its initial total energy.

32 - (9702/11_Summer_2018_Q17) - Work, Energy & Power

An electrical generator is started at time zero. The total electrical energy generated during the first 5 seconds is shown in the graph.



What is the maximum electrical power generated at any instant during these first 5 seconds?

- A 10W
- B 13W
- C 30W
- D 50W



33 - (9702/13_Summer_2018_Q17) - Work, Energy & Power

A force of 1000 N is needed to lift the hook of a crane at a constant velocity. The crane is then used to lift a load of mass 1000 kg at a constant velocity of 0.50 m s^{-1} .

What is the power needed to lift the hook and the load?

- A 4.9 kW B 5.4 kW C 20 kW D 22 kW

34 - (9702/12_Summer_2018_Q18) - Work, Energy & Power

A steel sphere is dropped vertically onto a horizontal metal plate. The sphere hits the plate with speed u , leaves it at speed v , and rebounds vertically to half of its original height. Ignore air resistance.

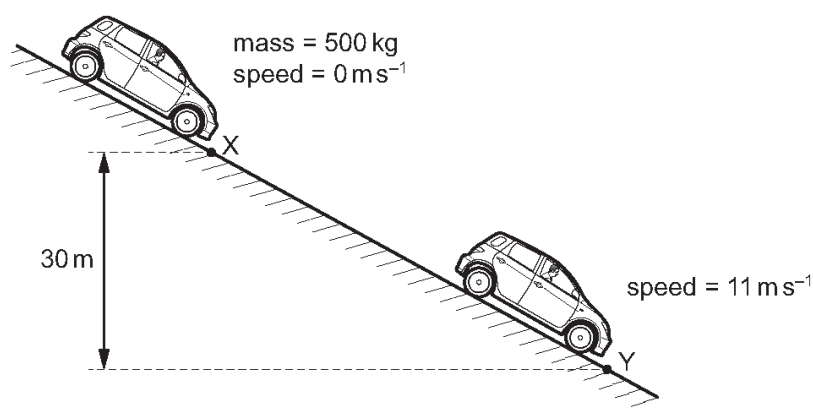
Which expression gives the value of $\frac{v}{u}$?

- A $\frac{1}{2^2}$ B $\frac{1}{2}$ C $\frac{1}{\sqrt{2}}$ D $1 - \frac{1}{\sqrt{2}}$

35 - (9702/12_Summer_2018_Q19) - Work, Energy & Power

A car of mass 500 kg is at rest at point X on a slope, as shown.

The car's brakes are released and the car rolls down the slope with its engine switched off. At point Y the car has moved through a vertical height of 30 m and has a speed of 11 m s^{-1} .



What is the energy dissipated by frictional forces when the car moves from X to Y?

- A $3.0 \times 10^4 \text{ J}$ B $1.2 \times 10^5 \text{ J}$ C $1.5 \times 10^5 \text{ J}$ D $1.8 \times 10^5 \text{ J}$

36 - (9702/11_Winter_2018_Q14) - Work, Energy & Power

A rocket is fired upwards.

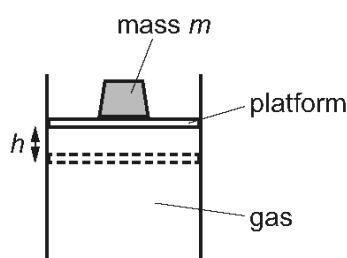
As it accelerates upwards after leaving the launch pad, which forms of energy are changing?

- A chemical energy, gravitational potential energy and kinetic energy
B chemical energy and gravitational potential energy only
C chemical energy and kinetic energy only
D gravitational potential energy and kinetic energy only



37 - (9702/11_Winter_2018_Q15) - Work, Energy & Power

A mass m is on top of a platform that is supported by gas in a cylinder of cross-sectional area A , as shown.



The platform has negligible mass and can move freely up and down.

The gas is heated and expands so that the mass is raised through a height h . Atmospheric pressure is p .

What is the ratio $\frac{\text{gain in gravitational potential energy of the mass}}{\text{work done by the gas}}$?

- A $\frac{mg}{pA}$ B $\frac{mg}{mg + pA}$ C $\frac{pA}{mg}$ D $\frac{mg - pA}{mg}$

38 - (9702/12_Winter_2018_Q15) - Work, Energy & Power

A bungee jumper on a platform over a river is attached to an elastic rope that is 20m long when unstretched. He falls towards the river and his lowest point is 30m below the platform.

The initial gravitational potential energy of the jumper is transferred to other forms during the jump.

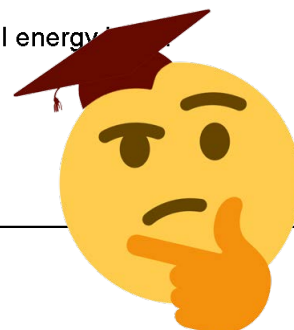
Which other forms of energy do the jumper and rope have when the jumper has fallen half-way and when he is at the lowest point of his jump?

	half-way	lowest point
A	kinetic energy and elastic potential energy	kinetic energy and elastic potential energy
B	kinetic energy and elastic potential energy	elastic potential energy only
C	kinetic energy only	kinetic energy and elastic potential energy
D	kinetic energy only	elastic potential energy only

39 - (9702/13_Winter_2018_Q15) - Work, Energy & Power

Which statement about energy is **not** correct?

- A Energy is never lost but it may be transferred between different forms.
 B In an inelastic collision, the total energy is constant.
 C The efficiency of a system is the ratio of the useful energy output to the total energy.
 D When a machine does work, friction reduces the total energy.



40 - (9702/12_Winter_2018_Q16) - Work, Energy & Power

A cylinder contains a fixed mass of gas. The gas, at a constant pressure of $1.3 \times 10^5 \text{ Pa}$, expands from a volume of 900 cm^3 to a volume of 1100 cm^3 .

What is the work done by the gas during this expansion?

- A 26 J B 130 J C 2600 J D 13 000 J

41 - (9702/13_Winter_2018_Q16) - Work, Energy & Power

An electric kettle is rated as having an input power of 1.50 kW and an efficiency of 65.0% .

The kettle is switched on for 2.00 minutes.

How much energy is transferred to the water in the kettle?

- A 0.975 kJ B 117 kJ C 180 kJ D 277 kJ

42 - (9702/11_Winter_2018_Q17) - Work, Energy & Power

The force resisting the motion of a car is proportional to the square of the car's speed. The magnitude of the force at a speed of 20.0 m s^{-1} is 800 N .

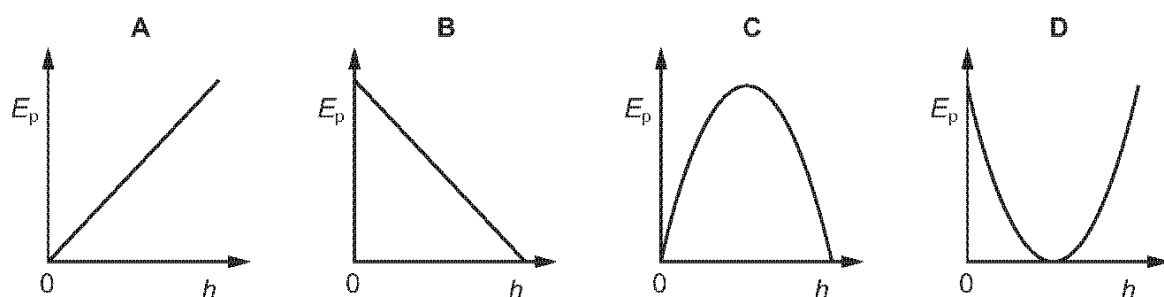
What useful output power is required from the car's engine to maintain a steady speed of 40.0 m s^{-1} ?

- A 32 kW B 64 kW C 128 kW D 512 kW

43 - (9702/12_Winter_2018_Q17) - Work, Energy & Power

An object is thrown into the air.

Which graph shows how the gravitational potential energy E_p of the object varies with height h above the ground?



44 - (9702/13_Winter_2018_Q17) - Work, Energy & Power

On a planet, a gravitational force F acts on a mass of 6.0 kg. The mass is moved by force F a distance of 30 m in the direction of the gravitational field. The work done by the field is 450 J.

What is the force F on the mass and what is the acceleration of free fall g on the planet?

	F/N	g/ms^{-2}
A	0.067	0.011
B	0.067	0.40
C	15	2.5
D	15	90

45 - (9702/12_Winter_2018_Q18) - Work, Energy & Power

A car of mass 1800 kg accelerates along a horizontal road so that its speed increases from 20 ms^{-1} to 25 ms^{-1} in a time of 5.4 s.

What is the average useful power output of the car's engine?

- A 4.2 kW B 38 kW C 120 kW D 1100 kW

46 - (9702/13_Winter_2018_Q18) - Work, Energy & Power

A girl of mass 50 kg runs up a flight of 20 steps in 7.0 seconds. Each step is 25 cm high.

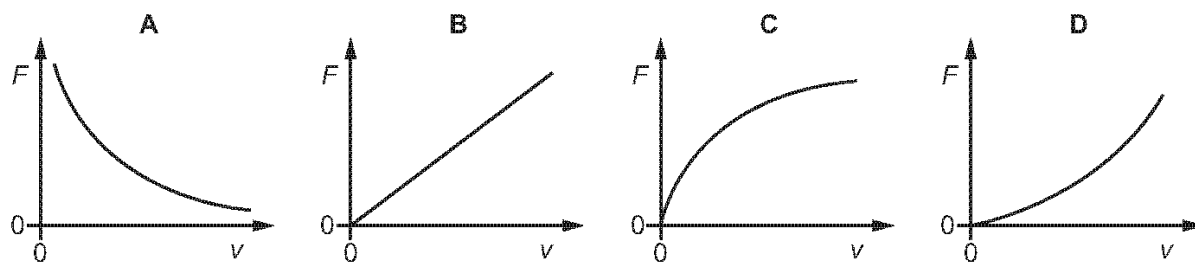
What is the useful average output power provided by the girl to climb the flight of steps?

- A 18 W B 36 W C 350 W D 2500 W

47 - (9702/12_Winter_2018_Q19) - Work, Energy & Power

A variable force is applied to ensure that a constant power is supplied to a train.

Which graph best shows the variation of the force F applied with the velocity v of the train?



48 - (9702/13_Summer_2019_Q4) - Measurement Techniques, Work, Energy & Power

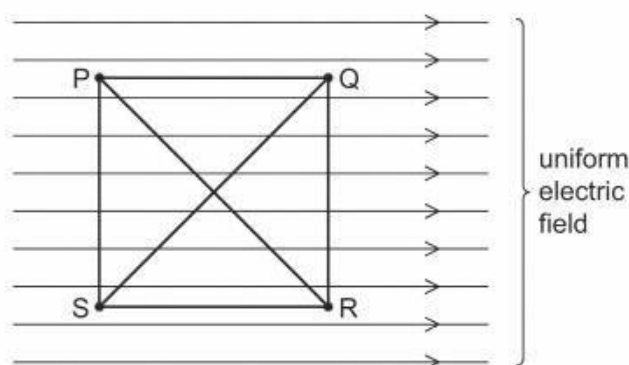
What is the approximate kinetic energy of an Olympic athlete when running at maximum speed during a 100 m race?

- A 400 J B 4000 J C 40 000 J D 400 000 J



49 - (9702/12_Summer_2019_Q13) - *Electric Fields, Work, Energy & Power*

A small positive charge can move inside a uniform electric field.



The charge moves along different straight paths between points P, Q, R and S.

Which row gives two paths that result in the same total work done on the charge?

	path 1	path 2
A	P to R	Q to S
B	P to R	P to S
C	S to Q	S to R
D	S to Q	R to P

50 - (9702/13_Summer_2019_Q15) - *Work, Energy & Power*

Which statement about the principle of conservation of energy is correct?

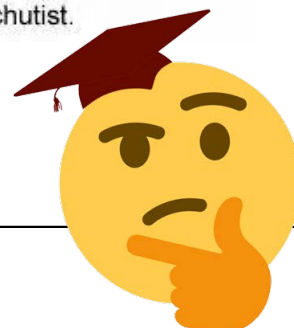
- A Energy conversion helps to conserve energy sources.
- B Energy is conserved only in systems with an efficiency of 100%.
- C The supply of energy is limited so energy should be conserved.
- D The total amount of energy in a closed system is constant.

51 - (9702/12_Summer_2019_Q16) - *Work, Energy & Power*

A parachutist is falling at constant (terminal) velocity.

Which statement is **not** correct?

- A Gravitational potential energy is converted into kinetic energy of the air.
- B Gravitational potential energy is converted into kinetic energy of the parachutist.
- C Gravitational potential energy is converted into thermal energy of the air.
- D Gravitational potential energy is converted into thermal energy of the parachutist.



52 - (9702/13_Summer_2019_Q16) - Work, Energy & Power

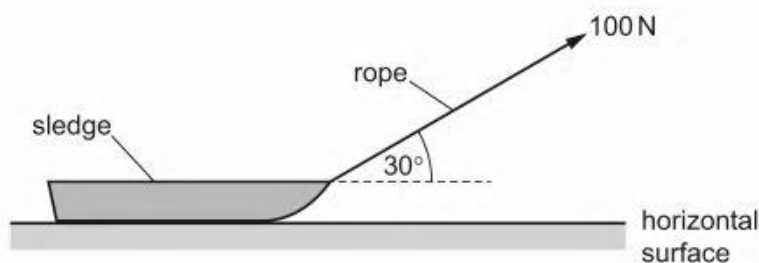
A student can run or walk up the stairs to her classroom.

Which statement describes the power required and the gravitational potential energy gained while running up the stairs compared to walking up them?

- A Running provides more gravitational potential energy and uses more power.
- B Running provides more gravitational potential energy and uses the same power.
- C Running provides the same gravitational potential energy and uses more power.
- D Running provides the same gravitational potential energy and uses the same power.

53 - (9702/11_Summer_2019_Q17) - Work, Energy & Power

A rope is attached to a sledge and a boy uses the rope to pull the sledge along a horizontal surface with a constant velocity. The tension in the rope is 100 N and the rope is held at 30° to the horizontal.

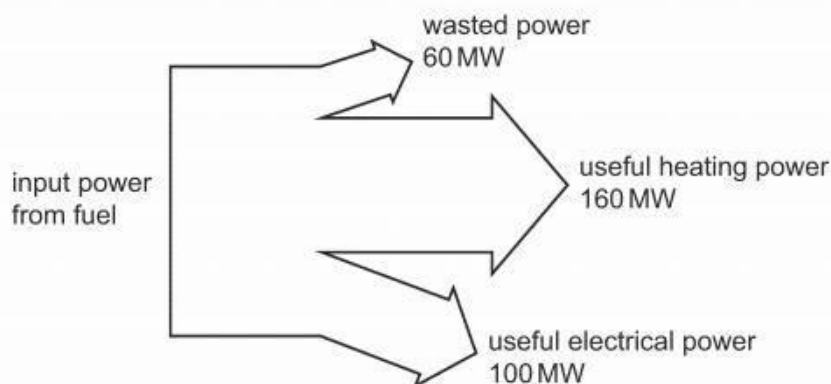


How much work does the boy do on the sledge when he pulls it a distance of 5.0 m along the surface?

- A 250 J
- B 290 J
- C 430 J
- D 500 J

54 - (9702/12_Summer_2019_Q17) - Work, Energy & Power

A combined heat and power (CHP) station generates electrical power and useful heat. The diagram shows the input and output powers for a CHP station.



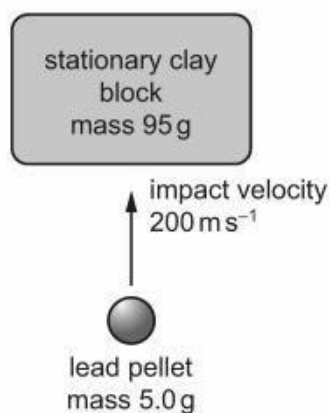
What is the efficiency of the CHP station for producing useful power?

- A 31%
- B 38%
- C 50%
- D 81%



55 - (9702/13_Summer_2019_Q17) - Dynamics, Work, Energy & Power

A lead pellet is shot vertically upwards into a clay block that is stationary at the moment of impact but is able to rise freely after impact.



The mass of the pellet is 5.0 g and the mass of the clay block is 95 g.

The pellet hits the block with an initial vertical velocity of 200 m s⁻¹. It embeds itself in the block and does not emerge.

How high above its initial position will the block rise?

- A** 5.1 m **B** 5.6 m **C** 10 m **D** 100 m

56 - (9702/11_Summer_2019_Q18) - Work, Energy & Power

The kinetic energy E_k of an object of mass m moving at speed v is given by the equation shown.

$$E_k = \frac{1}{2} mv^2$$

Which equation is **not** used in the derivation of this equation?

- A** $F = ma$ **B** $s = vt$ **C** $v^2 = u^2 + 2as$ **D** $W = Fs$

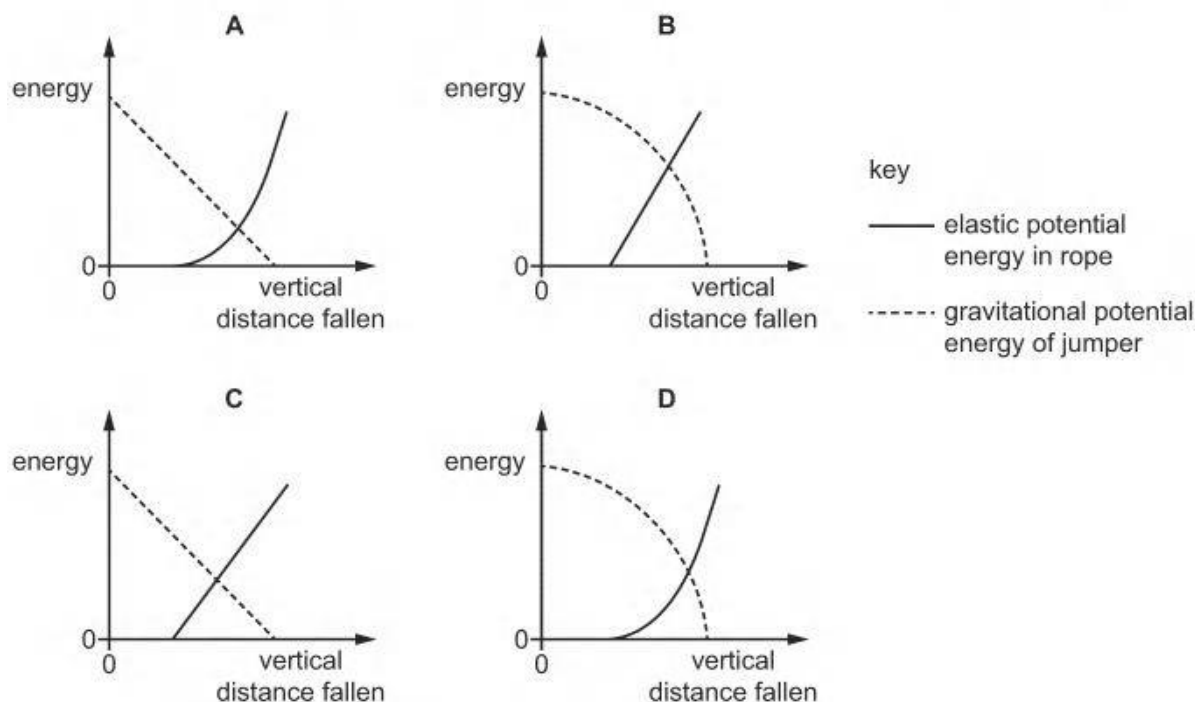


57 - (9702/12_Summer_2019_Q18) - Work, Energy & Power

A bungee jumper jumps off a high bridge, when attached to it by a long elastic rope which obeys Hooke's law.

The gravitational potential energy of the jumper is measured relative to the lowest point reached by the jumper.

Which graph shows the variation of the gravitational potential energy of the jumper, and the elastic potential energy in the rope, with the vertical distance fallen from the top of the bridge?



58 - (9702/13_Summer_2019_Q18) - Work, Energy & Power

On the surface of a planet, 30 J of work is done against gravity to raise a mass of 1.0 kg through a height of 10 m.

How much work must be done to raise a mass of 4.0 kg through a height of 5.0 m on this planet?

- A** 15 J **B** 60 J **C** 120 J **D** 200 J

59 - (9702/11_Summer_2019_Q19) - Work, Energy & Power

A grasshopper of mass 0.12 g jumps vertically. It uses its back legs over a time of 0.020 s to jump, leaving the ground with a velocity of 3.0 m s^{-1} .

What is the average power developed by the legs of the grasshopper?

- A** $9.0 \times 10^{-3} \text{ W}$ **B** $1.8 \times 10^{-2} \text{ W}$ **C** $2.7 \times 10^{-2} \text{ W}$ **D** 37 W



60 - (9702/12_Summer_2019_Q19) - Work, Energy & Power

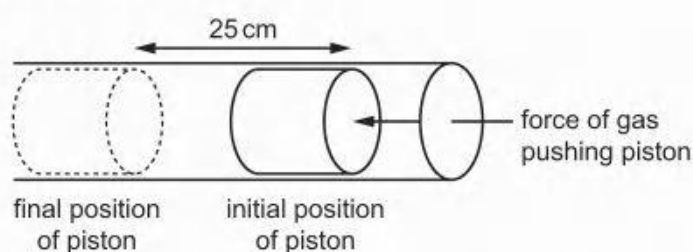
A train on a mountain railway is carrying 200 people of average mass 70 kg up a slope at an angle of 30° to the horizontal and at a speed of 6.0 m s^{-1} . The train itself has a mass of 80 000 kg. The percentage of the power from the engine which is used to raise the passengers and the train is 40%.

What is the power of the engine?

- A 1.1 MW B 2.8 MW C 6.9 MW D 14 MW

61 - (9702/12_Winter_2019_Q14) - Work, Energy & Power

The gas in an engine does work on a piston of cross-sectional area 80 cm^2 . The pressure on the piston has a constant value of $4.6 \times 10^5 \text{ Pa}$.



How much work is done by the gas on the piston when it moves through a distance of 25 cm?

- A $9.2 \times 10^2 \text{ J}$ B $9.2 \times 10^4 \text{ J}$ C $9.2 \times 10^6 \text{ J}$ D $9.2 \times 10^8 \text{ J}$

62 - (9702/13_Winter_2019_Q14) - Work, Energy & Power

Trains supply coal to a power station. The table shows quantities describing the operation of the power station.

	symbol	unit
power station average output	P	W
number of trains per day	N	
mass of coal on a train	M	kg
energy from 1 kg of coal	E	J
number of seconds in one day	S	

Which expression gives the efficiency of the power station?

- A $\frac{PS}{NME}$ B $\frac{PSN}{ME}$ C $\frac{NME}{PS}$ D $\frac{NM}{PSE}$



63 - (9702/11_Winter_2019_Q15) - Work, Energy & Power

An electric motor produces 120 W of useful mechanical output power. The efficiency of the motor is 60%.

Which row is correct?

	electrical power input / W	waste heat power output / W
A	72	48
B	192	72
C	200	72
D	200	80

64 - (9702/12_Winter_2019_Q15) - Work, Energy & Power

A power station using coal as fuel has an average power output of 3000 MW. Coal is supplied by 20 trains each day. The efficiency of the station in converting the thermal energy released from the coal to electrical energy is 26%.

A mass of 1.0 kg of coal will release 33 MJ of thermal energy when burnt.

Which mass of coal does each train bring?

A 2.5×10^4 kg B 6.3×10^4 kg C 1.5×10^8 kg D 3.0×10^7 kg

65 - (9702/13_Winter_2019_Q15) - Work, Energy & Power

A piston in a gas supply pump has an area of 500 cm^2 and it moves a distance of 30 cm.

The pump moves the gas against a fixed pressure of 4000 Pa.

How much work is done by the piston?

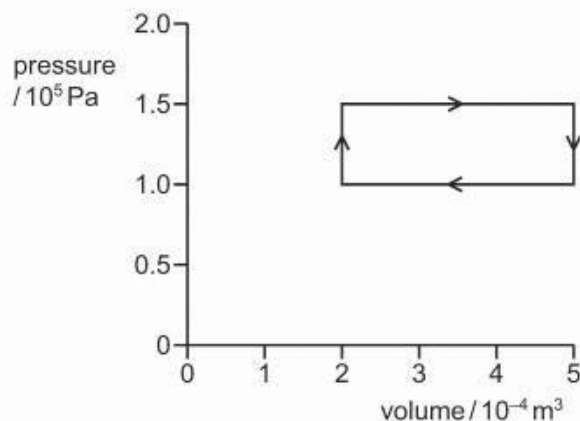
A 60 J B 6.0×10^3 J C 6.0×10^5 J D 6.0×10^7 J



66 - (9702/11_Winter_2019_Q16) - Work, Energy & Power

A fixed amount of a gas undergoes a series of changes to its pressure and volume.

In two of the changes, no work is done by or on the gas. In one change work is done by the gas on its surroundings. In another change work is done on the gas by its surroundings.

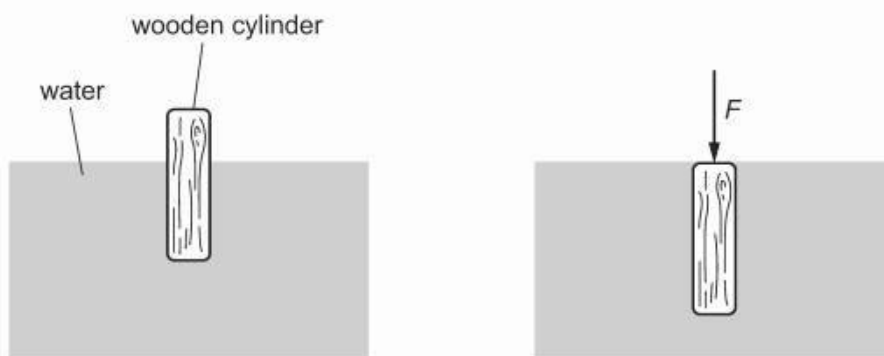


During the change when work is done on the gas by its surroundings, how much work is done on the gas?

- A 15 J B 25 J C 30 J D 45 J

67 - (9702/12_Winter_2019_Q16) - Work, Energy & Power

A wooden cylinder floats partially submerged in a bath of water. A force F is applied to the cylinder until it is just fully submerged.



Which statement is **not** correct?

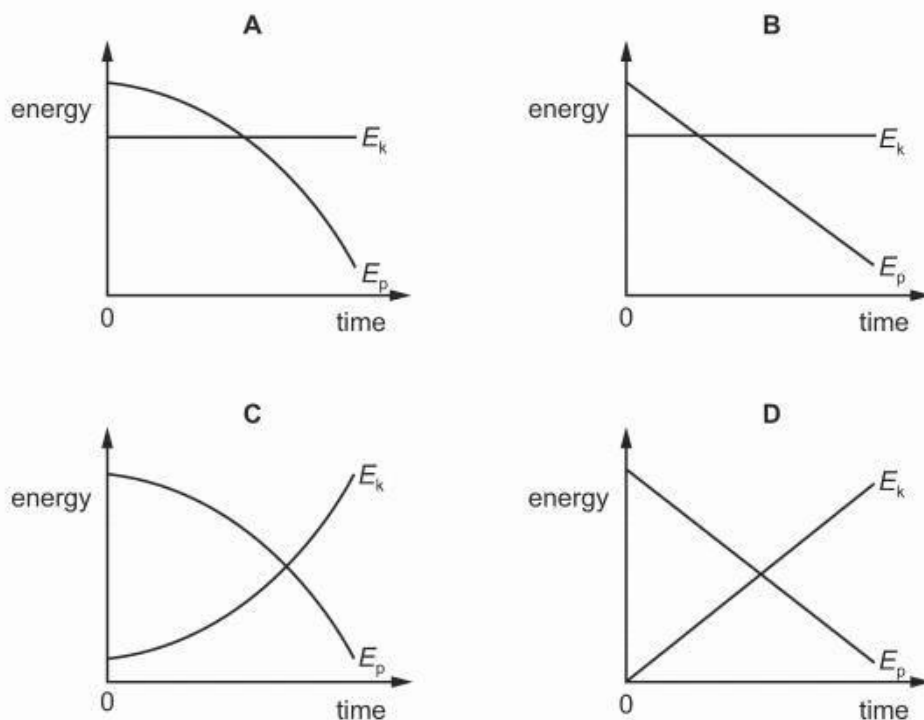
- A Some of the water gains gravitational potential energy.
B The cylinder loses gravitational potential energy.
C Work is done by force F on the cylinder.
D Work is done by the upthrust on the cylinder.



68 - (9702/13_Winter_2019_Q16) - Work, Energy & Power

A steel ball is falling at constant speed in oil.

Which graph shows the variation with time of the gravitational potential energy E_p and the kinetic energy E_k of the ball?



69 - (9702/11_Winter_2019_Q17) - Work, Energy & Power

An object travelling with a speed of 10 m s^{-1} has kinetic energy 1500 J.

The speed of the object is increased to 40 m s^{-1} .

What is the new kinetic energy of the object?

- A** 4500 J **B** 6000 J **C** 24000 J **D** 135000 J

70 - (9702/12_Winter_2019_Q17) - Work, Energy & Power

The motor of a crane lifts a load of mass 600 kg. The load rises vertically at a constant speed of 12 m per minute.

What is the useful power output of the motor?

- A** 0.12 kW **B** 1.2 kW **C** 7.2 kW **D** 71 kW



71 - (9702/13_Winter_2019_Q17) - Work, Energy & Power

The maximum useful output power of a car travelling on a horizontal road is P . The total resistive force acting on the car is kv^2 , where v is the speed of the car and k is a constant.

Which equation is correct when the car is travelling at maximum speed?

- A** $v^3 = \frac{P}{k}$ **B** $v^2 = \frac{P}{k}$ **C** $v = \left(\frac{P}{k}\right)^2$ **D** $v = \left(\frac{P}{k}\right)^3$

72 - (9702/11_Winter_2019_Q18) - Work, Energy & Power

The engine of a car exerts a force of 600 N in moving the car 1.0 km in 150 seconds.

What is the average useful output power of the engine?

- A** 4.0 W **B** 4.0 kW **C** 90 kW **D** 90 MW

73 - (9702/13_Winter_2019_Q18) - Work, Energy & Power

Initially, four identical uniform blocks, each of mass m and thickness h , are spread on a table.



The acceleration of free fall is g .

How much work is done on the blocks in stacking them on top of one another?

- A** $3mgh$ **B** $6mgh$ **C** $8mgh$ **D** $10mgh$

74 - (9702/12_Summer_2020_Q14) - Work, Energy & Power

During an interval of time, fuel supplies energy X to a car.

Some of this energy is converted into kinetic energy as the car accelerates.

The rest of the energy Y is lost as thermal energy.

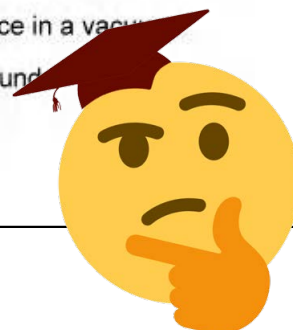
What is the efficiency of the car?

- A** $\frac{X}{X-Y}$ **B** $\frac{Y}{X-Y}$ **C** $\frac{X-Y}{X}$ **D** $\frac{X-Y}{Y}$

75 - (9702/12_Summer_2020_Q15) - Work, Energy & Power

In which situation is work done on an object?

- A** The object slides with a constant velocity along a horizontal frictionless surface in a vacuum.
B A person holds the object at arm's length and at a fixed height above the ground.
C A person pushes the object up a frictionless ramp.
D The stationary object floats partially submerged in water.



76 - (9702/11_Summer_2020_Q16) - Work, Energy & Power

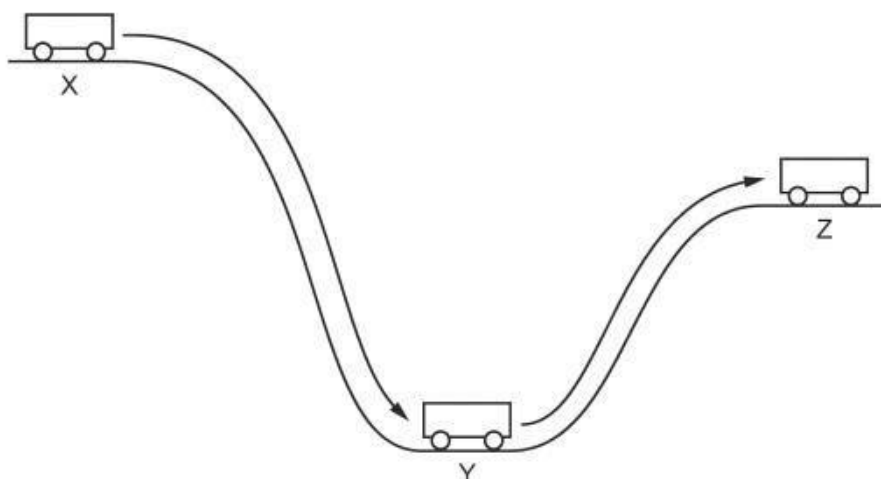
A mass attached to the lower end of a spring bounces up and down.

At which points in the path of the mass do the gravitational potential energy of the mass (GPE), the elastic potential energy in the spring (EPE) and the kinetic energy of the mass (KE) have their highest values?

	GPE	EPE	KE
A	bottom	middle	top
B	bottom	top	middle
C	top	bottom	middle
D	top	bottom	top

77 - (9702/13_Summer_2020_Q16) - Work, Energy & Power

A trolley starts from rest at X. It rolls down to Y and eventually comes to rest at Z.



Which row is a possible summary of the energy changes during this process?

	X to Y	Y to Z
A	PE → KE	KE → PE
B	PE → KE	KE → PE + heat
C	PE → KE + heat	KE → PE
D	PE → KE + heat	KE → PE + heat

key

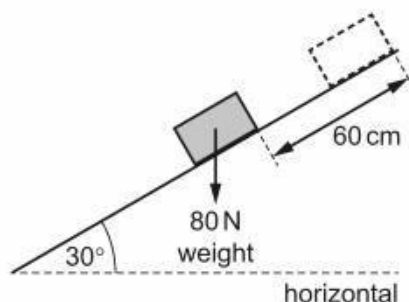
PE = potential energy

KE = kinetic energy



78 - (9702/11_Summer_2020_Q17) - Work, Energy & Power

A block of weight 80 N is pushed a distance of 60 cm up a slope inclined at 30° to the horizontal. There is a frictional force of 25 N between the block and the surface of the slope.



What is the work W_g done against the gravitational force and the work W_f done against the frictional force?

	W_g / J	W_f / J
A	24	7.5
B	24	15
C	48	7.5
D	48	15

79 - (9702/12_Summer_2020_Q17) - Work, Energy & Power

An escalator in an underground station has 25 people standing on it and is moving with a speed of 4.3 m s^{-1} . The average mass of a person is 78 kg and the angle of the escalator to the horizontal is 40° .

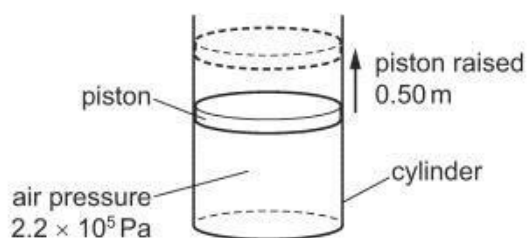
What is the minimum power required to lift these people?

- A 5.4 kW B 6.4 kW C 53 kW D 63 kW



80 - (9702/13_Summer_2020_Q17) - Work, Energy & Power

A cylinder is heated, causing the air inside to expand at a constant pressure of $2.2 \times 10^5 \text{ Pa}$.



The expansion of the air causes the piston to rise through a vertical distance of 0.50 m, doing 11 kJ of work. Frictional forces are negligible.

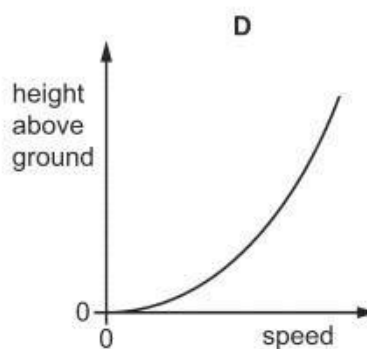
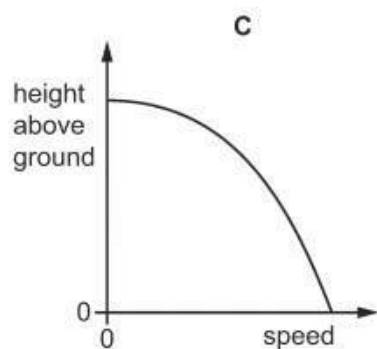
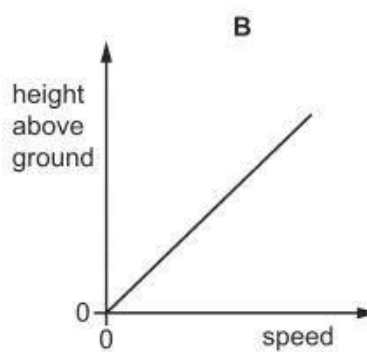
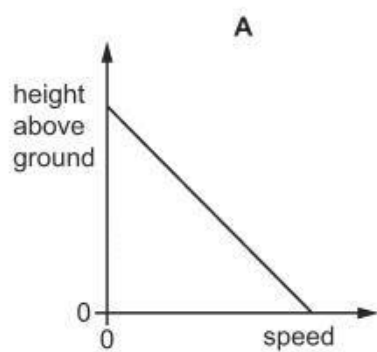
What is the cross-sectional area of the piston?

- A $1.0 \times 10^{-4} \text{ m}^2$
- B $2.5 \times 10^{-2} \text{ m}^2$
- C $5.0 \times 10^{-2} \text{ m}^2$
- D $1.0 \times 10^{-1} \text{ m}^2$

81 - (9702/11_Summer_2020_Q18) - Work, Energy & Power

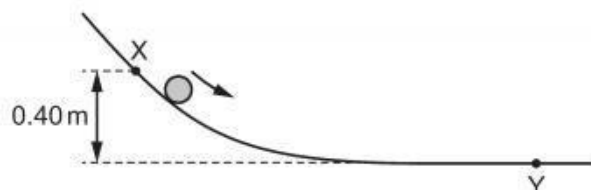
A ball is dropped from rest and falls towards the ground. Air resistance is negligible.

Which graph shows the variation with speed of the height of the ball above the ground?



82 - (9702/13_Summer_2020_Q18) - Work, Energy & Power

A ball slides down a curved track, as shown.



Point X is at a height of 0.40 m above point Y. The speed of the ball at point X is 2.5 ms^{-1} .

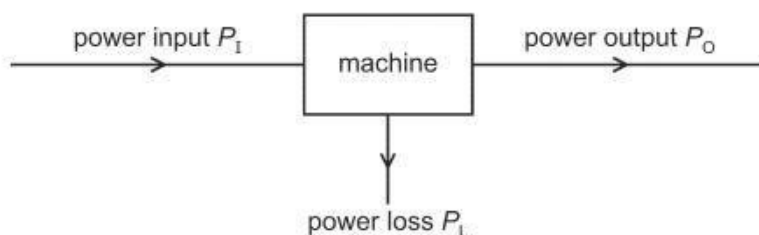
Frictional forces are negligible.

What is the speed of the ball at point Y?

- A 2.8 ms^{-1} B 3.2 ms^{-1} C 3.8 ms^{-1} D 14 ms^{-1}

83 - (9702/11_Summer_2020_Q19) - Work, Energy & Power

Power is transferred through a machine as shown.

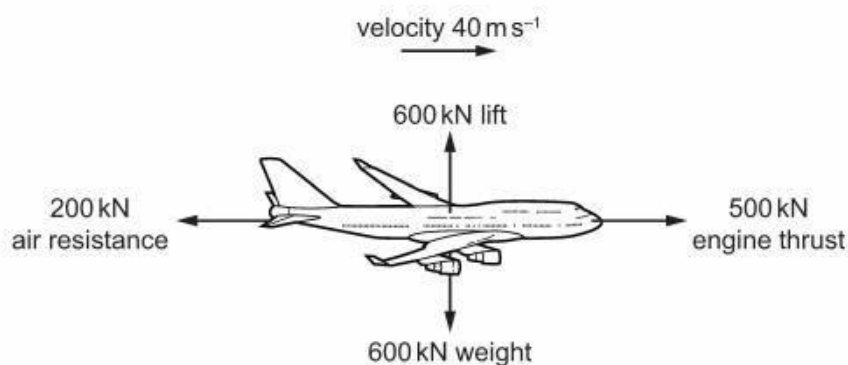


What is the efficiency of the machine?

- A $\frac{P_I}{P_O + P_L}$ B $\frac{P_L}{P_I}$ C $\frac{P_L}{P_O}$ D $\frac{P_O}{P_I}$

84 - (9702/13_Summer_2020_Q19) - Work, Energy & Power

The force diagram shows an aircraft accelerating. At the instant shown, the velocity of the aircraft is 40 ms^{-1} .



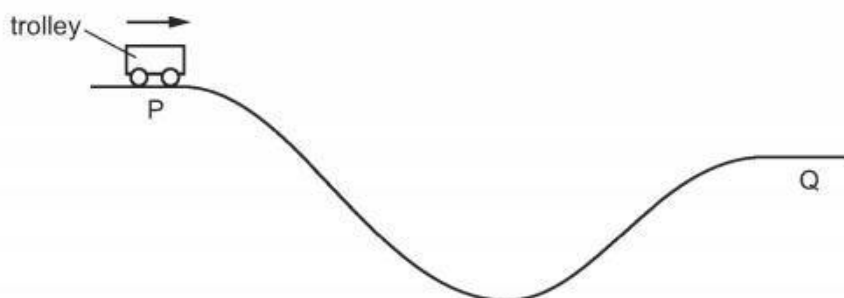
At which rate is its kinetic energy increasing?

- A 2.4 MW B 8.0 MW C 12 MW D 20 MW



85 - (9702/11_Winter_2020_Q15) - Work, Energy & Power

A trolley runs from P to Q along a track. At Q its potential energy is 50 kJ less than at P.



At P, the kinetic energy of the trolley is 5 kJ. Between P and Q, the trolley does 10 kJ of work against friction.

What is the kinetic energy of the trolley at Q?

- A 35 kJ B 45 kJ C 55 kJ D 65 kJ

86 - (9702/11_Winter_2020_Q16) - Work, Energy & Power

A hydroelectric power station uses the gravitational potential energy of water to generate electrical energy.

In one particular power station, the mass of water flowing per unit time is $1.5 \times 10^5 \text{ kg s}^{-1}$. The water falls through a vertical height of 120 m.

The electrical power generated is 100 MW.

What is the efficiency of the power station?

- A 5.6% B 43% C 57% D 77%

87 - (9702/12_Winter_2020_Q16) - Work, Energy & Power

A ball is thrown vertically upwards. Air resistance is negligible.

Which statement is correct?

- A By the principle of conservation of energy, the total energy of the ball is constant throughout its motion.
B By the principle of conservation of momentum, the momentum of the ball is constant throughout its motion.
C The kinetic energy of the ball is greatest at the greatest height attained.
D The potential energy of the ball increases at a constant rate during its ascent.



88 - (9702/13_Winter_2020_Q16) - Work, Energy & Power

A ball drops onto a horizontal surface and bounces elastically.

What happens to the kinetic energy of the ball during the very short time that it is in contact with the surface?

- A Most of the kinetic energy is lost as heat and sound.
- B The kinetic energy decreases to zero and then returns to its original value.
- C The kinetic energy remains constant because it is an elastic collision.
- D The kinetic energy remains constant in magnitude but changes direction.

89 - (9702/11_Winter_2020_Q17) - Work, Energy & Power

Which amount of energy is **not** 2400 J?

- A the decrease in gravitational potential energy of a mass of 60 kg when it moves vertically downwards through 40 m near the Earth's surface
- B the energy transferred in 15 s by a machine of power 160 W
- C the kinetic energy of a mass of 12 kg moving at a speed of 20 m s^{-1}
- D the work done by a gas expanding against a constant external pressure of 120 kPa when its volume increases by 0.020 m^3

90 - (9702/12_Winter_2020_Q17) - Work, Energy & Power

A hammer with 10 J of kinetic energy hits a nail and pushes it 5.0 mm into a plank.

Both the hammer and nail come to rest after the collision.

What is the approximate average force that acts on the nail while it moves through 5.0 mm?

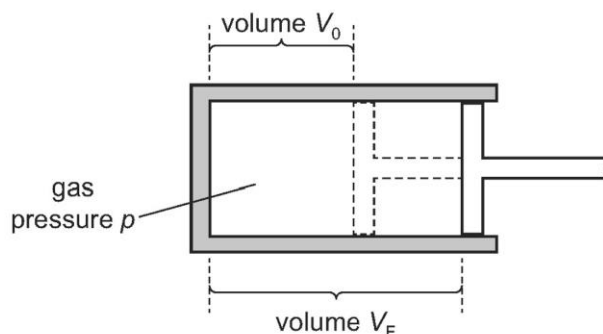
- A 0.050 N B 2.0 N C 50 N D 2000 N



91 - (9702/13_Winter_2020_Q17) - Work, Energy & Power

Some gas in a cylinder is supplied with thermal energy q .

The gas does useful work in expanding at constant pressure p from volume V_0 to volume V_F , as shown.



Which expression gives the efficiency of this process?

- A $\frac{pV_0}{q}$ B $\frac{V_F}{V_0q}$ C $\frac{p(V_F - V_0)}{q}$ D $\frac{(V_F - V_0)}{V_0q}$

92 - (9702/11_Winter_2020_Q18) - Work, Energy & Power

A train of mass $300\,000\text{ kg}$ is accelerating at 0.80 ms^{-2} . At one instant, the speed of the train is 5.0 ms^{-1} and the resistive force to its motion is 15 kN .

At this instant, what is the rate of increase of kinetic energy of the train?

- A 0.075 MW B 1.2 MW C 1.3 MW D 3.8 MW

93 - (9702/12_Winter_2020_Q18) - Work, Energy & Power

The change in gravitational potential energy ΔE of an object of mass m when moving through height Δh near the surface of the Earth is given by the equation shown.

$$\Delta E = mg\Delta h$$

Which equation is needed as part of the derivation of this expression?

- A kinetic energy = $\frac{1}{2} \times \text{mass} \times (\text{speed})^2$
B moment = force $\times$ distance
C weight = mass $\times$ acceleration of free fall
D work done = power $\times$ time



94 - (9702/13_Winter_2020_Q18) - Work, Energy & Power

An object of mass 0.30 kg is thrown vertically upwards from the ground with an initial velocity of 8.0 m s^{-1} . The object reaches a maximum height of 1.9 m.

How much work is done against air resistance as the object rises to its maximum height?

- A 4.0 J B 5.6 J C 9.6 J D 15 J

95 - (9702/12_Winter_2020_Q19) - Work, Energy & Power

A racing car has an output power of 300 kW when travelling at a constant speed of 60 m s^{-1} .

What is the total resistive force acting on the car?

- A 5 kN B 10 kN C 50 kN D 100 kN

96 - (9702/13_Winter_2020_Q19) - Work, Energy & Power

A water pump raises a mass of $27 \times 10^3 \text{ kg}$ of water through a vertical distance of 80 m in a time of 1.0 hour.

What is the average useful output power of the pump?

- A 0.60 kW B 5.9 kW C 36 kW D 350 kW

97 - (9702/13_Summer_2021_Q1) - Work, Energy & Power

What is a reasonable estimate of the kinetic energy of an Olympic athlete sprinting in a 100 m race?

- A 40 J B 400 J C 4000 J D 40 000 J

98 - (9702/11_Summer_2021_Q15) - Work, Energy & Power

A rocket is fired upwards.

As it accelerates upwards after leaving the launch pad, which forms of energy are changing?

- A chemical energy, gravitational potential energy and kinetic energy
B chemical energy and gravitational potential energy only
C chemical energy and kinetic energy only
D gravitational potential energy and kinetic energy only



99 - (9702/12_Summer_2021_Q15) - Work, Energy & Power

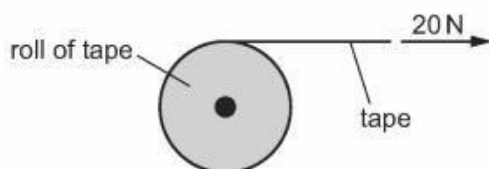
A stone is falling vertically through the air at a constant (terminal) velocity.

Which energy change is occurring?

- A gravitational potential energy to thermal energy
- B gravitational potential energy to kinetic energy of the stone
- C kinetic energy to gravitational potential energy of the stone
- D kinetic energy of the stone to thermal energy

100 - (9702/11_Summer_2021_Q16) - Work, Energy & Power

A roll of tape of length 50 m requires a constant force of 20 N to unwrap it.

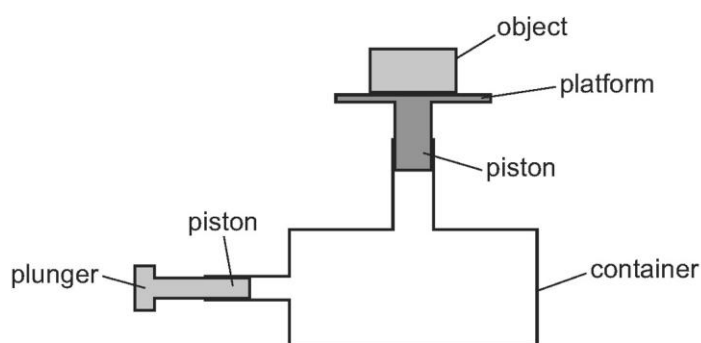


What is the work done in unwrapping the whole roll?

- A 0.4 J B 2.5 J C 500 J D 1000 J

101 - (9702/12_Summer_2021_Q16) - Work, Energy & Power

An object of weight 12 N rests on a platform on top of a container with two pistons, as shown. The container contains a fixed mass of gas, and the pistons are free to move.



The plunger is slowly pushed 4.0 cm to the right. As a result, the object slowly moves upwards a distance 0.50 cm.

How much work is done on the object?

- A 0.060 J B 0.48 J C 6.0 J D 48 J



102 - (9702/13_Summer_2021_Q16) - Work, Energy & Power

A spring is initially neither compressed nor extended.

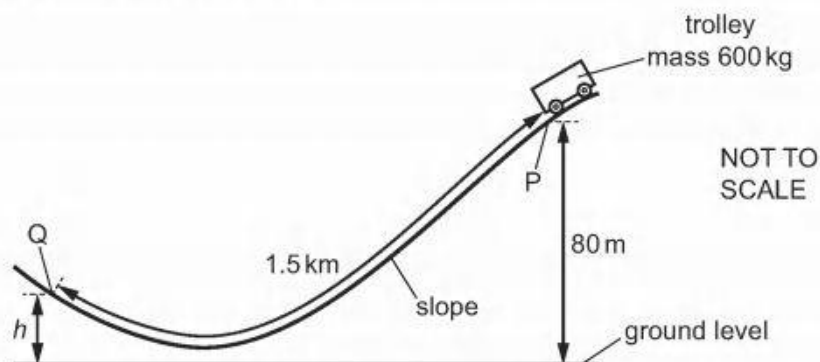
A force can be applied to this spring so that it is either compressed to a shorter length or extended to a longer length.

What is the change in the elastic potential energy in the spring when it is extended and when it is compressed?

	change in the elastic potential energy	
	spring is extended	spring is compressed
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

103 - (9702/11_Summer_2021_Q17) - Work, Energy & Power

A trolley of mass 600 kg is initially at point P on a slope, at a height of 80 m above ground level, as shown. The trolley is released from rest and moves along the slope, first coming to rest at point Q, at height h above ground level.



The total distance PQ moved by the trolley along the slope is 1.5 km. A constant resistive force of 300 N opposes the motion of the trolley on the slope.

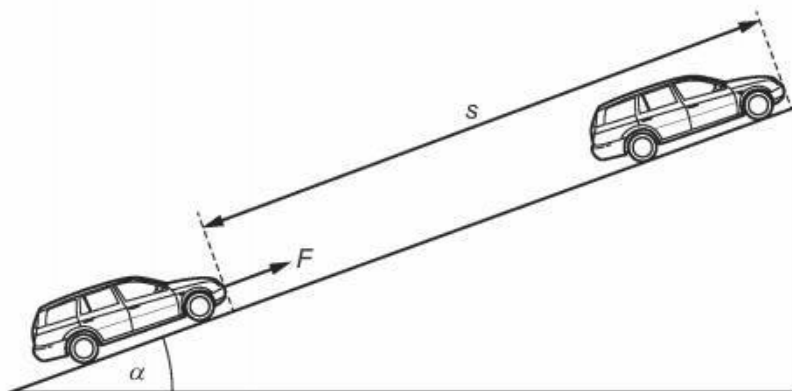
What is h ?

- A 3.5 m B 76 m C 79 m D 80 m



104 - (9702/12_Summer_2021_Q17) - Work, Energy & Power

A constant force F , acting on a car of mass m , moves the car up a slope through a distance s at constant velocity v . The angle of the slope to the horizontal is α .



The acceleration of free fall is g .

What is the ratio $\frac{\text{gravitational potential energy gained by car}}{\text{work done by force } F}$?

- A $\frac{mgs \sin \alpha}{Fv}$ B $\frac{mv}{Fs}$ C $\frac{mv^2}{2Fs}$ D $\frac{mg \sin \alpha}{F}$

105 - (9702/13_Summer_2021_Q17) - Work, Energy & Power

A sample of gas is sealed in a cylinder by a piston. The frictionless piston is free to move, so that the pressure of the gas remains constant at $1.80 \times 10^5 \text{ Pa}$.

The gas initially occupies a volume of $2.40 \times 10^{-4} \text{ m}^3$.

The gas now does 14.4 J of work.

What is the volume of the gas after doing this work?

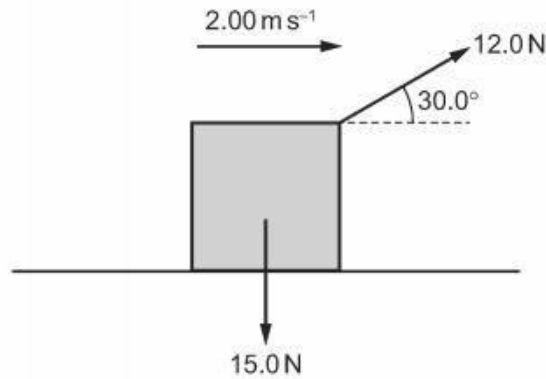
- A $0.80 \times 10^{-4} \text{ m}^3$
B $1.60 \times 10^{-4} \text{ m}^3$
C $3.20 \times 10^{-4} \text{ m}^3$
D $4.00 \times 10^{-4} \text{ m}^3$



106 - (9702/11_Summer_2021_Q18) - Work, Energy & Power

An object of weight 15.0 N is pulled along a horizontal surface at a constant velocity of 2.00 m s^{-1} .

The force pulling the object is 12.0 N at 30.0° to the horizontal, as shown.



What is the power used to move the object?

- A 12.0 W B 20.8 W C 24.0 W D 30.0 W

107 - (9702/12_Summer_2021_Q18) - Work, Energy & Power

What is the definition of power?

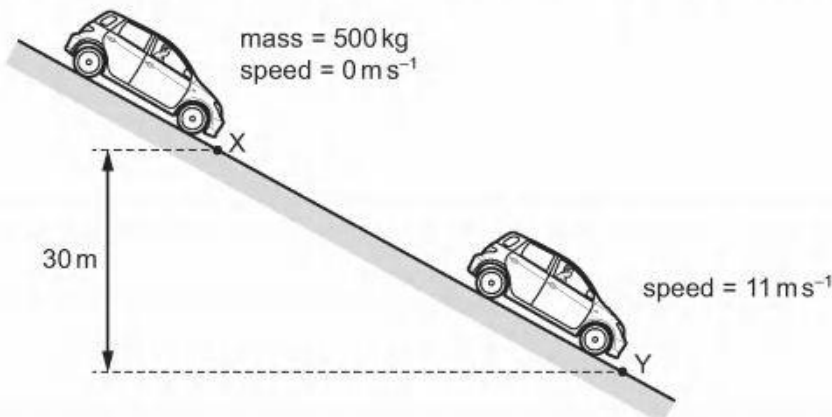
- A Power is the product of force and velocity.
B Power is the product of force and work done per unit time.
C Power is the product of force per unit time and velocity.
D Power is the rate at which work is done.



108 - (9702/13_Summer_2021_Q18) - Work, Energy & Power

A car of mass 500 kg is at rest at point X on a slope, as shown.

The car's brakes are released and the car rolls down the slope with its engine switched off. At point Y the car has moved through a vertical height of 30 m and has a speed of 11 m s^{-1} .



What is the energy dissipated by frictional forces when the car moves from X to Y?

- A $3.0 \times 10^4 \text{ J}$ B $1.2 \times 10^5 \text{ J}$ C $1.5 \times 10^5 \text{ J}$ D $1.8 \times 10^5 \text{ J}$

109 - (9702/13_Summer_2021_Q19) - Work, Energy & Power

Which expression **cannot** be used to calculate power?

- A $\frac{\text{force} \times \text{displacement}}{\text{time}}$
B force $\times$ velocity
C $\frac{\text{work done}}{\text{time}}$
D work done $\times$ velocity

110 - (9702/11_Winter_2021_Q15) - Work, Energy & Power

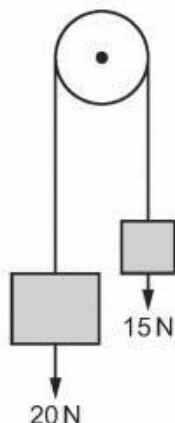
Which statement about energy is **not** correct?

- A Energy is never lost but it may be transferred between different forms.
B In an inelastic collision, the total energy is constant.
C The efficiency of a system is the ratio of the useful energy output to the total energy input.
D When a machine does work, friction reduces the total energy.



111 - (9702/11_Winter_2021_Q16) - Work, Energy & Power

A pulley of radius 0.40 m supports weights of 20 N and 15 N by means of a thin string, as shown.



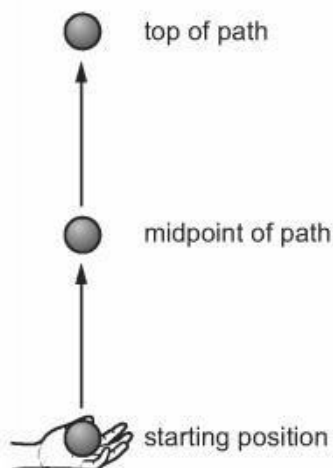
The weights are moved by slowly rotating the pulley clockwise through an angle of 60° .

What is the increase in the total gravitational potential energy of the weights?

- A 0.33 J B 2.0 J C 2.1 J D 15 J

112 - (9702/12_Winter_2021_Q16) - Work, Energy & Power

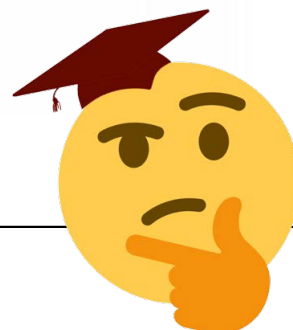
A ball is thrown vertically upwards into the air. It rises to the top of its path before beginning to fall vertically downwards.



Assume that the gravitational potential energy of the ball is zero at its starting position.

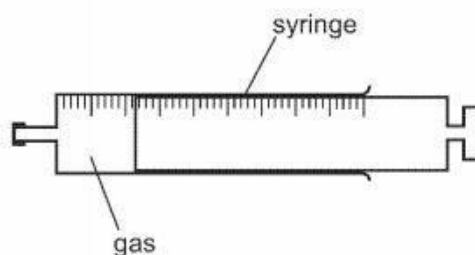
Which statement about the ball is **not** correct?

- A As it rises, its kinetic energy is transferred to gravitational potential energy.
B At the midpoint of its path, its gravitational potential energy is equal to its initial kinetic energy.
C At the top of its path, its kinetic energy is zero.
D At the top of its path, its total energy is less than its initial total energy.



113 - (9702/13_Winter_2021_Q16) - Work, Energy & Power

A gas is contained inside a syringe, as shown.



The initial volume of the gas is 2.00 cm^3 .

Atmospheric pressure is 101 kPa .

What is the work done by the gas on the atmosphere when the gas is heated and expands to a volume of 6.00 cm^3 ?

- A $404 \mu\text{J}$ B 404 mJ C 404 J D 404 kJ

114 - (9702/11_Winter_2021_Q17) - Work, Energy & Power

A car of mass 1500 kg accelerates from an initial speed of 15 m s^{-1} . This acceleration causes the car to gain $3.0 \times 10^5 \text{ J}$ of kinetic energy.

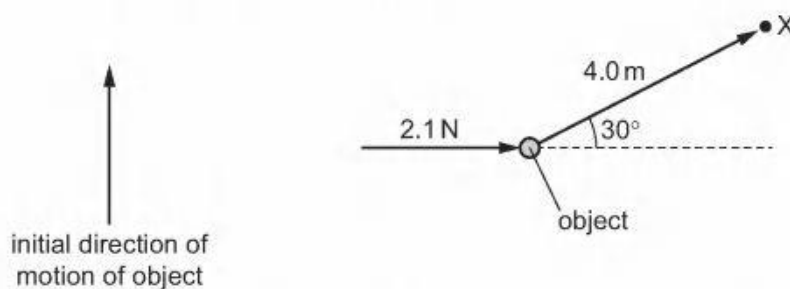
What is the change in the speed of the car?

- A 5.4 m s^{-1} B 10 m s^{-1} C 20 m s^{-1} D 25 m s^{-1}

115 - (9702/12_Winter_2021_Q17) - Work, Energy & Power

An object slides with constant velocity across a horizontal sheet of ice. Friction is negligible.

A constant horizontal force of 2.1 N is then applied to the object as shown.



A short time after applying the force, the object reaches point X at a displacement of 4.0 m from its position when the force was first applied.

What is the work done by the force on the object as it travels to point X?

- A 4.2 J B 4.8 J C 7.3 J D 8.4 J



116 - (9702/13_Winter_2021_Q17) - Work, Energy & Power

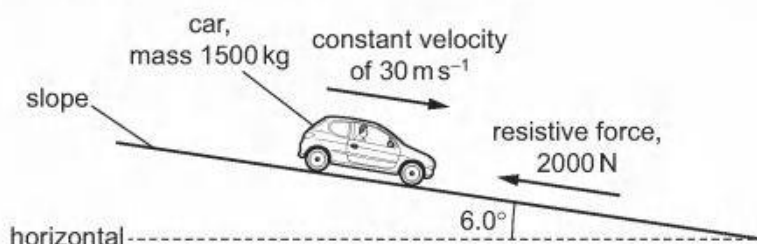
A mechanical device does useful work at rate X and wastes energy at rate Y .

Which expression gives the efficiency of this device?

- A $\frac{X}{Y}$ B $\frac{(X - Y)}{Y}$ C $\frac{X}{(X + Y)}$ D $\frac{(X - Y)}{(X + Y)}$

117 - (9702/11_Winter_2021_Q18) - Work, Energy & Power

A car of mass 1500 kg travels at a constant velocity of 30 m s^{-1} down a slope. The slope is at an angle of 6.0° to the horizontal, as shown.



The magnitude of the total resistive force acting on the car is 2000 N.

What is the power output of the car's engine?

- A 14 kW B 60 kW C 110 kW D 380 kW

118 - (9702/12_Winter_2021_Q18) - Work, Energy & Power

The energy conversions inside a power station burning fossil fuel can be simplified as shown.

chemical energy $W \rightarrow$ thermal energy $X \rightarrow$ electrical energy Y

Which expression gives the efficiency of the power station?

- A $\frac{Y}{W}$ B $\frac{Y}{(W + X)}$ C $\frac{Y}{X}$ D $\frac{Y}{(W + X + Y)}$

119 - (9702/13_Winter_2021_Q18) - Work, Energy & Power

Car P has kinetic energy 240 kJ.

Car Q has half the mass and twice the speed of car P.

What is the kinetic energy of car Q?

- A 120 kJ B 240 kJ C 480 kJ D 960 kJ



120 - (9702/11_Winter_2021_Q19) - Work, Energy & Power

A metal wire, of cross-sectional area A and unstretched length l , is subjected to stress σ . As a result it has strain ϵ .

Which expression gives the Young modulus of the metal?

- A $\frac{\epsilon}{\sigma}$ B $\frac{\epsilon A}{\sigma l}$ C $\frac{\sigma}{\epsilon}$ D $\frac{\sigma l}{\epsilon A}$

121 - (9702/12_Winter_2021_Q19) - Work, Energy & Power

Car X is travelling at half the speed of car Y. Car X has twice the mass of car Y.

Which statement is correct?

- A Car X has half the kinetic energy of car Y.
B Car X has one quarter of the kinetic energy of car Y.
C Car X has twice the kinetic energy of car Y.
D The two cars have the same kinetic energy.

122 - (9702/13_Winter_2021_Q19) - Work, Energy & Power

A water pump is driven by an engine. The pump raises a volume of 0.50 m^3 of water in 1.0 minute from a depth of 30 m. The pump has an efficiency of 70%.

The density of water is 1000 kg m^{-3} .

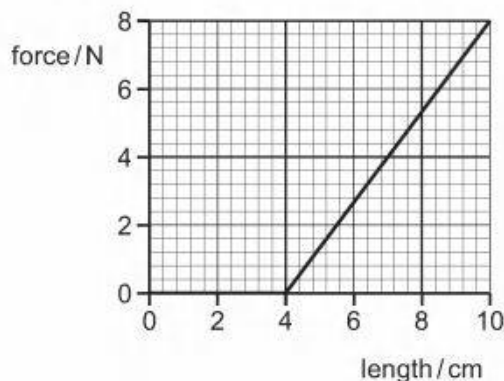
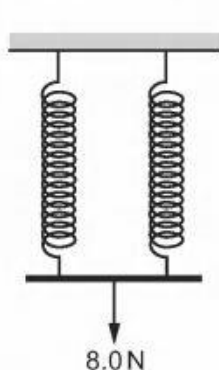
What is the useful output power from the engine?

- A 2.5 kW B 3.5 kW C 150 kW D 210 kW

123 - (9702/11_Winter_2021_Q20) - Work, Energy & Power

Two identical springs are connected in parallel.

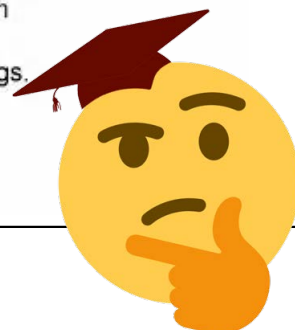
A weight of 8.0 N is hung from the combination, as shown.



The graph shows the variation with length of the force applied to **one** of the springs.

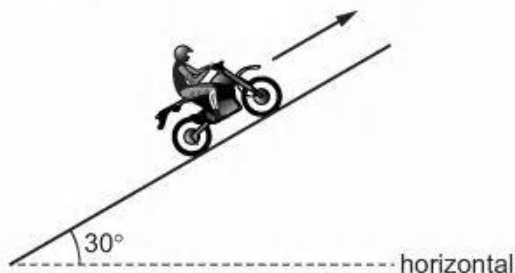
What is the strain energy in **one** of the springs?

- A 0.060 J B 0.12 J C 0.14 J D 0.24 J



124 - (9702/12_Winter_2021_Q20) - Work, Energy & Power

The total weight of a motorbike and rider is 1800 N. The motorbike travels in a straight line at constant speed up a hill at an angle of 30° to the horizontal.



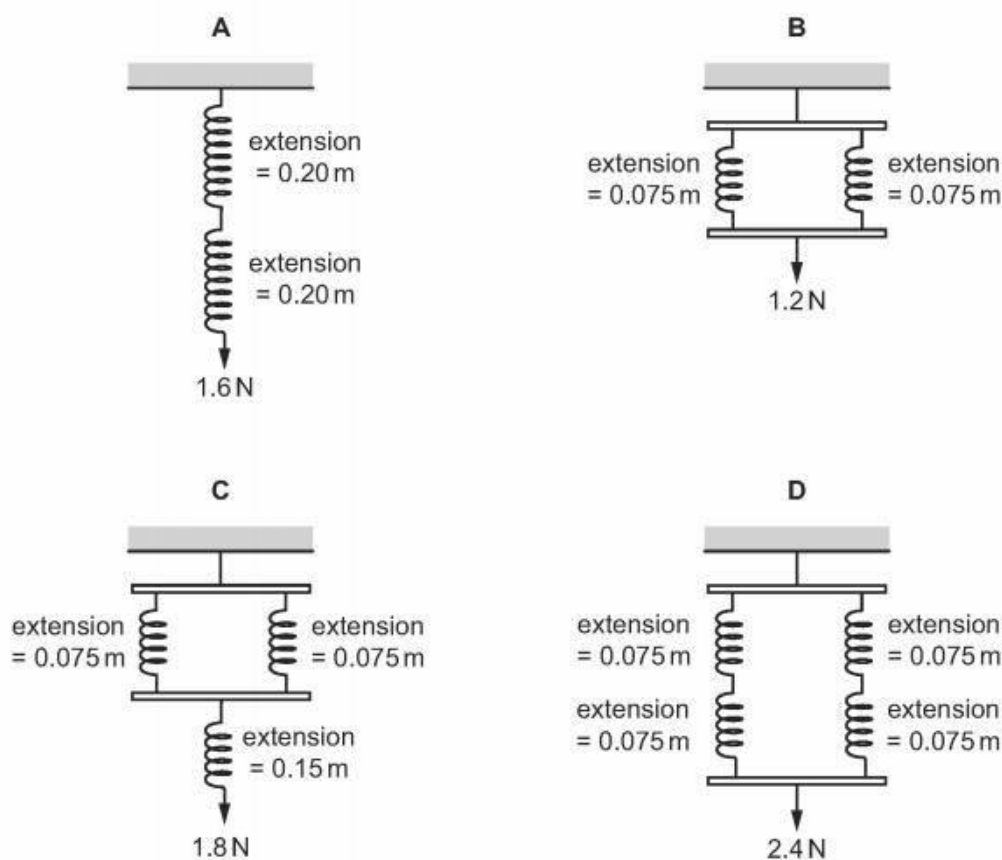
The useful output power of the motorbike is 36 000 W. The total resistive force due to air resistance and friction on the motorbike and rider is 2400 N.

What is the speed of the motorbike?

- A 8.6 ms^{-1} B 11 ms^{-1} C 15 ms^{-1} D 24 ms^{-1}

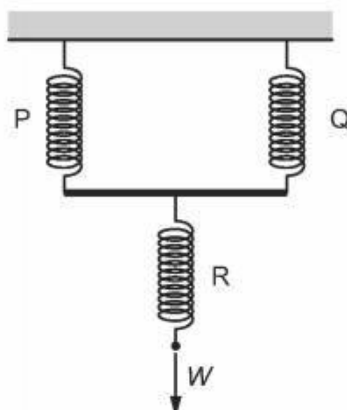
125 - (9702/13_Winter_2021_Q20) - Work, Energy & Power

Which spring combination has an overall spring constant of 8.0 N m^{-1} ?



126 - (9702/12_Winter_2021_Q21) - Work, Energy & Power

Three springs are arranged vertically as shown.



Springs P and Q are identical and each has spring constant k . Spring R has spring constant $3k$.

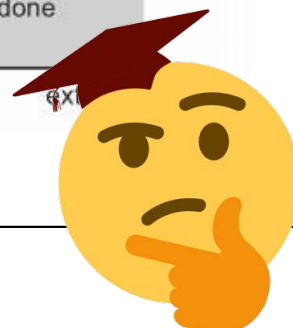
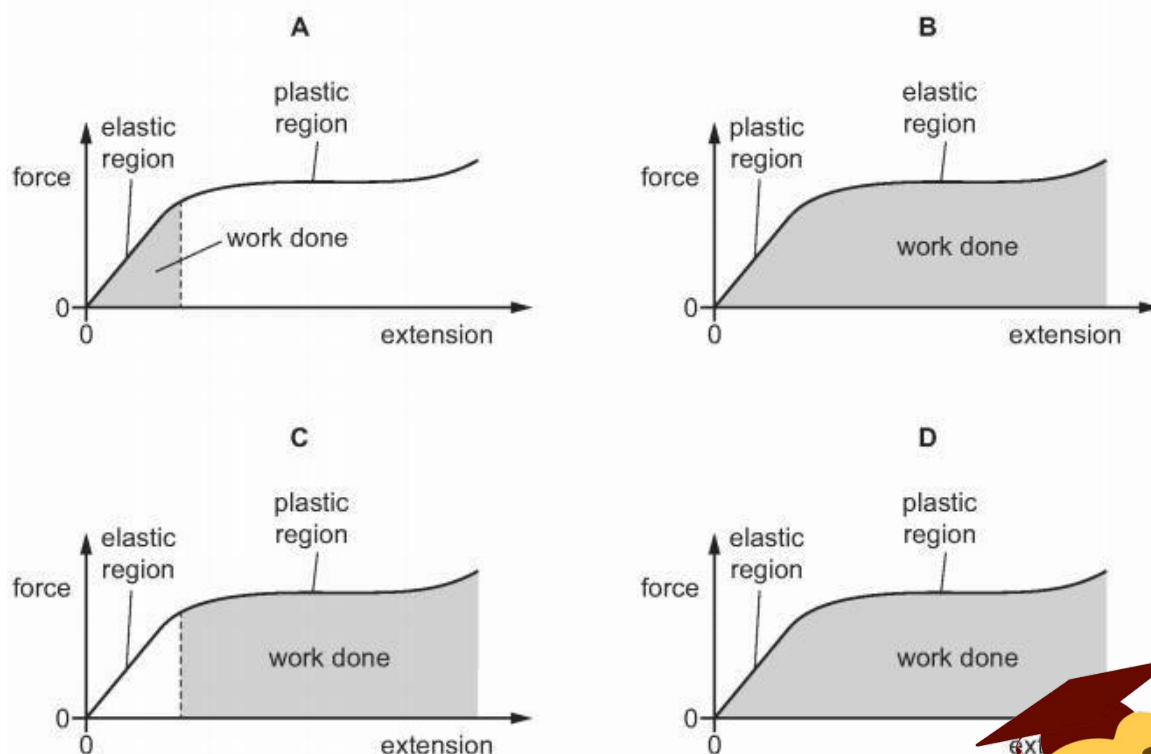
What is the increase in the overall length of the arrangement when a force W is applied as shown?

- A $\frac{5W}{6k}$ B $\frac{4W}{3k}$ C $\frac{7}{2}kW$ D $4kW$

127 - (9702/13_Winter_2021_Q21) - Work, Energy & Power

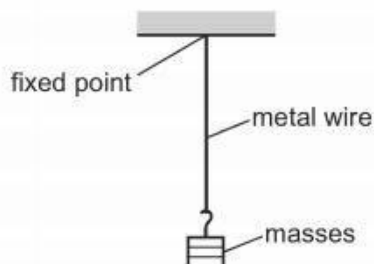
A metal wire is stretched to breaking point and the force-extension graph is plotted.

Which graph is correctly labelled with the elastic region, the plastic region and the area representing the work done to stretch the wire until it breaks?

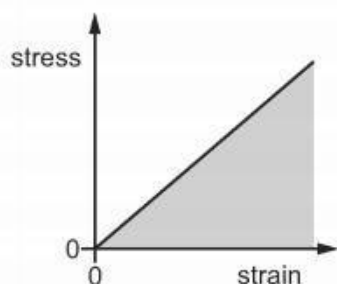


128 - (9702/12_Winter_2021_Q22) - Work, Energy & Power

A length of metal wire is attached to a fixed point and hangs vertically. Masses are then suspended from the wire. Assume that the cross-sectional area of the wire remains constant.



A stress–strain graph for the wire is plotted, as shown.



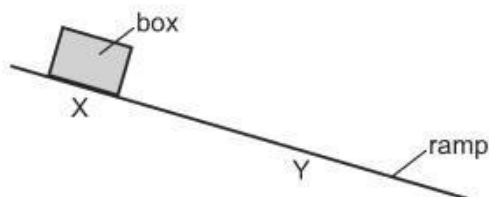
What is represented by the shaded area under the graph?

- A strain energy in the wire
- B $\frac{\text{strain energy in the wire}}{\text{cross-sectional area of the wire}}$
- C $\frac{\text{strain energy in the wire}}{\text{original length of the wire}}$
- D $\frac{\text{strain energy in the wire}}{\text{original volume of the wire}}$

129 - (9702/11_Summer_2022_Q16) - Work, Energy & Power

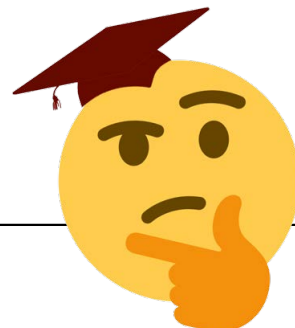
A box slides down a rough ramp.

The change in the gravitational potential energy of the box is 16 J as it moves between positions X and Y. The box has 24 J of kinetic energy at X and 35 J of kinetic energy at Y.



How much work is done against the frictional force?

- A 5 J
- B 19 J
- C 27 J
- D 43 J



130 - (9702/12_Summer_2022_Q16) - Work, Energy & Power

Which product of two quantities is equal to power?

- A force $\times$ distance
- B force $\times$ velocity
- C work done $\times$ time
- D work done $\times$ velocity

131 - (9702/11_Summer_2022_Q17) - Work, Energy & Power

The total energy supplied to an electric motor is E . Energy Q is wasted and the remaining energy does useful work.

What is the efficiency of the motor?

- A $\frac{Q}{E}$
- B $\left(\frac{Q}{E}\right) - 1$
- C $1 - \left(\frac{Q}{E}\right)$
- D $\frac{(1-Q)}{E}$

132 - (9702/12_Summer_2022_Q17) - Work, Energy & Power

Researchers have developed a new type of filament lamp with an efficiency of 40%. Old-type filament lamps have an efficiency of 5.0%. The two types of lamp produce the same useful output power.

What is the ratio $\frac{\text{input power to new type of lamp}}{\text{input power to old type of lamp}}$?

- A 0.13
- B 0.63
- C 1.6
- D 8.0

133 - (9702/13_Summer_2022_Q17) - Work, Energy & Power

What is meant by the efficiency of a system?

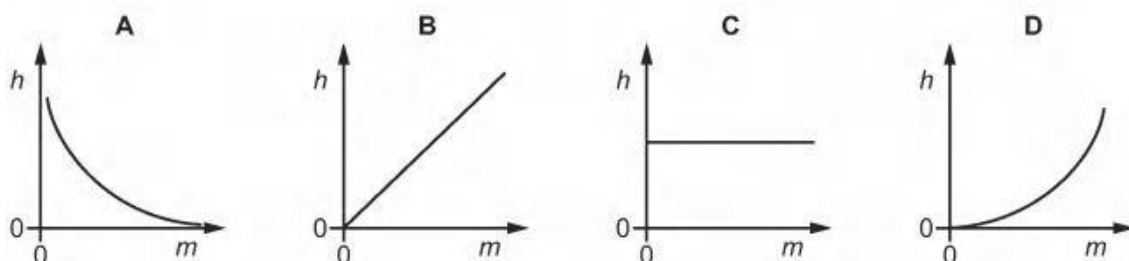
- A the difference between the useful energy output from the system and the total energy input
- B the difference between the useful energy output from the system and the wasted energy output
- C the ratio of the useful energy output from the system to the total energy input
- D the ratio of the useful energy output from the system to the wasted energy output



134 - (9702/11_Summer_2022_Q18) - Work, Energy & Power

Objects with different masses are placed on the horizontal surface of a table. The objects are then raised to different heights above the table. The gain in gravitational potential energy of each object is the same.

Which graph best shows the variation of the height h of the objects above the table with their mass m ?



135 - (9702/12_Summer_2022_Q18) - Work, Energy & Power

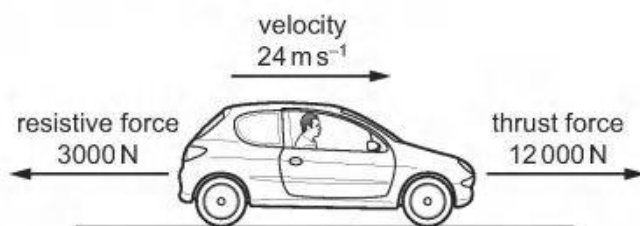
A student attempts to derive the formula for kinetic energy E_k . She begins by considering an object of mass m which is initially at rest. A constant force F applied to the object causes it to accelerate to final velocity v in displacement s . The kinetic energy gained by the object is equal to the work done on the object by the force F .

Which equation would the student **not** need in order to derive the formula for E_k ?

- A $F = ma$ B $W = Fs$ C $E = \frac{1}{2}Fs$ D $v^2 = u^2 + 2as$

136 - (9702/13_Summer_2022_Q18) - Work, Energy & Power

A car of weight 15 000 N is travelling along a horizontal road.



At one instant, the thrust force acting on the car from the engine is 12 000 N and the resistive force acting on the car is 3000 N. The velocity of the car at this instant is 24 m s^{-1} .

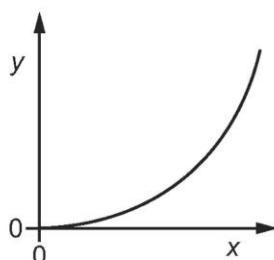
What is the power output from the engine?

- A 72 kW B 220 kW C 290 kW D 360 kW



137 - (9702/13_Summer_2022_Q19) - Work, Energy & Power

The diagram shows the variation of a quantity y with a quantity x for objects in a uniform gravitational field.



What could x and y represent?

	x	y
A	mass for different objects moving at the same speed	kinetic energy
B	speed for an object of constant mass	kinetic energy
C	vertical distance fallen for an object of constant mass	change of gravitational potential energy
D	mass for different objects falling the same vertical distance	change of gravitational potential energy

138 - (9702/13_Winter_2022_Q16) - Work, Energy & Power

Which expression could be used to calculate power?

- A $\frac{(\text{current})^2}{\text{resistance}}$
- B $\frac{\text{force} \times \text{displacement}}{\text{time}}$
- C $\text{current} \times (\text{resistance})^2$
- D $\frac{\text{weight}}{\text{time}}$

139 - (9702/11_Winter_2022_Q17) - Work, Energy & Power

A man of mass 75 kg runs up a staircase consisting of 30 steps. Each step is 20 cm high.

The man takes a time of 7.0 s to run from the bottom of the staircase to the top.

What is the average rate of increase of gravitational potential energy of the man?

- A 64 W B 450 W C 630 W D 4400 W



140 - (9702/12_Winter_2022_Q17) - Work, Energy & Power

A motor is used to lift a load vertically upwards.

The load has weight W .

The motor produces useful power output P .

The load is lifted at constant velocity v .

Which expression gives the time taken for the motor to lift the load vertically upwards through a distance d ?

A $\frac{P}{Wd}$

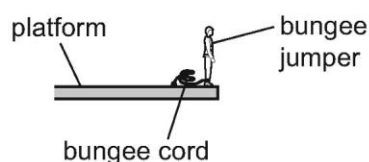
B $\frac{Wv}{P}$

C $\frac{Wd}{P}$

D $\frac{Pv}{W}$

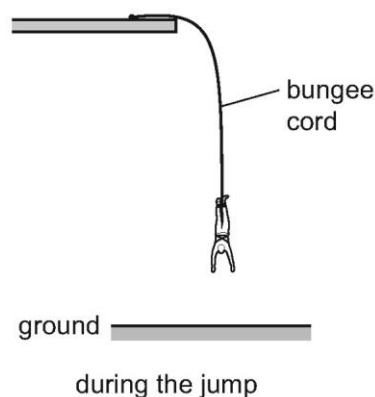
141 - (9702/13_Winter_2022_Q17) - Work, Energy & Power

A bungee jumper jumps from a platform and is decelerated by an elastic bungee cord, as shown.



ground 
before jumping

NOT TO
SCALE



ground 
during the jump

When the jumper makes the jump, his initial gravitational potential energy is converted into his kinetic energy and into elastic potential energy in the cord.

At which part of the jump are all three types of energy non-zero?

- A on the platform before the jump
- B on the way down before the cord has started to extend
- C on the way down as he decelerates
- D at the bottom of the jump when he is stationary



142 - (9702/11_Winter_2022_Q18) - Work, Energy & Power

An alpha-particle has $2.2 \times 10^{-13} \text{ J}$ of kinetic energy.

What is the speed of the alpha-particle?

- A $4.1 \times 10^6 \text{ m s}^{-1}$
- B $5.8 \times 10^6 \text{ m s}^{-1}$
- C $8.1 \times 10^6 \text{ m s}^{-1}$
- D $1.2 \times 10^7 \text{ m s}^{-1}$

143 - (9702/12_Winter_2022_Q18) - Work, Energy & Power

A lamp is switched on for 2.0 hours. The power input to the lamp is 1.0 W. The energy given out by the lamp as light is $7.0 \times 10^3 \text{ J}$.

How much energy is converted to other forms by the lamp?

- A 120 J
- B 200 J
- C 3400 J
- D 7200 J

144 - (9702/13_Winter_2022_Q18) - Work, Energy & Power

An object is displaced horizontally to the right in a uniform vertical gravitational field.

Which statement describes the change in the gravitational potential energy of the object?

- A It decreases in direct proportion to the displacement.
- B It does not change with the displacement.
- C It increases in direct proportion to the displacement.
- D It increases in direct proportion to the square of the displacement.

145 - (9702/12_Winter_2022_Q19) - Work, Energy & Power

An object of mass m is dropped onto the surface of two planets, X and Y, which have no atmosphere.

The height from which the object is dropped and the change in gravitational potential energy of the object, for each planet, are given in the table.

	height / m	change in gravitational potential energy
planet X	3	ΔE
planet Y	4	$4\Delta E$

The acceleration of free fall near the surface of planet X is g_X .

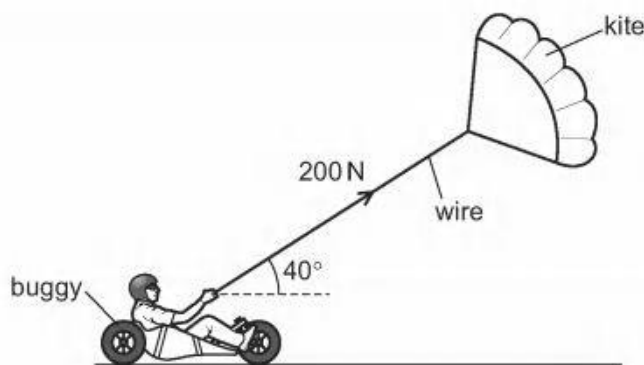
What is the acceleration of free fall near the surface of planet Y?

- A $\frac{3}{4}g_X$
- B $\frac{4}{3}g_X$
- C $3g_X$
- D $4g_X$



146 - (9702/11_Summer_2023_Q16) - Work, Energy & Power

A man sits on a buggy that is pulled along by a wire attached to a kite. The wire is at an angle of 40° to the horizontal and has a constant tension of 200 N. The man and buggy travel a distance of 20 m along a straight horizontal path. The wire and the path of the buggy are in the same vertical plane.



What is the work done by the tension force on the man and buggy?

- A 2.6 kJ B 3.1 kJ C 3.4 kJ D 4.0 kJ

147 - (9702/11_Summer_2023_Q17) - Work, Energy & Power

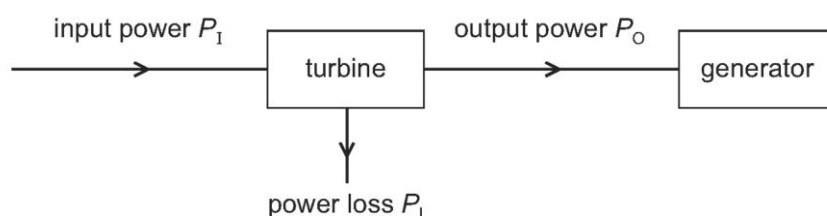
A ball is thrown vertically upwards from the surface of the Earth.

Which statement describes the energy of the ball as it rises through the air?

- A The kinetic energy of the ball decreases as the gravitational potential energy decreases.
B The kinetic energy of the ball decreases as the gravitational potential energy increases.
C The kinetic energy of the ball increases as the gravitational potential energy decreases.
D The total energy of the ball increases.

148 - (9702/12_Summer_2023_Q15) - Work, Energy & Power

A steam turbine is used to drive a generator. The input power to the turbine is P_I and the output power is P_O . The power loss in the turbine is P_L , as shown.



What is the efficiency of the turbine?

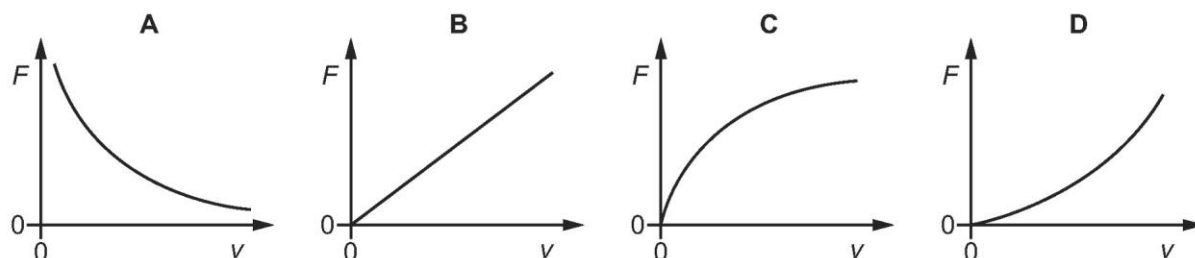
- A $\frac{P_L}{P_O}$ B $\frac{P_I}{P_O}$ C $\frac{P_L}{P_I}$ D $\frac{P_O}{P_I}$



149 - (9702/12_Summer_2023_Q16) - Work, Energy & Power

A variable force is applied to ensure that a constant power is supplied to a train.

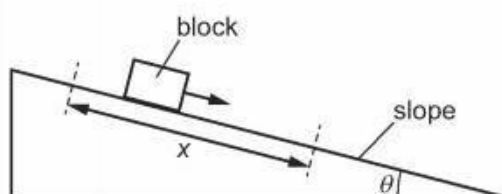
Which graph best shows the variation of the force F applied with the velocity v of the train?



150 - (9702/12_Summer_2023_Q17) - Work, Energy & Power

A block is released from rest and slides a distance x down a straight slope.

The slope is at an angle θ to the horizontal.



The slope is frictionless and air resistance is negligible.

The acceleration of free fall is g .

Which expression gives the final speed of the block?

- A $\sqrt{\frac{gx \sin \theta}{2}}$ B $\sqrt{2gx \sin \theta}$ C $\sqrt{2gx}$ D $2gx \sin \theta$

151 - (9702/13_Summer_2023_Q14) - Work, Energy & Power

An object is falling at a constant speed through a viscous liquid. F_U is the upthrust on the object due to the liquid. W_L is the weight of the liquid displaced by the object. W_O is the weight of the object.

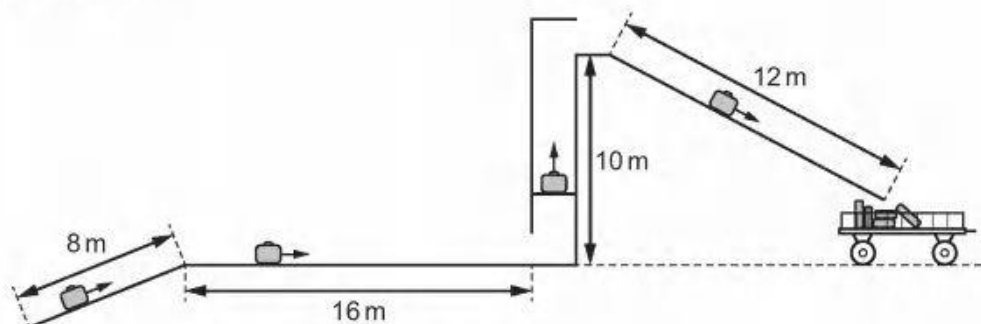
Which equation **must** be correct?

- A $F_U = W_L$
B $F_U = W_O - W_L$
C $F_U = W_O$
D $F_U = W_O + W_L$



152 - (9702/13_Summer_2023_Q15) - Work, Energy & Power

An airport has a mechanical system for moving luggage. The system uses a horizontal conveyor belt, a sloping conveyor belt, a lift and a frictionless slide. A suitcase is moved around the airport using this system.



Resistive forces opposing the motion of the suitcase are negligible.

For which movement of the suitcase is the net work done on the suitcase greatest?

- A moving the suitcase a distance of 8 m at a constant speed up the sloping conveyor belt
- B moving the suitcase a distance of 16 m at a constant speed along the horizontal conveyor belt
- C moving the suitcase a distance of 10 m at a constant speed vertically upwards on the lift
- D moving the suitcase a distance of 12 m at increasing speed downwards on the slide

153 - (9702/13_Summer_2023_Q16) - Work, Energy & Power

A car moves along a horizontal road with a constant velocity v against a resistive force F .

The engine of the car has an efficiency of 25%.

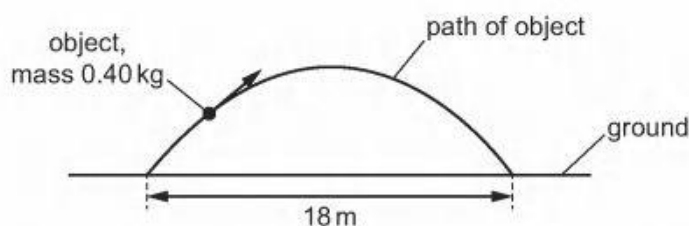
What is the input power to the engine?

- A $\frac{Fv}{4.0}$
- B $\frac{4.0}{Fv}$
- C $4.0Fv$
- D $\frac{4.0F}{v}$



154 - (9702/13_Summer_2023_Q17) - Work, Energy & Power

An object of mass 0.40 kg is projected into the air and follows a curved path above horizontal ground.



The object takes a time of 1.5 s to move along its path. The object lands a horizontal distance of 18 m from its initial position. Air resistance is negligible.

What is the kinetic energy of the object at its maximum height?

- A 0 J B 2.4 J C 11 J D 29 J

155 - (9702/11_Winter_2023_Q15) - Work, Energy & Power

A crate of mass 50 kg is pushed a distance of 6.0 m along a horizontal surface against a constant resistive force of 70 N. The crate moves at a constant speed. It is then lifted, at a constant speed, through a vertical distance of 1.2 m onto the back of a lorry.

What is the total work done in this process?

- A 420 J B 480 J C 590 J D 1000 J

156 - (9702/11_Winter_2023_Q16) - Work, Energy & Power

The input power to a television is P_{in} . The useful sound and light power emitted by the television is P_{out} .

What is the efficiency of the television?

- A $\frac{P_{\text{out}}}{P_{\text{in}}}$ B $\frac{P_{\text{in}} - P_{\text{out}}}{P_{\text{in}}}$ C $\frac{P_{\text{in}}}{P_{\text{out}}}$ D $\frac{P_{\text{out}}}{P_{\text{in}} - P_{\text{out}}}$

157 - (9702/11_Winter_2023_Q17) - Work, Energy & Power

A builder holding a brick of mass 3000 g drops the brick on his foot.

What is a reasonable estimate of the change in gravitational potential energy of the brick?

- A 30 J B 300 J C 3000 J D 30 000 J



158 - (9702/12_Winter_2023_Q15) - Work, Energy & Power

An electric car travels at a constant speed of 70 km h^{-1} for 80 km on a straight horizontal road and uses energy E from its battery.

The total resistive force acting on the car is proportional to $(\text{speed})^2$. Assume that the electric motor is 100% efficient.

How much energy is used from the battery when the car travels at a constant speed of 60 km h^{-1} for 80 km on the straight horizontal road?

- A $0.73E$ B $0.86E$ C $1.2E$ D $1.4E$

159 - (9702/12_Winter_2023_Q16) - Work, Energy & Power

What is meant by the efficiency of a system?

- A the total energy input to the system divided by the useful energy output by the system
B the useful energy output from the system divided by the energy wasted by the system
C the useful energy output from the system divided by the total energy input to the system
D the energy wasted by the system divided by the total energy input to the system

160 - (9702/12_Winter_2023_Q17) - Work, Energy & Power

When an object of mass m is raised through a vertical height Δh , the gain of its gravitational potential energy is ΔE_p .

ΔE_p and Δh are related by the equation

$$\Delta E_p = mg\Delta h,$$

where g is the acceleration of free fall.

The definition of which physical quantity is needed to derive this equation?

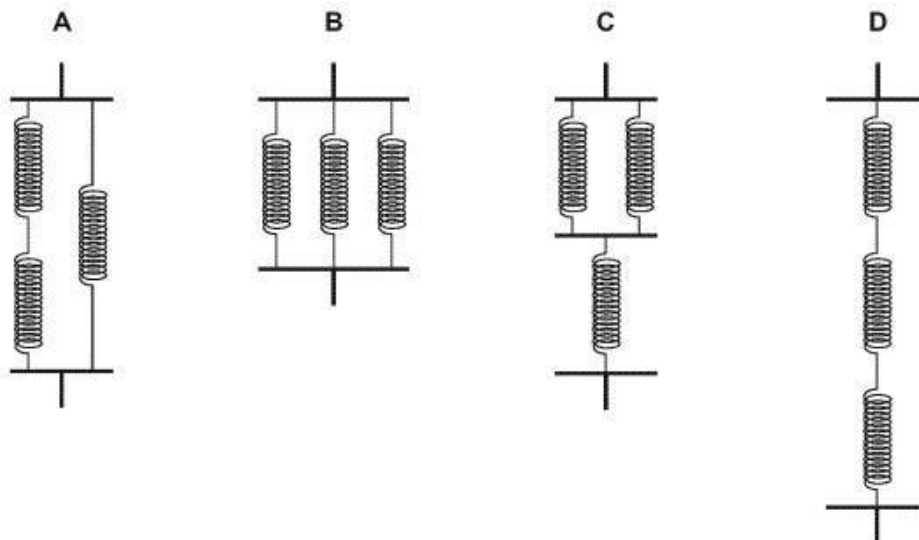
- A acceleration
B momentum
C power
D work done



161 - (9702/12_Winter_2023_Q18) - Work, Energy & Power

Three identical springs, each with the same spring constant, are connected together in four different arrangements, as shown.

Which arrangement has the largest combined spring constant?



162 - (9702/13_Winter_2023_Q16) - Work, Energy & Power

A system has a useful power output of 4.0 W and a wasted power of 16 W.

What is the efficiency of the system?

- A 5.0% B 20% C 25% D 80%

163 - (9702/13_Winter_2023_Q17) - Work, Energy & Power

A parachutist is falling towards the ground at a constant speed v . The rate at which she is losing gravitational potential energy is R .

The acceleration of free fall is g .

What is the mass of the parachutist?

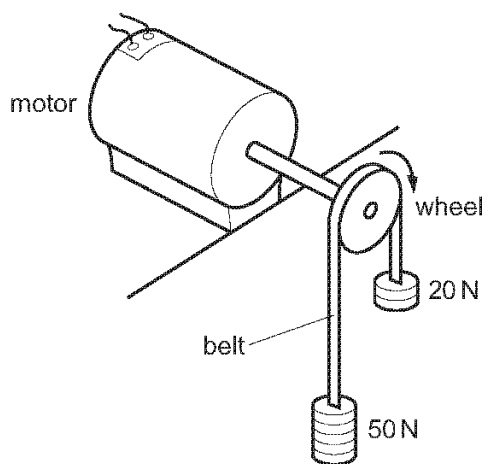
- A $\frac{gv}{R}$ B $\frac{R}{gv}$ C $\frac{2R}{v^2}$ D $\frac{v^2}{2R}$



1 - (9702/13_Winter_2017_Q19) - Dynamics, Motion In A Circle

The diagram shows an arrangement used to find the output power of an electric motor.

The wheel attached to the motor's axle has a circumference of 0.5 m and the belt which passes over it is stationary when the weights have the values shown.



When the wheel is making 20 revolutions per second, what is the output power of the motor?

- A 300 W B 500 W C 600 W D 700 W



1 - (9702/13_Summer_2017_Q18) - Deformation Of Solids

Two wires with the same Young modulus E and cross-sectional area A , but different lengths L , are subject to different tensile forces F . The extension e of each wire is the same.

The column headings in the table show four different quantities.

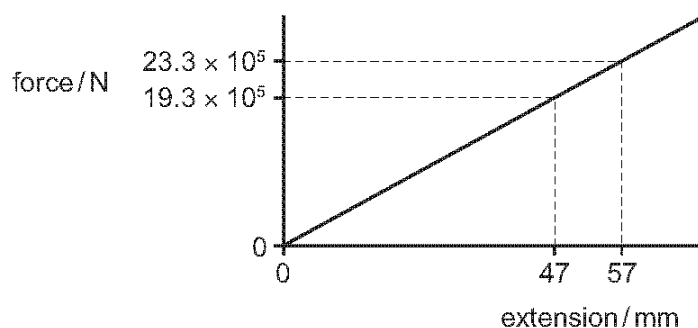
Which quantities have the same value and which quantities have different values for the two wires?

	$\frac{FL}{e}$	$\frac{Ae}{L}$	$\frac{E}{FL}$
A	different	different	same
B	different	same	same
C	same	different	different
D	same	different	same

2 - (9702/12_Summer_2017_Q19) - Deformation Of Solids

A cable on a suspension bridge supports a weight of $19.3 \times 10^5 \text{ N}$. This weight causes the cable to stretch by 47 mm.

A lorry crossing the bridge then increases the force on the cable to $23.3 \times 10^5 \text{ N}$. The force-extension graph for the cable is shown.



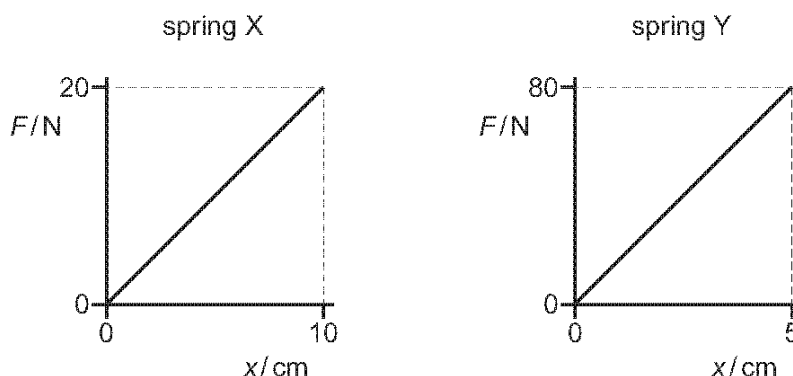
What is the **increase** in strain energy in the cable when the lorry is crossing the bridge?

- A** 21 kJ **B** 23 kJ **C** 45 kJ **D** 66 kJ



3 - (9702/13_Summer_2017_Q19) - Deformation Of Solids

Two springs X and Y stretch elastically. The graphs show the variation with extension x of the force F applied to each spring.



Which statement is correct?

- A** When each spring is given the same extension, the energy stored in Y is 4 times the energy stored in X.
- B** When each spring is given the same extension, the energy stored in Y is 8 times the energy stored in X.
- C** When the same force is applied to each spring, the energy stored in Y is 4 times the energy stored in X.
- D** When the same force is applied to each spring, the energy stored in Y is 8 times the energy stored in X.

4 - (9702/11_Summer_2017_Q20) - Deformation Of Solids

A wire of diameter d and length l hangs vertically from a fixed point. The wire is extended by hanging a mass M on its end. The Young modulus of the wire is E . The acceleration of free fall is g .

Which equation is used to determine the extension x of the wire?

- A** $x = \frac{Ml}{\pi d^2 E}$ **B** $x = \frac{Mgl}{\pi d^2 E}$ **C** $x = \frac{4Mgl}{\pi d E}$ **D** $x = \frac{4Mgl}{\pi d^2 E}$



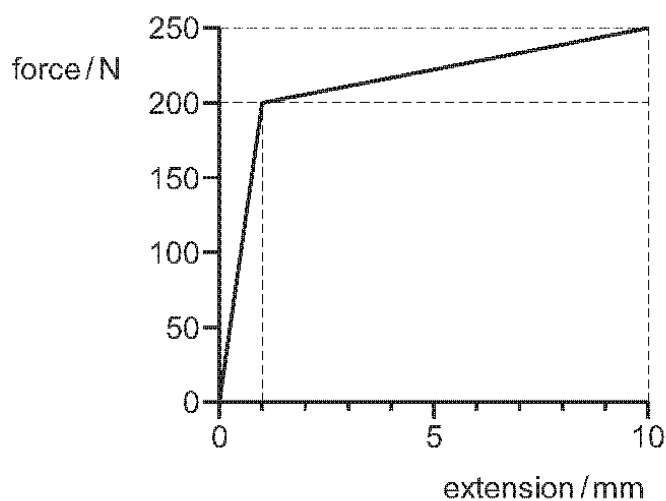
5 - (9702/12_Summer_2017_Q20) - Physical Quantities & Units, Deformation Of Solids

What are the units of stress, strain and the Young modulus?

	stress	strain	Young modulus
A	newton	metre	pascal
B	newton	no unit	newton
C	pascal	metre	newton
D	pascal	no unit	pascal

6 - (9702/13_Summer_2017_Q20) - Deformation Of Solids

The diagram shows the force-extension graph for a steel wire, up to its breaking point.



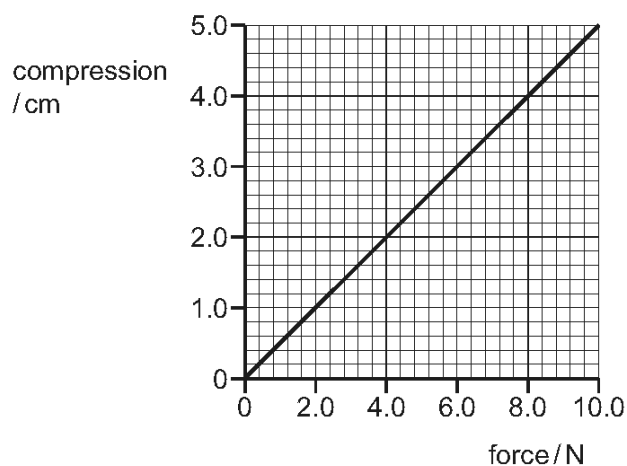
What is the best estimate of the work done to break the wire?

- A** 2.1 J **B** 2.3 J **C** 2.4 J **D** 2.5 J

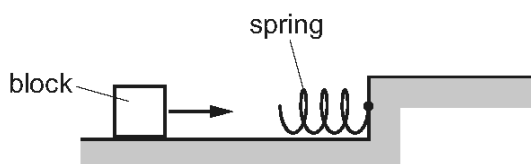


7 - (9702/11_Summer_2017_Q21) - Deformation Of Solids

The variation of the compression of a spring with the force applied to it is shown in the graph.



A block slides along a horizontal frictionless surface towards the spring, as shown.



The block is brought to rest by the spring. When the spring reaches a compression of 4.0 cm, all of the kinetic energy of the block is transferred to the elastic potential energy of the spring.

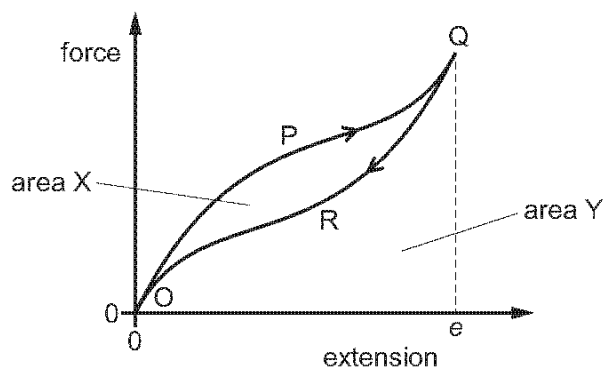
What is the kinetic energy of the block when it first makes contact with the spring?

- A 0.16 J B 0.32 J C 16 J D 32 J



8 - (9702/12_Summer_2017_Q21) - *Deformation Of Solids*

A rubber band is stretched and then relaxed to its original length. The diagram shows the force-extension graph for this process.



As the force is increased, the curve follows the path OPQ to extension e . As the force is reduced, the curve follows the path QRO to return to zero extension.

The area labelled X is between the curves OPQ and QRO. The area labelled Y is bounded by the curve QRO and the horizontal axis.

Which statement about the process is correct?

- A** Area X is the energy which heats the band as it is stretched to extension e .
- B** (Area X + area Y) is the minimum energy required to stretch the band to extension e .
- C** Area X is the elastic potential energy stored in the band when it is stretched to extension e .
- D** (Area Y – area X) is the net work done on the band during the process.

9 - (9702/11_Winter_2017_Q20) - *Deformation Of Solids*

A spring is loaded with weights. When the weights are removed, the spring returns to its original length.

The spring is then loaded with heavier weights. When the weights are removed, the spring is longer than it was originally.

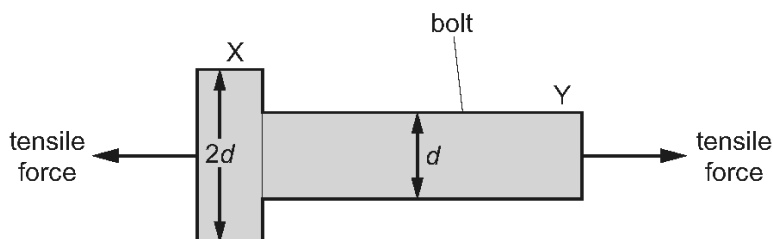
Which types of deformation are shown by this experiment?

- A** both elastic and plastic deformation
- B** elastic deformation only
- C** neither elastic nor plastic deformation
- D** plastic deformation only



10 - (9702/12_Winter_2017_Q20) - Deformation Of Solids

A bolt is subjected to a tensile force, as shown.



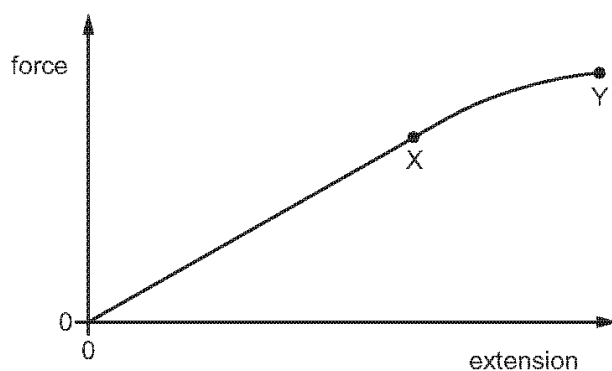
The bolt has a circular cross-section. At end X the diameter is $2d$. At end Y the diameter is d .

What is the ratio $\frac{\text{stress at Y}}{\text{stress at X}}$?

- A 0.25 B 0.50 C 2.0 D 4.0

11 - (9702/13_Winter_2017_Q20) - Deformation Of Solids

A sample of metal is subjected to a force which increases to a maximum value and then decreases back to zero. A force-extension graph for the sample is shown.



When the sample contracts, it follows the same force-extension curve as when it was being stretched.

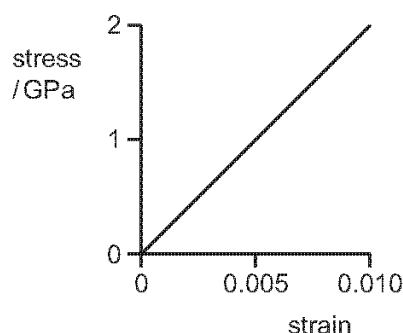
What is the behaviour of the metal between X and Y?

- A both elastic and plastic
B not elastic and not plastic
C plastic but not elastic
D elastic but not plastic



12 - (9702/11_Winter_2017_Q21) - Deformation Of Solids

The stress-strain graph for a metal is shown.



What is the strain energy per unit volume of a rod made from this metal when the strain of the rod is 0.010?

- A** 10 kJ m^{-3} **B** 100 kJ m^{-3} **C** 1.0 MJ m^{-3} **D** 10 MJ m^{-3}

13 - (9702/12_Winter_2017_Q21) - Deformation Of Solids

A rectangular block of steel supporting a very large component of a bridge has a height of 15 cm and a cross-section of $20 \text{ cm} \times 12 \text{ cm}$. It is designed to compress 1 mm when under maximum, evenly distributed, load.

The Young modulus of steel is $2.0 \times 10^{11} \text{ N m}^{-2}$.

What is the maximum load it can support?

- A** 32 MN **B** 56 GN **C** 720 GN **D** 32 TN

14 - (9702/13_Winter_2017_Q21) - Deformation Of Solids

A load is hung from the end of a metal wire. The load is increased and the wire stretches elastically. The table shows the length of the wire for different loads.

load / kN	length / mm
0	500.0
1.0	502.0
2.0	504.0
3.0	506.0
4.0	508.0

When the load is 4.0 kN, what is the strain energy stored in the wire?

- A** 16 J **B** 32 J **C** 1.0 kJ **D** 2.0 kJ

15 - (9702/11_Summer_2018_Q1) - Physical Quantities & Units, Deformation Of Solids

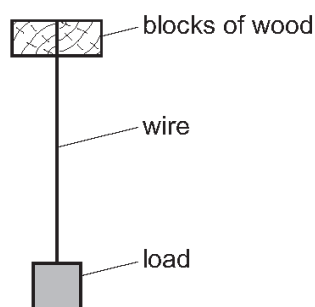
What is a unit for stress?

- A** $\text{kg m}^{-1} \text{ s}^{-2}$ **B** $\text{kg m}^{-2} \text{ s}^{-2}$ **C** N m^{-1} **D** N m



16 - (9702/11_Summer_2018_Q18) - Deformation Of Solids

The diagram shows a wire of diameter D and length L that is firmly clamped at one end between two blocks of wood. A load is applied to the wire which extends its length by x .



A second wire is made of the same material, but of diameter $2D$ and length $3L$. Both wires obey Hooke's law.

What is the extension of the second wire when the same load is applied?

- A $\frac{2}{3}x$ B $\frac{3}{4}x$ C $\frac{4}{3}x$ D $\frac{3}{2}x$

17 - (9702/13_Summer_2018_Q18) - Deformation Of Solids

Data for a steel wire on an electric guitar are listed.

$$\text{diameter} = 5.0 \times 10^{-4} \text{ m}$$

$$\text{Young modulus} = 2.0 \times 10^{11} \text{ Pa}$$

$$\text{tension} = 20 \text{ N}$$

The wire snaps and contracts elastically. Assume the wire obeys Hooke's law.

By what percentage does the length l of a piece of the wire contract?

- A $1.3 \times 10^{-4} \%$ B $5.1 \times 10^{-4} \%$ C $1.3 \times 10^{-2} \%$ D $5.1 \times 10^{-2} \%$

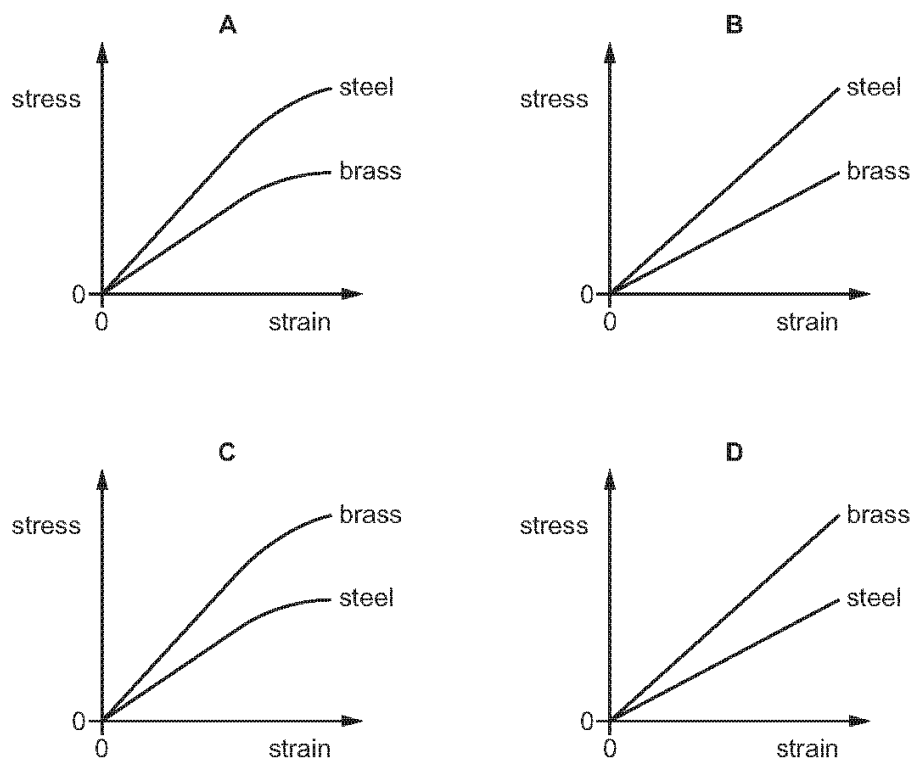


18 - (9702/11_Summer_2018_Q19) - *Deformation Of Solids*

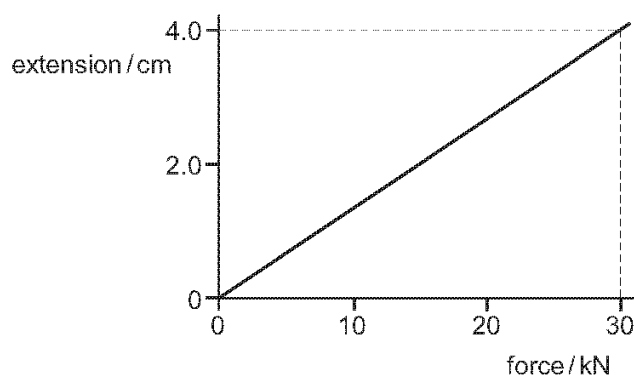
Two wires, one made of brass and the other of steel, are stretched in an experiment. Both wires obey Hooke's law during this experiment.

The Young modulus for brass is less than the Young modulus for steel.

Which graph shows how the stress varies with strain for both wires in this experiment?

**19** - (9702/13_Summer_2018_Q19) - *Deformation Of Solids*

The graph shows how the extension of a spring varies with the force used to stretch it.



What is the strain energy in the spring when the extension is 4.0 cm?

- A** 60 J **B** 120 J **C** 600 J **D** 1200 J



20 - (9702/12_Summer_2018_Q20) - *Deformation Of Solids*

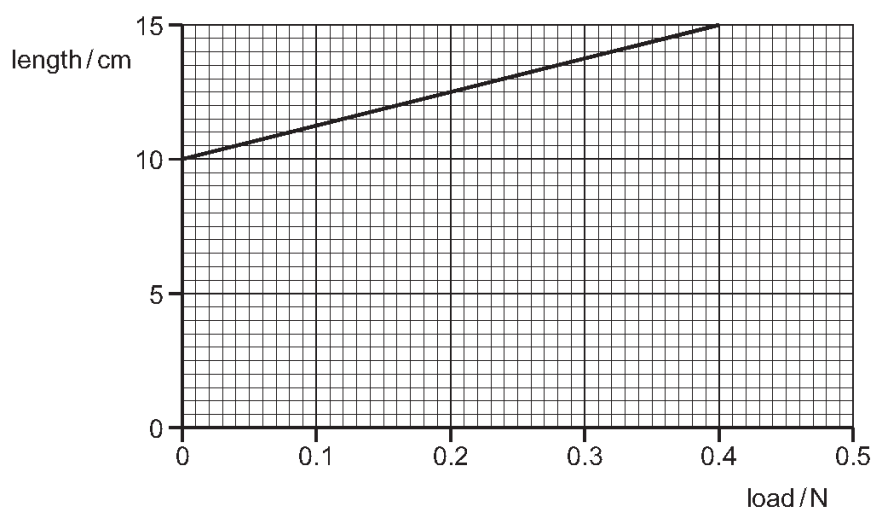
An elastic material with Young modulus E is subjected to a tensile stress S . Hooke's law is obeyed.

What is the expression for the elastic energy stored per unit volume of the material?

- A $\frac{E}{2S^2}$ B $\frac{2E}{S^2}$ C $\frac{S^2}{E}$ D $\frac{S^2}{2E}$

21 - (9702/12_Summer_2018_Q21) - *Deformation Of Solids*

The graph shows the length of a spring as it is stretched by an increasing load.



What is the spring constant of the spring?

- A 0.080 N m^{-1} B 0.13 N m^{-1} C 2.7 N m^{-1} D 8.0 N m^{-1}

22 - (9702/11_Winter_2018_Q9) - *Deformation Of Solids*

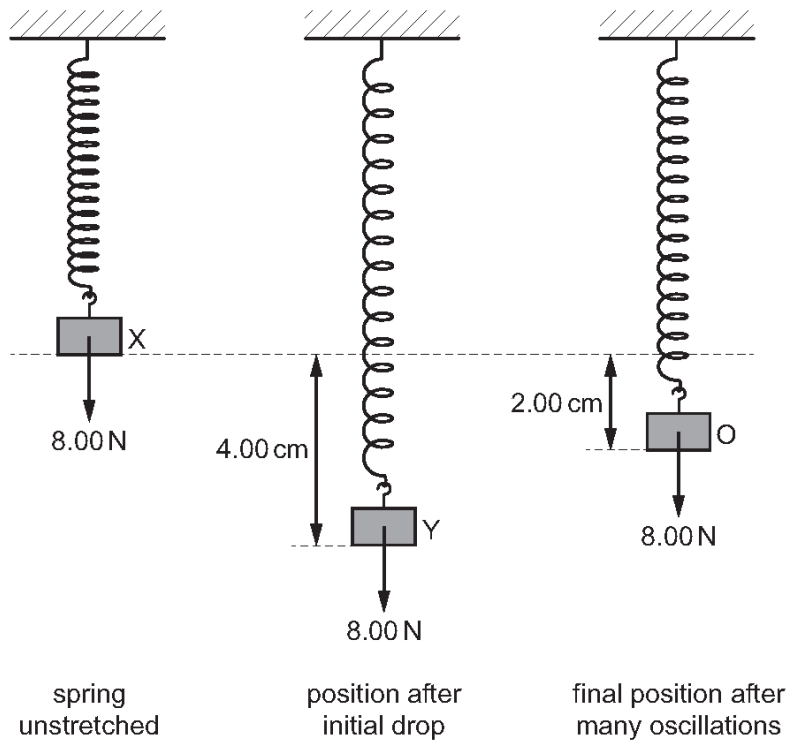
What is a statement of the principle of conservation of momentum?

- A A force is equal to the rate of change of momentum of the body upon which it acts.
B In a perfectly elastic collision, the relative momentum of the bodies before impact is equal to their relative momentum after impact.
C The momentum of a body is the product of the mass of the body and its velocity.
D The total momentum of a system of interacting bodies remains constant, providing no resultant external force acts on the system.



23 - (9702/11_Winter_2018_Q16) - Deformation Of Solids

An 8.00 N weight is attached to the lower end of a spring which is fixed at its upper end. The weight is initially held at rest at position X and the spring is unstretched. The weight is then released and falls to position Y, which is 4.00 cm below X. The weight oscillates and then eventually comes to rest at O, which is 2.00 cm below X.



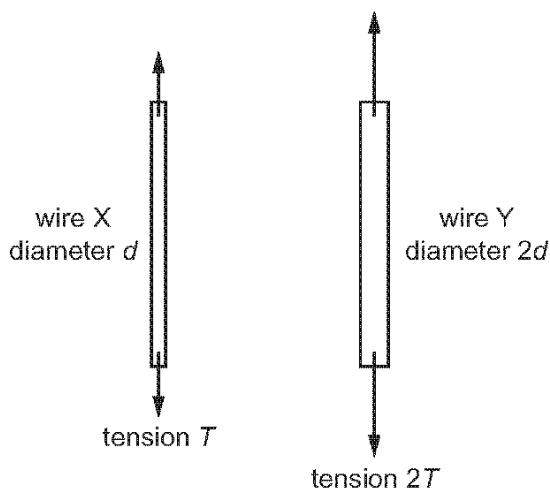
How much energy is lost from the system?

- A 0.04 J B 0.08 J C 0.16 J D 0.32 J



24 - (9702/11_Winter_2018_Q18) - Deformation Of Solids

Two wires X and Y are made from the same material. Wire Y has twice the diameter and experiences twice the tension of wire X. The wires obey Hooke's law and have the same original length.



Wire X has extension e .

What is the extension of wire Y?

- A $\frac{e}{4}$ B $\frac{e}{2}$ C e D $2e$

25 - (9702/11_Winter_2018_Q19) - Deformation Of Solids

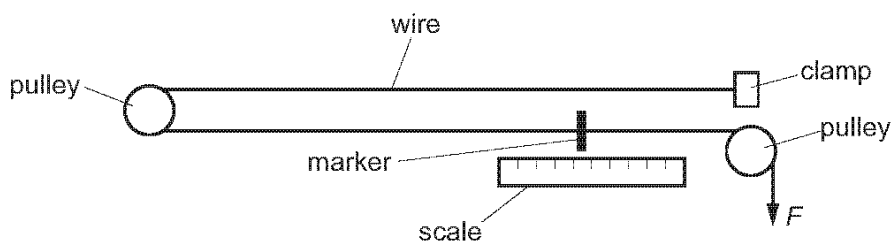
What is represented by the gradient of a graph of force (vertical axis) against extension (horizontal axis) for a wire obeying Hooke's law?

- A elastic limit
B spring constant
C stress
D Young modulus



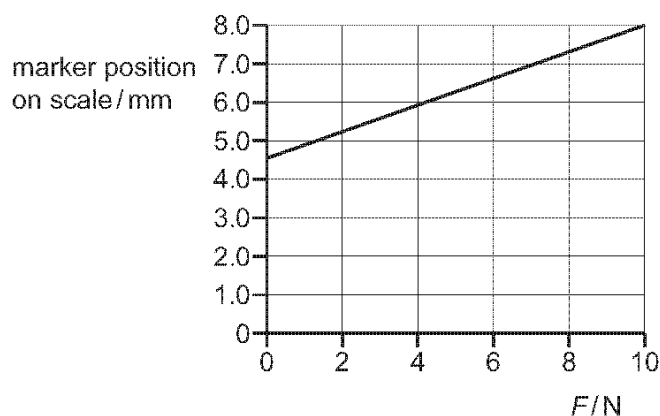
26 - (9702/13_Winter_2018_Q19) - Deformation Of Solids

In an experiment to measure the Young modulus of a metal, a wire of the metal of diameter 0.25 mm is clamped, as shown.



The wire passes from a clamp, around a frictionless pulley, and then to a second frictionless pulley where loads F are applied to it. A marker is attached to the wire so that the total length of wire between the clamp and the marker is initially 3.70 m. A scale is fixed near to this marker.

The graph shows how the reading on the scale varies with F .



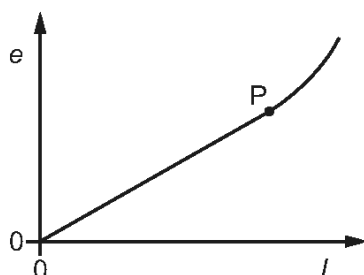
What is the Young modulus of the metal?

- A $5.5 \times 10^{10} \text{ Pa}$
- B $9.4 \times 10^{10} \text{ Pa}$
- C $1.6 \times 10^{11} \text{ Pa}$
- D $2.2 \times 10^{11} \text{ Pa}$



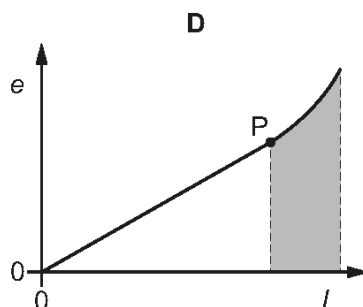
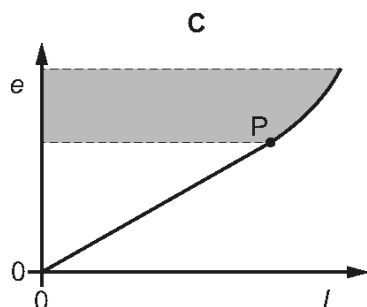
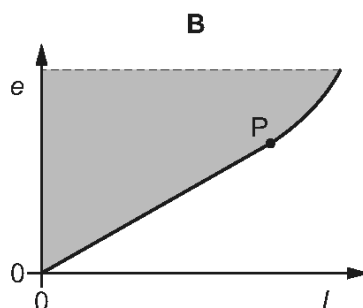
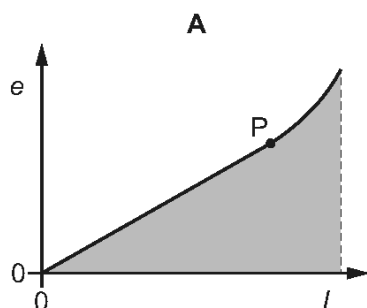
27 - (9702/11_Winter_2018_Q20) - Deformation Of Solids

Forces are applied to the ends of a rod so that its length increases. The variation with load L of the extension e of the rod is shown.



The point P is the elastic limit.

Which shaded area represents the work done during the plastic deformation of the rod?



28 - (9702/12_Winter_2018_Q20) - Deformation Of Solids

A metal cylinder is able to withstand a compressive force of 4.0 kN without deforming plastically.



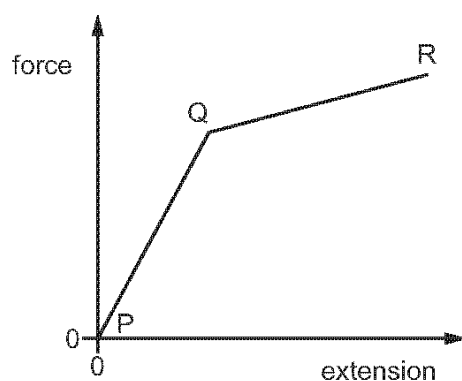
The cylinder has cross-sectional area A and would be at its elastic limit when a stress σ is applied.

What is a possible pair of values for A and σ ?

	A/m^2	σ/MPa
A	1.5×10^{-5}	50
B	1.5×10^{-5}	80
C	7.5×10^{-5}	50
D	7.5×10^{-5}	80

29 - (9702/13_Winter_2018_Q20) - Deformation Of Solids

A scientist is investigating the properties of a new material. She plots a force-extension graph for the material up to its breaking point.



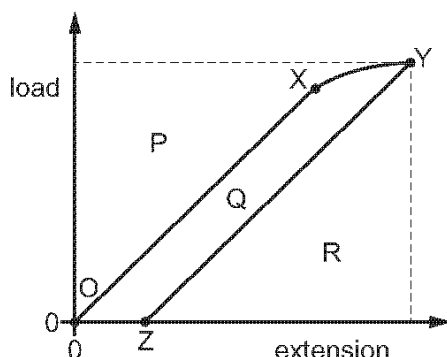
Which statement **must** be correct?

- A The area under the graph from P to R is the strain energy stored in the material.
- B The area under the graph from P to R is the work done in stretching the material.
- C The material stretches elastically from Q to R.
- D The material stretches plastically from P to Q.



30 - (9702/12_Winter_2018_Q21) - Deformation Of Solids

A wire has both elastic and plastic properties. When it is slowly loaded, its extension varies with load as shown by line OXY. The removal of the load is represented by line YZ. This creates areas P, Q and R on the graph.



Which area represents the maximum elastic potential energy stored in the wire?

- A P B Q C Q + R D R

31 - (9702/13_Summer_2019_Q19) - Deformation Of Solids

Four solid steel rods, each of length 2.0 m and cross-sectional area 250 mm^2 , equally support an object weighing 10 kN. The weight of the object causes the rods to contract by 0.10 mm. The rods obey Hooke's law.

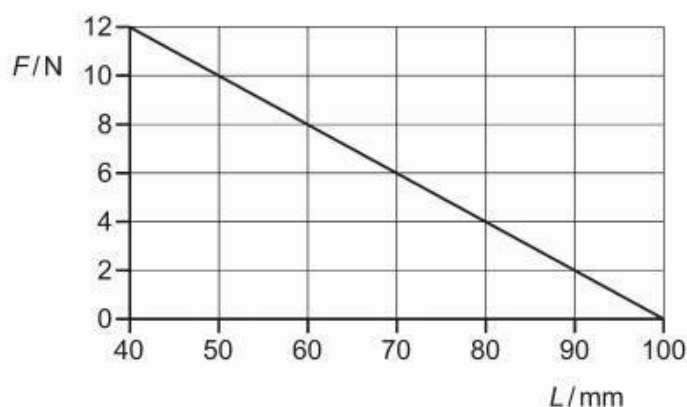
What is the Young modulus of steel?

- A $2.0 \times 10^8 \text{ Nm}^{-2}$
B $2.0 \times 10^{11} \text{ Nm}^{-2}$
C $8.0 \times 10^8 \text{ Nm}^{-2}$
D $8.0 \times 10^{11} \text{ Nm}^{-2}$



32 - (9702/11_Summer_2019_Q20) - Deformation Of Solids

A spring of original length 100 mm is compressed by a force. The graph shows the variation of the compressing force F with the length L of the spring.



What is the energy stored in the spring when the length is 70 mm?

- A** 0.090 J **B** 0.21 J **C** 0.27 J **D** 0.63 J

33 - (9702/12_Summer_2019_Q20) - Deformation Of Solids

A wire X is stretched by a force and gains elastic potential energy E .

The same force is applied to wire Y of the same material, with the same initial length but twice the diameter of wire X. Both wires obey Hooke's law.

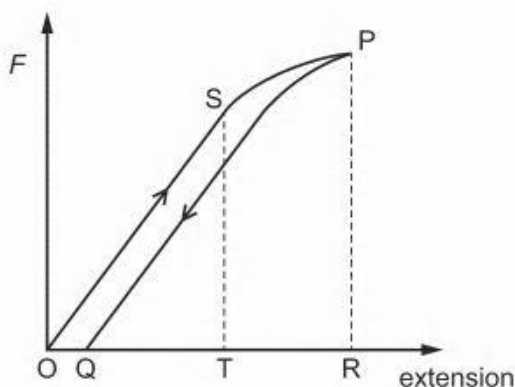
What is the gain in elastic potential energy of wire Y?

- A** $0.25E$ **B** $0.5E$ **C** $2E$ **D** $4E$

34 - (9702/13_Summer_2019_Q20) - Deformation Of Solids

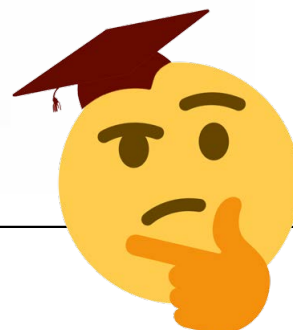
A wire is attached at one end to a fixed point. A tensile force F is applied to the other end of the wire, causing it to extend. This is shown on the graph by the line OSP.

The force F is then gradually reduced to zero and the wire contracts. This is shown on the graph by the line PQ.



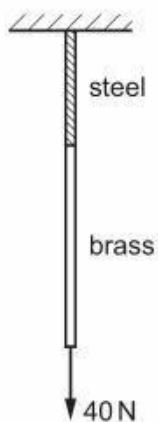
Which area on the graph represents the work done by the wire as it contracts?

- A** OSTO **B** OSPRO **C** QPRQ **D** OSPQO



35 - (9702/11_Summer_2019_Q21) - Deformation Of Solids

A 0.80 m length of steel wire and a 1.4 m length of brass wire are joined together. The combined wires are suspended from a fixed support and a force of 40 N is applied, as shown.



The Young modulus of steel is 2.0×10^{11} Pa.

The Young modulus of brass is 1.0×10^{11} Pa.

Each wire has a cross-sectional area of 2.4×10^{-6} m².

The wires obey Hooke's law.

What is the total extension? Ignore the weights of the wires.

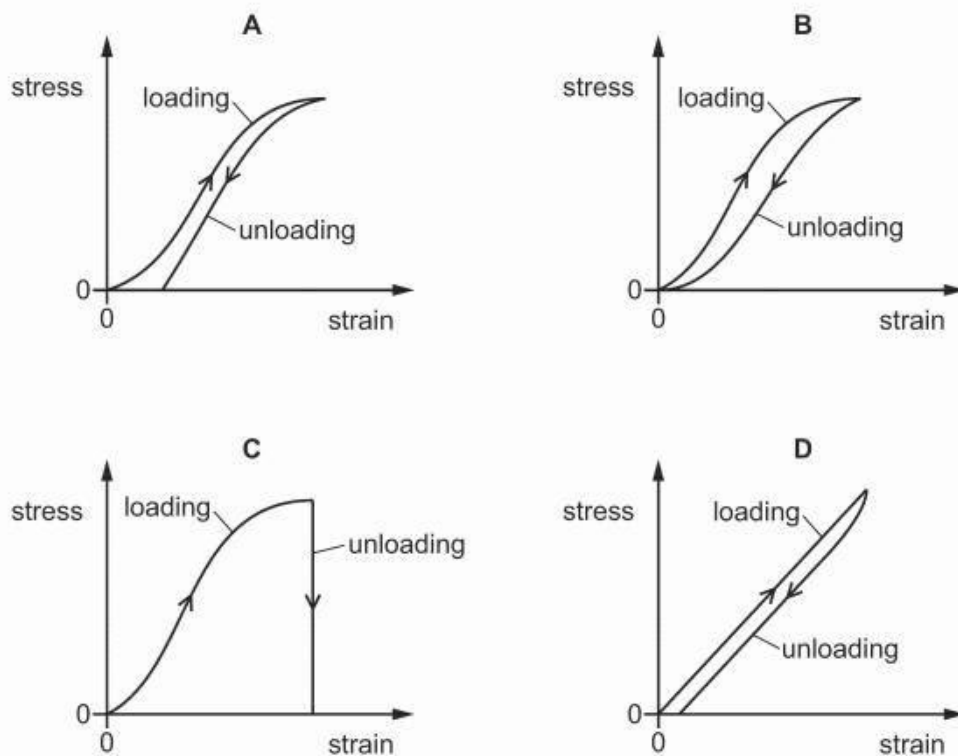
A 1.7×10^{-4} m **B** 3.0×10^{-4} m **C** 3.9×10^{-4} m **D** 9.0×10^{-4} m



36 - (9702/12_Summer_2019_Q22) - Deformation Of Solids

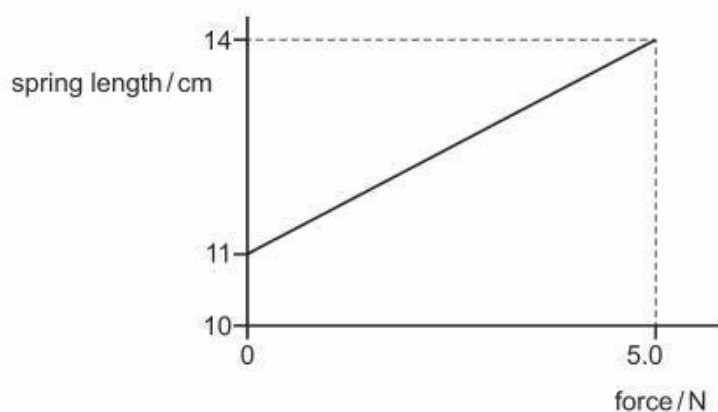
The stress-strain graphs for loading and unloading four different materials are shown.

Which material exhibits purely elastic behaviour?



37 - (9702/12_Winter_2019_Q18) - Deformation Of Solids

The graph shows the effect of applying a force of up to 5.0 N to a spring.



The spring obeys Hooke's law for forces up to 7.0 N.

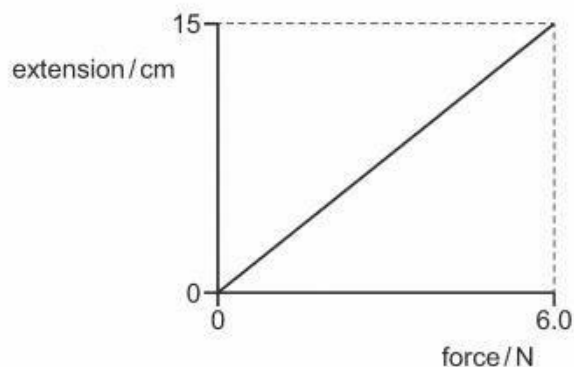
What is the total extension of the spring produced by a 7.0 N force?

- A 4.2 cm B 5.6 cm C 15 cm D 20 cm



38 - (9702/11_Winter_2019_Q19) - Deformation Of Solids

An extension–force graph for a spring is shown.

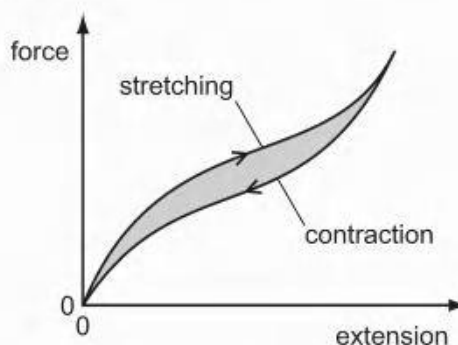
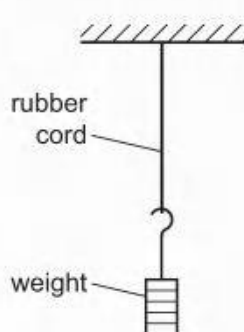


What is the spring constant of the spring?

- A 0.025 N m^{-1} B 0.40 N m^{-1} C 2.5 N m^{-1} D 40 N m^{-1}

39 - (9702/12_Winter_2019_Q19) - Deformation Of Solids

A rubber cord hangs from a rigid support. A weight attached to its lower end is gradually increased from zero, and then gradually reduced to zero.



The force–extension curve for contraction is below the force–extension curve for stretching.

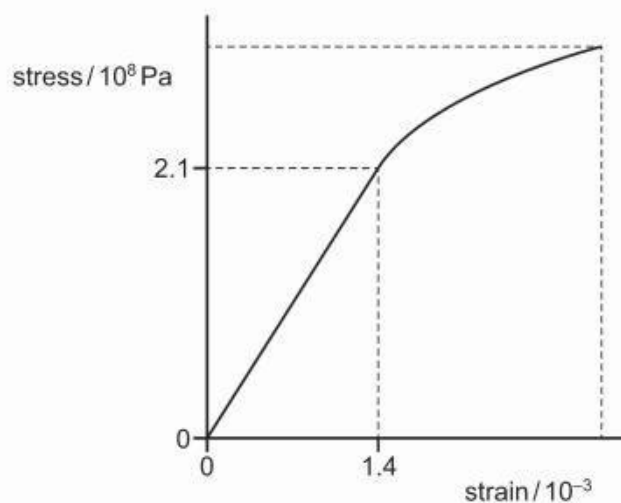
What does the shaded area between the curves represent?

- A the elastic potential energy stored in the rubber cord
B the thermal energy dissipated in the rubber cord
C the work done on the rubber cord during stretching
D the work done by the rubber cord during contraction



40 - (9702/13_Winter_2019_Q19) - Deformation Of Solids

The stress–strain graph for a wire is shown.

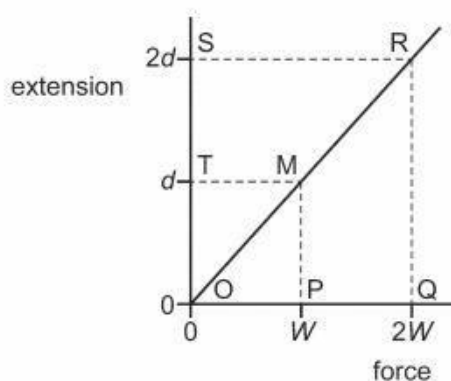


What is the Young modulus of the material of the wire?

- A $6.7 \times 10^{-12} \text{ Pa}$
- B $6.7 \times 10^{-9} \text{ Pa}$
- C $1.5 \times 10^8 \text{ Pa}$
- D $1.5 \times 10^{11} \text{ Pa}$

41 - (9702/11_Winter_2019_Q20) - Deformation Of Solids

A wire is extended by a force. The graph shows how the extension of the wire varies with the force applied.



Initially a force W gives an extension d . The force is then increased to $2W$. This increases the extension to $2d$.

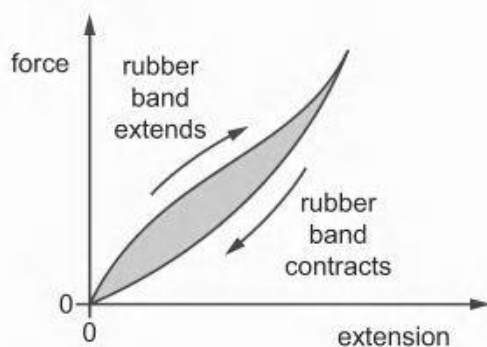
Which area of the graph represents the work done by the force when the force increases from W to $2W$?

- A ORQ
- B OQRS
- C ORS
- D TMRS



42 - (9702/13_Winter_2019_Q20) - Deformation Of Solids

The diagram shows a force–extension graph for a rubber band as the band is extended and then the stretching force is decreased to zero.



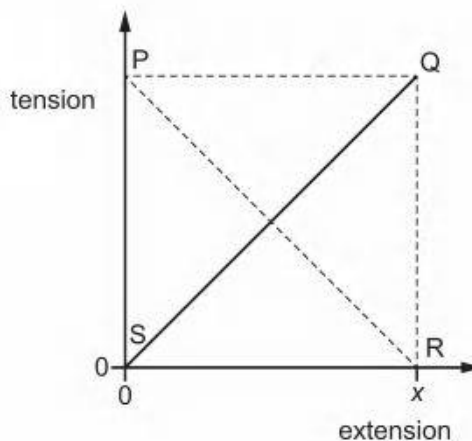
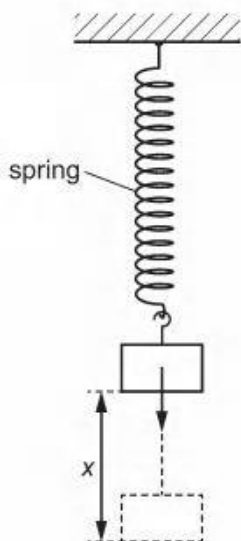
What can be deduced from the graph?

- A The rubber band does not return to its original length when the force is decreased to zero.
- B The rubber band obeys Hooke's law for the extensions shown.
- C The rubber band remains elastic for the extensions shown.
- D The shaded area represents the work done in extending the rubber band.



43 - (9702/12_Summer_2020_Q16) - Deformation Of Solids

A spring is attached at one end to a fixed point. A mass is then hung from the other end of the spring. The spring has extension x when the system is in equilibrium.



The variation of the tension in the spring with its extension is shown on the graph.

Which statement is correct?

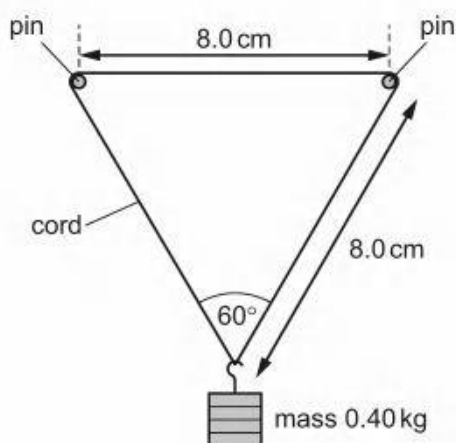
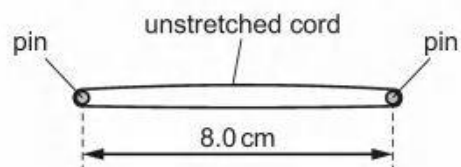
- A Area SPR represents the energy stored in the spring which cannot be recovered.
- B Area SPQR represents the energy stored in the spring which can be recovered.
- C Area SPQ represents the loss of gravitational potential energy of the mass due to the extension of the spring.
- D Area SQR represents the elastic potential energy stored in the spring.



44 - (9702/12_Summer_2020_Q18) - Deformation Of Solids

An elastic cord of unstretched total length 16.0 cm and cross-sectional area $2.0 \times 10^{-6}\text{ m}^2$ is held horizontally by two smooth pins a distance 8.0 cm apart.

The cord obeys Hooke's law. A load of mass 0.40 kg is suspended centrally on the cord. The angle between the two sides of the cord supporting the load is 60° .



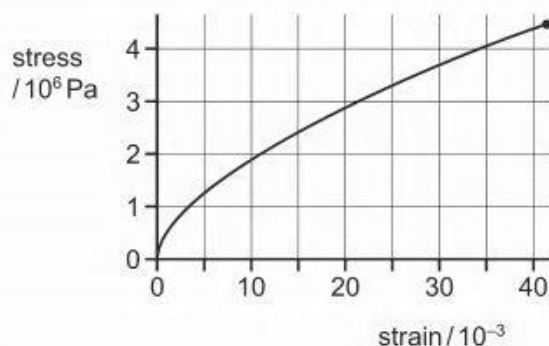
What is the Young modulus of the cord material?

- A $5.7 \times 10^5\text{ Pa}$ B $1.1 \times 10^6\text{ Pa}$ C $2.3 \times 10^6\text{ Pa}$ D $3.9 \times 10^6\text{ Pa}$



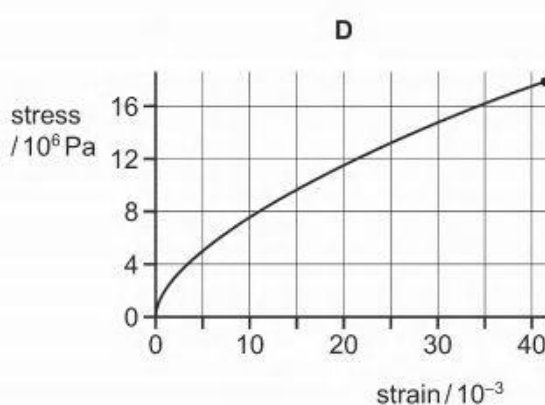
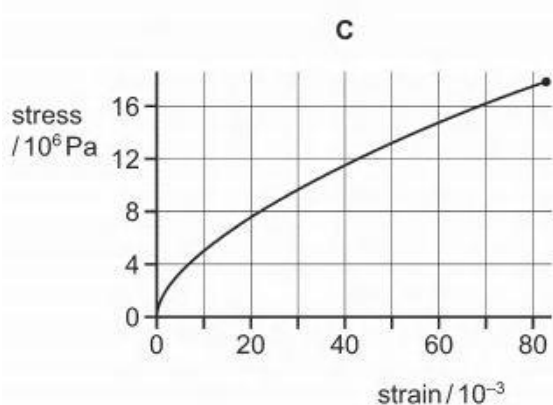
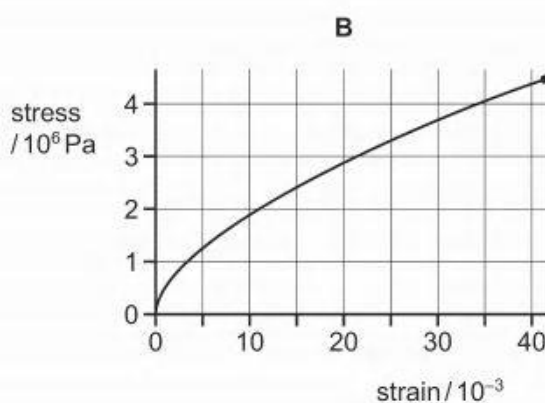
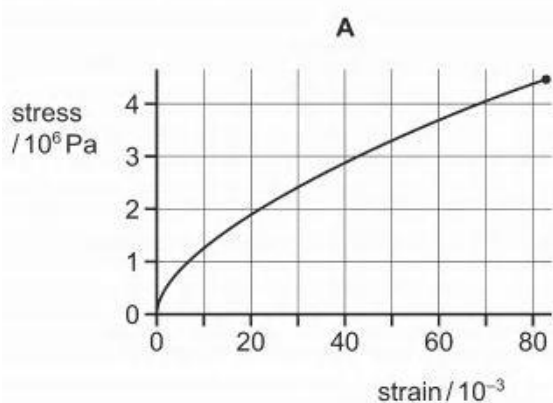
45 - (9702/12_Summer_2020_Q19) - Deformation Of Solids

A student is investigating the mechanical properties of a metal. He applies different loads to a long thin wire up to its breaking point, and measures the extension of the wire for each load. He then plots a graph of stress against strain.



The student repeats the experiment with a wire made from the same metal, with twice the original length and half the diameter.

Which graph is obtained?

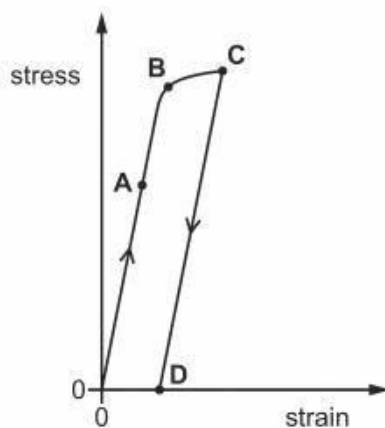


46 - (9702/11_Summer_2020_Q20) - *Deformation Of Solids*

A tensile force is used to extend a sample of a material. The force is then removed.

The variation with strain of the applied stress is shown on the graph.

Which point on the graph could represent the elastic limit for the material?



47 - (9702/12_Summer_2020_Q20) - *Deformation Of Solids*

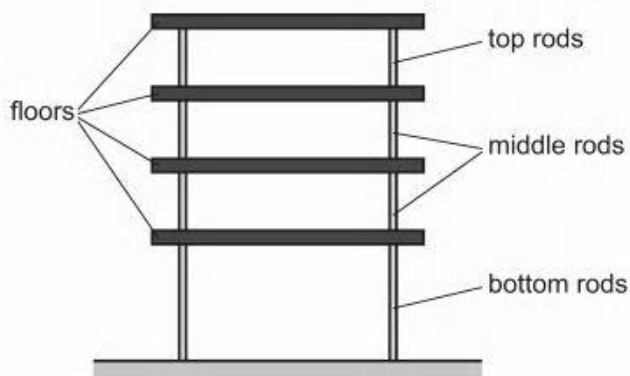
Which statement describes what is meant by the plastic deformation of a material?

- A It always obeys Hooke's law.
- B It does not return to its original length when the extending force is removed.
- C It never obeys Hooke's law.
- D It returns to its original length when the extending force is removed.



48 - (9702/13_Summer_2020_Q20) - *Deformation Of Solids*

The diagram shows a simplified model of a building with four identical heavy floors.



The spacing of the bottom floor from the ground is twice that of the spacing between the floors. Between each floor are equal numbers of vertical steel supporting rods of negligible mass compared with the floors. The rods are of different diameters so that the stress in each rod is the same.

What is the ratio $\frac{\text{diameter of bottom rods}}{\text{diameter of top rods}}$?

- A 2 B 4 C 8 D 16

49 - (9702/11_Summer_2020_Q21) - *Deformation Of Solids*

A tensile force is applied to an unstretched rubber band, causing it to stretch. The tensile force is then removed.

Which statement about the rubber band **must** be correct?

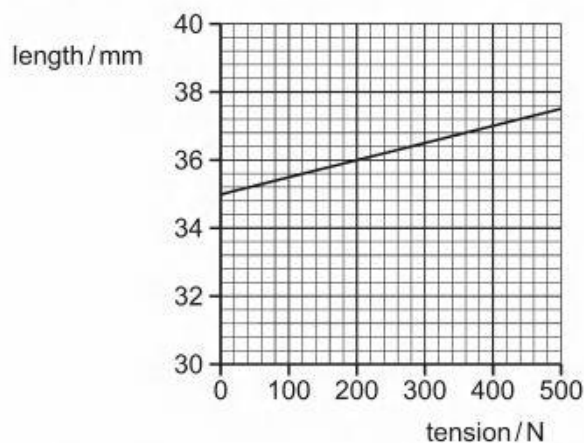
- A If the rubber band stretches elastically and plastically, all the work done by the force is converted to thermal energy in the rubber.
- B If the rubber band stretches elastically, it obeys Hooke's law.
- C If the rubber band stretches elastically, the gradient of the force–extension graph represents the work done by the force.
- D If the rubber band stretches plastically, the rubber band will be longer after the force is removed than it was before the force is applied.



50 - (9702/13_Summer_2020_Q21) - Deformation Of Solids

The Achilles tendon in a rabbit's leg is stretched when the rabbit jumps.

The graph shows the variation with tension of the length of the tendon.

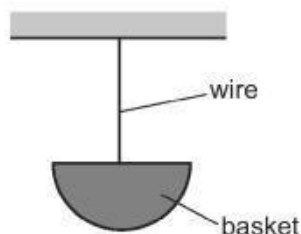


What is the strain energy in the tendon when the tension is 400 N?

- A** 0.40 J **B** 0.80 J **C** 2.4 J **D** 7.4 J

51 - (9702/11_Winter_2020_Q19) - Deformation Of Solids

A wire of circular cross-section, which obeys Hooke's law, is used to suspend a basket as shown.



The Young modulus for the material of the wire is 2.5×10^{11} Pa.

When a weight of 34 N is added to the basket, the strain in the wire increases by 6.0×10^{-5} .

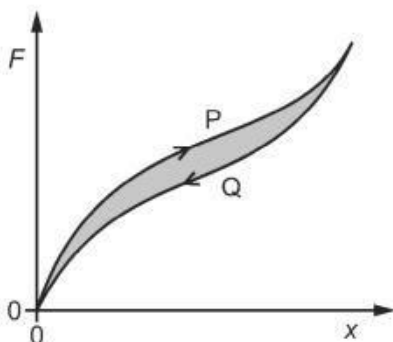
What is the radius of the wire?

- A** 7.2×10^{-7} m **B** 2.3×10^{-6} m **C** 8.5×10^{-4} m **D** 1.7×10^{-3} m



52 - (9702/11_Winter_2020_Q20) - Deformation Of Solids

An unstretched rubber cord is stretched by a force. The force F is plotted against the extension x . F is slowly increased from zero, causing the cord to extend along path P. F is then reduced back to zero along path Q.



What is represented by the shaded area?

- A the elastic energy stored in the rubber cord
- B the energy that causes plastic deformation
- C the energy dissipated as heat
- D the work done to extend the rubber cord

53 - (9702/12_Winter_2020_Q20) - Deformation Of Solids

A mass of 60.0 g is suspended from a spring and the distance from the bottom of the spring to the floor is measured to be 16.4 cm.

The mass is replaced with a 100.0 g mass and the distance from the bottom of the spring to the floor is now measured to be 12.6 cm. The spring obeys Hooke's law.

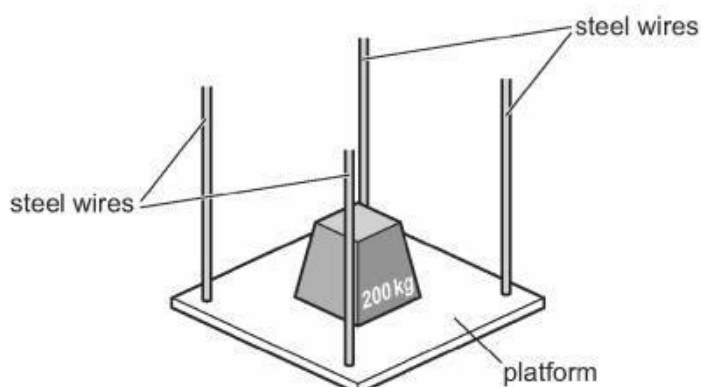
What is the spring constant of the spring?

- A 1.05 Nm^{-1} B 1.35 Nm^{-1} C 10.3 Nm^{-1} D 103 Nm^{-1}



54 - (9702/13_Winter_2020_Q20) - Deformation Of Solids

A platform is suspended by four steel wires. Each wire is 5.0 m long and has a diameter of 3.0 mm. The Young modulus of steel is 2.1×10^{11} Pa.



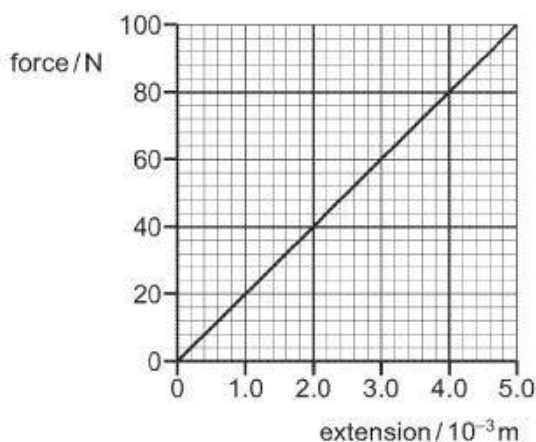
The wires obey Hooke's law when a load of mass 200 kg is placed on the platform.

How far will the platform descend because of the extension of the wires?

- A 1.7×10^{-4} m B 4.1×10^{-4} m C 1.7×10^{-3} m D 6.6×10^{-3} m

55 - (9702/12_Winter_2020_Q21) - Deformation Of Solids

The graph shows the force–extension graph for a wire.



The wire is already extended by a force of 60 N.

How much work is done to increase the extension of the wire by 2.0 mm?

- A 0.040 J B 0.090 J C 0.16 J D 0.25 J

56 - (9702/13_Winter_2020_Q21) - Deformation Of Solids

A tensile force of 7.00 MN is applied to a sample of steel. This causes the sample to extend by 5.00 mm in the direction of the force. The sample obeys Hooke's law.

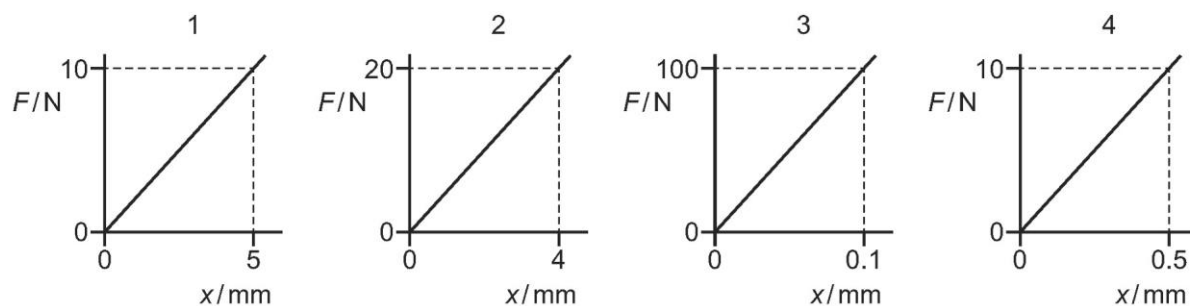
What is the work done to extend the sample?

- A 17.5 J B 35.0 J C 17.5 kJ D 35.0 kJ



57 - (9702/11_Summer_2021_Q19) - Deformation Of Solids

The spring constants of four springs are determined by plotting the following graphs of force F against extension x .



Which order of the graphs shows **decreasing** spring constants?

- A $2 \rightarrow 1 \rightarrow 3 \rightarrow 4$
- B $3 \rightarrow 4 \rightarrow 2 \rightarrow 1$
- C $4 \rightarrow 2 \rightarrow 1 \rightarrow 3$
- D $4 \rightarrow 3 \rightarrow 2 \rightarrow 1$

58 - (9702/12_Summer_2021_Q19) - Deformation Of Solids

A steel bar of circular cross-section is under tension T , as shown.

The diameter of the wide portion is double the diameter of the narrow portion.



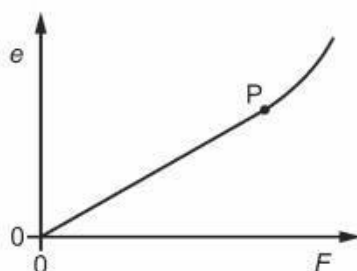
What is the value of $\frac{\text{stress in the wide portion}}{\text{stress in the narrow portion}}$?

- A 0.25
- B 0.50
- C 2.0
- D 4.0



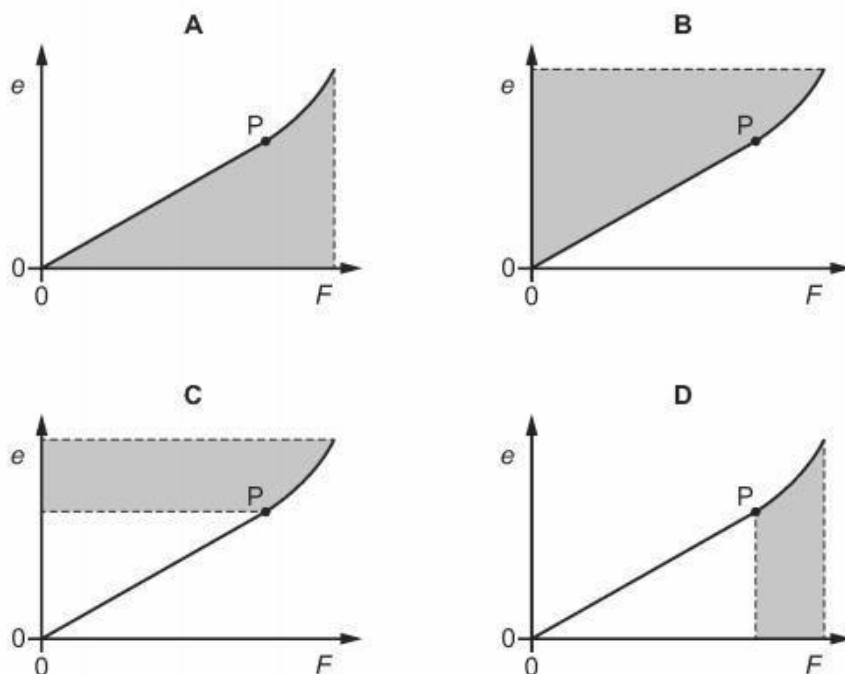
59 - (9702/11_Summer_2021_Q20) - Deformation Of Solids

Forces are applied to the ends of a rod so that its length increases. The variation with force F of the extension e of the rod is shown.



The point P is the elastic limit.

Which shaded area represents the work done during the plastic deformation of the rod?



60 - (9702/12_Summer_2021_Q20) - Deformation Of Solids

Two guitar strings are stretched by tensile forces.

String X is stretched by a tensile force F that causes an extension x .

String Y is stretched by a tensile force $2F$ that causes an extension $2x$.

The strings obey Hooke's law.

What is the ratio $\frac{\text{strain energy in stretched string X}}{\text{strain energy in stretched string Y}}$?

A 4

B 2

C $\frac{1}{2}$ D $\frac{1}{4}$ 

61 - (9702/13_Summer_2021_Q20) - Deformation Of Solids

The stress σ in a material is given by the equation shown.

$$\sigma = \frac{F}{A}$$

The strain ε in the same material is given by the equation shown.

$$\varepsilon = \frac{x}{L}$$

Which expression gives the Young modulus of the material?

- A $\frac{\varepsilon}{\sigma}$ B $\frac{Fx}{AL}$ C $\frac{\sigma x}{L}$ D $\frac{F}{A\varepsilon}$

62 - (9702/13_Summer_2021_Q21) - Deformation Of Solids

What is an example of plastic deformation?

- A A rubber ball is momentarily compressed every time it hits the ground.
B A spoon stirring some coffee in a ceramic mug hits its surface and makes a clinking sound.
C A toolbox is left on a horizontal plank. When the toolbox is removed, the plank is no longer straight.
D The spring in some bathroom weighing scales is compressed by a person standing on the scales.

63 - (9702/12_Summer_2022_Q19) - Deformation Of Solids

A metal wire obeys Hooke's law and has a Young modulus of 2.0×10^{11} Pa. The wire has an original length of 1.6 m and a diameter of 0.48×10^{-3} m.

What is the spring constant of the wire?

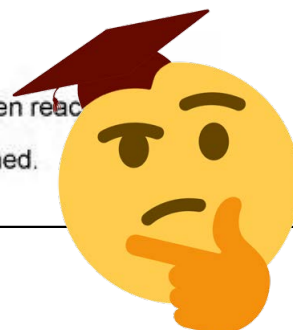
- A $7.2 \times 10^3 \text{ Nm}^{-1}$
B $2.3 \times 10^4 \text{ Nm}^{-1}$
C $2.9 \times 10^4 \text{ Nm}^{-1}$
D $9.0 \times 10^4 \text{ Nm}^{-1}$

64 - (9702/12_Summer_2022_Q20) - Deformation Of Solids

A wire is being stretched by a tensile force.

Which statement about the elastic limit **must** be correct?

- A The deformation is plastic after the elastic limit has been reached.
B The deformation is plastic until the elastic limit is reached.
C The extension is proportional to the tensile force after the elastic limit has been reached.
D The extension is proportional to the tensile force until the elastic limit is reached.



65 - (9702/13_Summer_2022_Q20) - Deformation Of Solids

A steel wire has a length of 300 cm and a cross-sectional area of 0.50 mm^2 . The Young modulus of steel is $2.0 \times 10^{11} \text{ Pa}$.

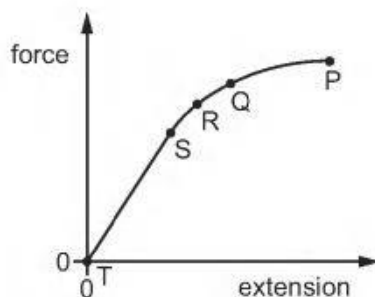
One end of the wire is attached to a fixed point. A load of 10 N is hung from the other end. The wire obeys Hooke's law.

What is the extension of the wire?

- A $3.0 \times 10^{-7} \text{ m}$
- B $3.0 \times 10^{-5} \text{ m}$
- C $3.0 \times 10^{-4} \text{ m}$
- D $3.0 \times 10^{-2} \text{ m}$

66 - (9702/13_Summer_2022_Q21) - Deformation Of Solids

The extension of a copper wire is measured for different forces applied to the wire. A graph is plotted to show the variation of the force on the wire against extension. The maximum force is applied at point P.



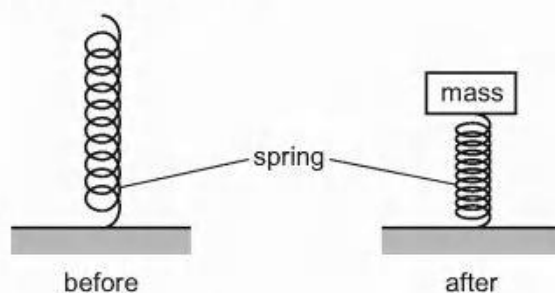
Which statement **must** be correct?

- A Point R is the limit of proportionality.
- B The elastic potential energy of the wire at point S is given by the area under the graph between points T and S.
- C There is no plastic deformation between points Q and P.
- D The wire obeys Hooke's law up to a point between R and Q.



67 - (9702/11_Winter_2022_Q16) - Deformation Of Solids

A spring is compressed by a mass, as shown.



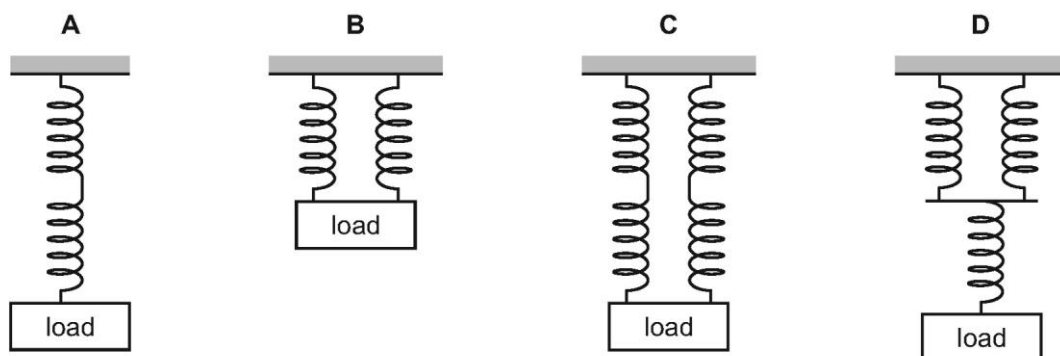
Which statement describes the changes to the energy of the spring when it is compressed by the mass?

- A The spring gains both gravitational potential energy and elastic potential energy.
- B The spring gains gravitational potential energy and loses elastic potential energy.
- C The spring loses both gravitational potential energy and elastic potential energy.
- D The spring loses gravitational potential energy and gains elastic potential energy.

68 - (9702/11_Winter_2022_Q19) - Deformation Of Solids

Identical springs are joined in four arrangements.

Which arrangement has the same spring constant as a single spring?



69 - (9702/11_Winter_2022_Q20) - Deformation Of Solids

An unstretched spring has a length of 2.0 cm.

The spring is then stretched within its limit of proportionality by a tensile force of 1.5 N so that the elastic potential energy stored in the spring is 0.045 J.

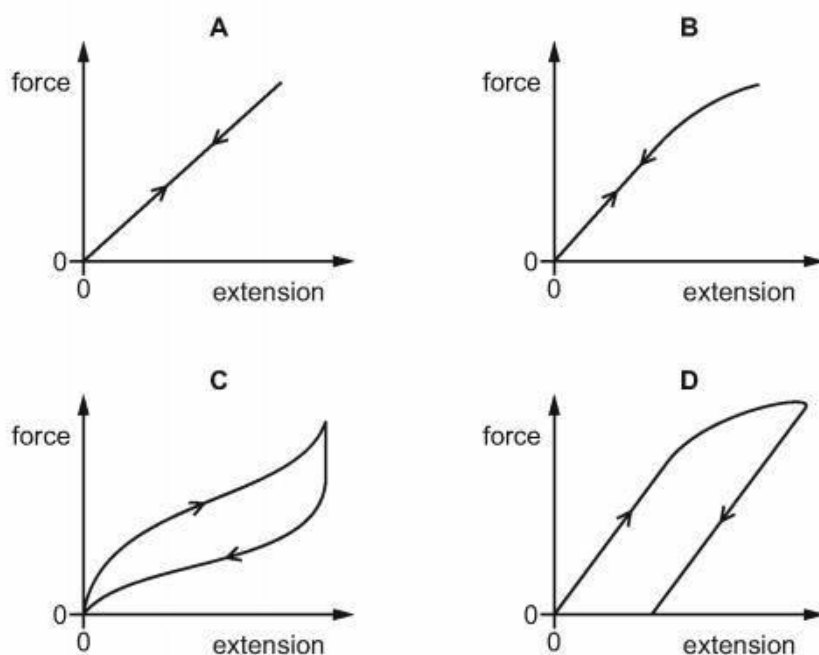
What is the stretched length of the spring?

- A 3.0 cm B 5.0 cm C 6.0 cm D 8.0 cm



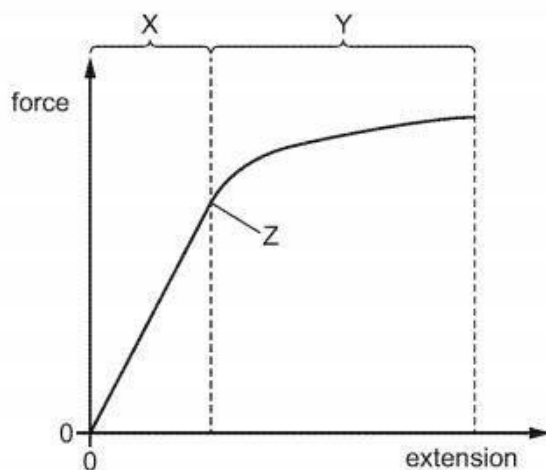
70 - (9702/11_Winter_2023_Q19) - Deformation Of Solids

Which force–extension graph shows plastic deformation of a sample of material?



71 - (9702/12_Winter_2023_Q19) - Deformation Of Solids

The force–extension graph for a wire is shown.



Which row could identify the labels X, Y and Z?

	limit of proportionality	region of elastic deformation	region of plastic deformation
A	X	Y	Z
B	Z	Y	X
C	Y	Z	X
D	Z	X	Y



72 - (9702/13_Winter_2023_Q18) - Deformation Of Solids

A copper wire of diameter 1.6 mm is stretched within its limit of proportionality by a tensile force of 430 N.

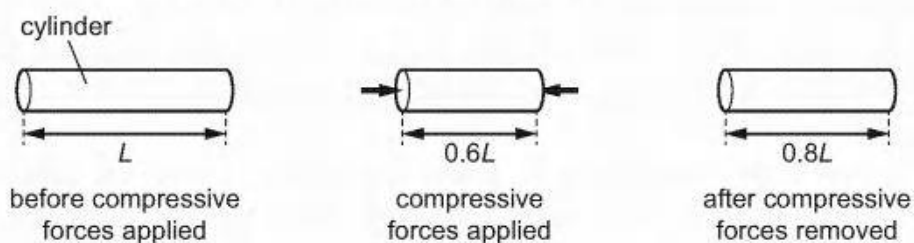
The Young modulus of copper is 130 GPa.

What is the strain in the wire?

- A 4.1×10^{-4} B 1.3×10^{-3} C 1.6×10^{-3} D 5.2×10^{-3}

73 - (9702/13_Winter_2023_Q19) - Deformation Of Solids

Compressive forces are applied normally to the end faces of a cylinder of initial length L . The cylinder is compressed by the forces so that its length decreases to $0.6L$. After the compressive forces are removed, the cylinder's length increases to $0.8L$.



What describes the deformation of the cylinder when its length was $0.6L$?

- A both elastic and plastic
B elastic only
C plastic only
D neither elastic nor plastic



1 - (9702/12_Winter_2022_Q20) - *Ideal Gases*

A known tensile force acts on a metal wire. The wire does not exceed its limit of proportionality.

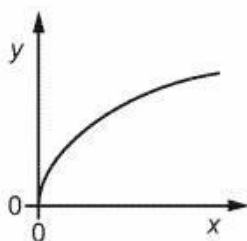
Which two measurements enable the strain of the wire to be calculated?

- A** the unstretched length of the wire and the cross-sectional area of the wire
- B** the unstretched length of the wire and the extension of the wire
- C** the Young modulus of the metal and the extension of the wire
- D** the Young modulus of the metal and the unstretched length of the wire

2 - (9702/12_Winter_2022_Q21) - *Ideal Gases*

A wire is extended by different forces. The wire obeys Hooke's law.

A graph is plotted to show the variation of a quantity y with a quantity x .



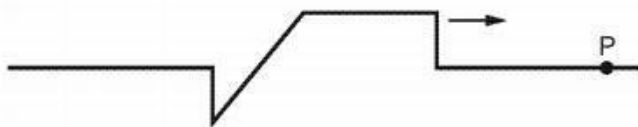
What could x and y represent?

	x	y
A	elastic potential energy	extension
B	extension	force
C	force	extension
D	extension	elastic potential energy

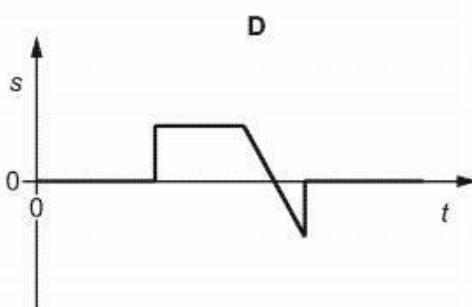
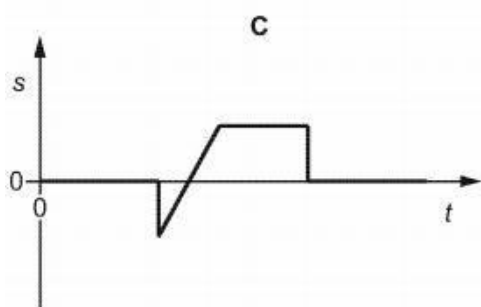
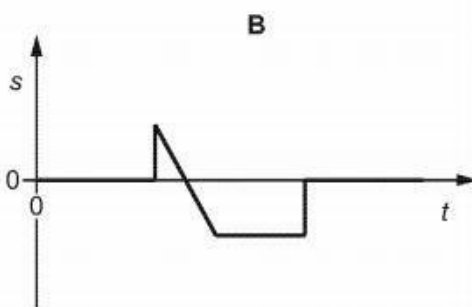
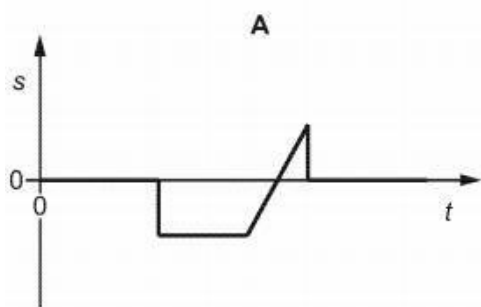


3 - (9702/12_Winter_2022_Q22) - Ideal Gases

A wave pulse moves along a stretched rope in the direction shown.



Which diagram shows the variation with time t of the displacement s of the particle P in the rope?



4 - (9702/13_Winter_2022_Q19) - Ideal Gases

A copper wire of length 3.6 m and diameter 1.22 mm is stretched by a force of 37 N. The wire obeys Hooke's law. The Young modulus of copper is 1.17×10^{11} Pa.

Which extension is caused by this force?

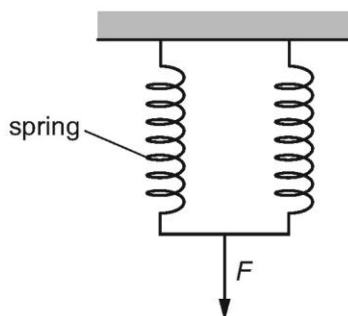
- A** 0.24 mm **B** 0.76 mm **C** 0.97 mm **D** 3.1 mm



5 - (9702/13_Winter_2022_Q20) - *Ideal Gases*

A spring has spring constant k . The spring obeys Hooke's law and experiences extension x when a force F is applied to it. The resulting elastic potential energy of the spring is E_P .

The diagram shows two of these springs joined together in parallel and hanging from a fixed beam.



What is the extension and total elastic potential energy of this arrangement when the same force F is applied?

	extension	total elastic potential energy
A	$\frac{1}{2}x$	$\frac{1}{2}E_P$
B	$\frac{1}{2}x$	$\frac{1}{4}E_P$
C	x	$\frac{1}{2}E_P$
D	x	$\frac{1}{4}E_P$



1 - (9702/12_Winter_2017_Q3) - *Thermal Properties Of Materials*

The units of specific heat capacity are $\text{J kg}^{-1} \text{K}^{-1}$.

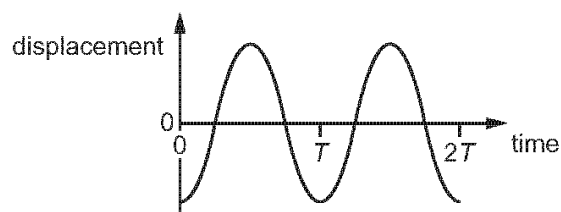
What are the SI base units of specific heat capacity?

- A $\text{m s}^{-2} \text{K}^{-1}$ B $\text{m s}^{-1} \text{K}^{-1}$ C $\text{m}^2 \text{s}^{-2} \text{K}^{-1}$ D $\text{m}^2 \text{s}^{-1} \text{K}^{-1}$

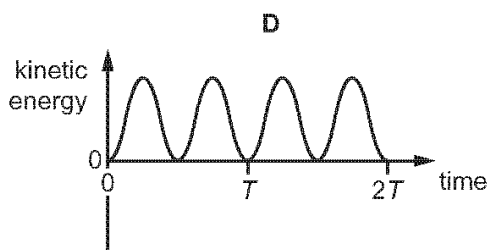
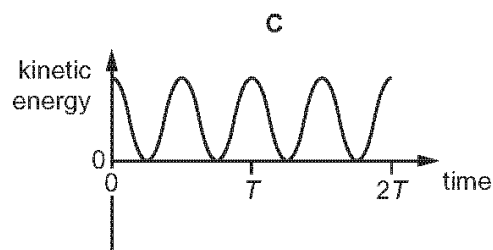
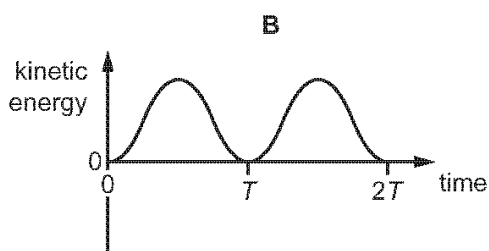
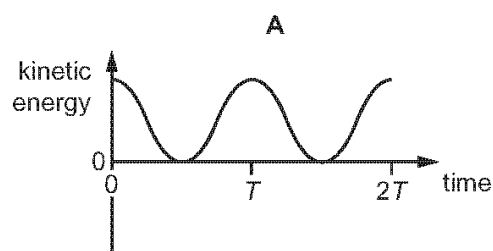


1 - (9702/12_Winter_2017_Q22) - Oscillations

When sound travels through air, the air particles vibrate. A graph of displacement against time for a single air particle is shown.



Which graph best shows how the kinetic energy of the air particle varies with time?



2 - (9702/12_Winter_2021_Q23) - Oscillations

The table contains descriptions and examples of waves.

Which row is correct?

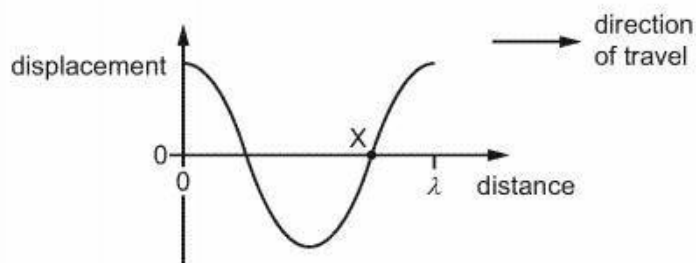
	description of wave	example
A	oscillations are parallel to the direction of energy transfer	gamma-rays
B	oscillations are parallel to the direction of energy transfer	ultraviolet waves
C	oscillations are perpendicular to the direction of energy transfer	sound waves
D	oscillations are perpendicular to the direction of energy transfer	X-rays



3 - (9702/12_Winter_2023_Q21) - Oscillations

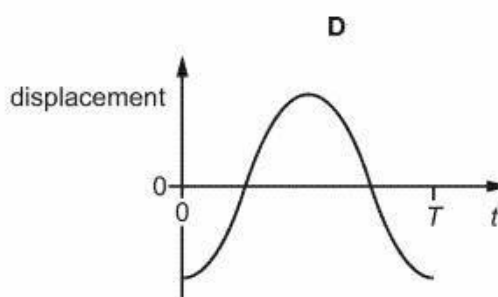
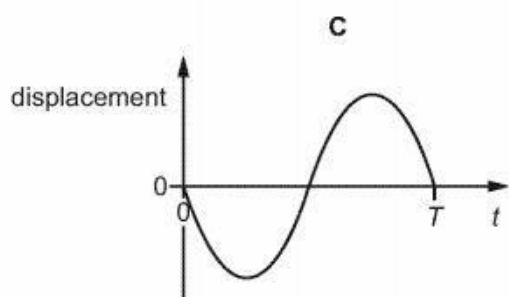
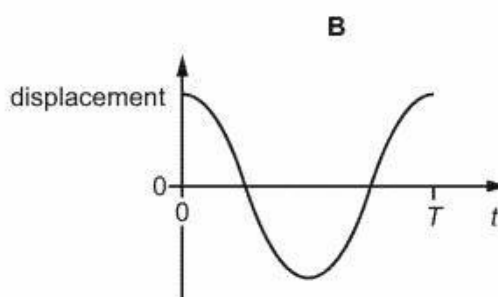
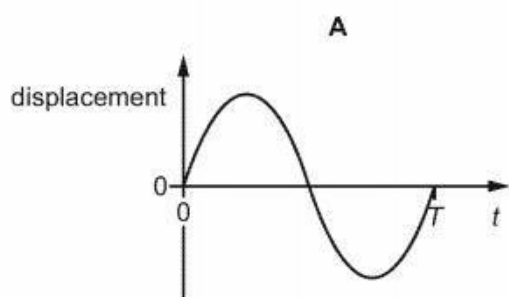
A transverse wave on a rope has wavelength λ and period T .

The graph shows the variation of the displacement of the particles of the rope with distance in the direction of travel of the wave at time $t = 0$.



A particle X is labelled.

Which graph shows the variation of the displacement of particle X with time t ?



1 - (9702/13_Summer_2017_Q21) - Waves

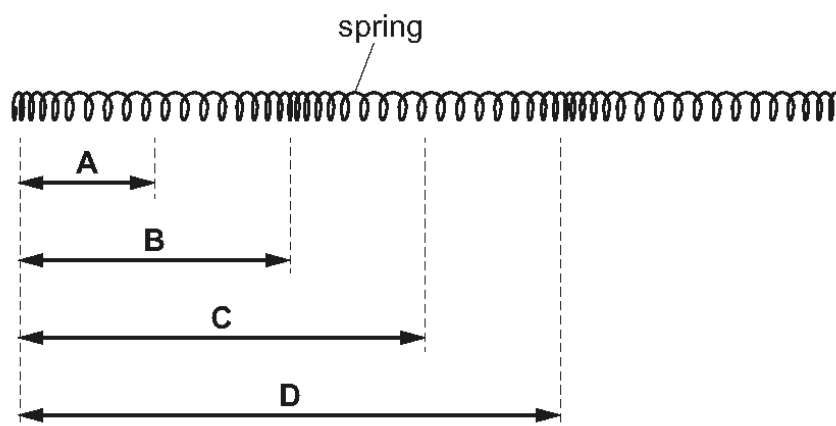
Which statement about electromagnetic waves in a vacuum is correct?

- A** Amplitude is inversely proportional to velocity.
- B** Frequency is inversely proportional to wavelength.
- C** Intensity is proportional to amplitude.
- D** Velocity is proportional to wavelength.

2 - (9702/11_Summer_2017_Q22) - Waves

A longitudinal wave travels through a long spring. The spring is shown at one instant.

What is the wavelength of the wave?



3 - (9702/12_Summer_2017_Q22) - Waves

The period of an electromagnetic wave is 1.0 ns.

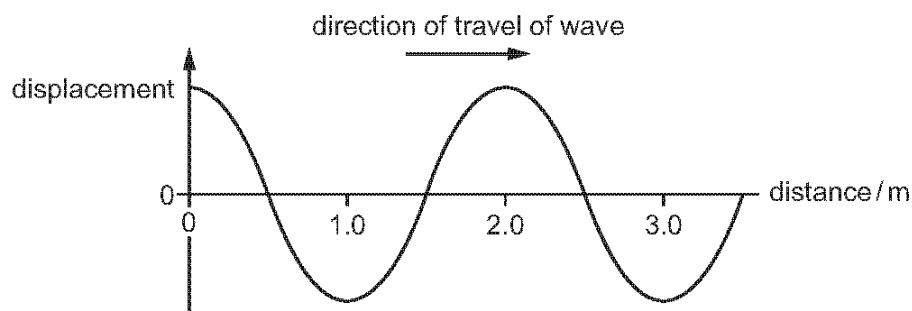
What are the frequency and wavelength of the wave?

	frequency / Hz	wavelength / m
A	1.0	3.0×10^8
B	1.0×10^6	300
C	1.0×10^9	0.30
D	1.0×10^{12}	3.0×10^{-4}



4 - (9702/13_Summer_2017_Q22) - Waves

A transverse wave travels along a rope. The graph shows the variation of the displacement of the particles in the rope with distance along it at a particular instant.



At which distance along the rope do the particles have maximum upwards velocity?

- A** 0.5 m **B** 1.0 m **C** 1.5 m **D** 2.0 m

5 - (9702/11_Summer_2017_Q23) - Waves

A sound wave has a frequency of 2500 Hz and a speed of 1500 m s^{-1} .

What is the shortest distance from a point of maximum pressure in the wave to a point of minimum pressure?

- A** 0.15 m **B** 0.30 m **C** 0.60 m **D** 1.20 m

6 - (9702/12_Summer_2017_Q23) - Waves

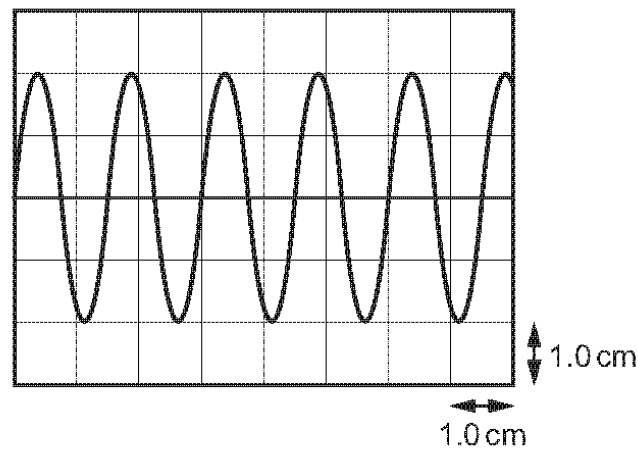
Which statement about progressive longitudinal waves is **not** correct?

- A** The oscillations of the particles are parallel to the direction of travel of the wave energy.
B They have a series of nodes and antinodes.
C They need a medium through which to travel.
D They transfer energy.



7 - (9702/13_Summer_2017_Q23) - Measurement Techniques, Waves

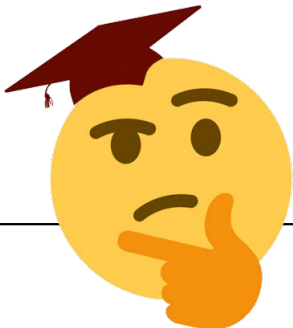
A trace is shown on the screen of a cathode-ray oscilloscope (c.r.o.).



The time-base setting is 2.5 ms cm^{-1} and the Y-gain is 2.0 V cm^{-1} .

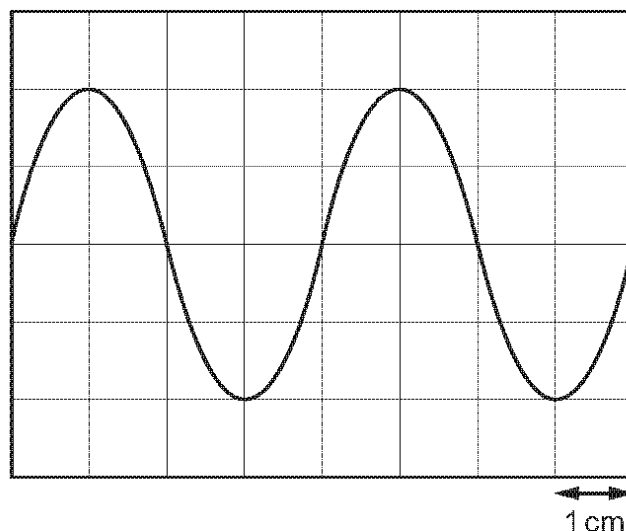
What is the frequency and the amplitude of the waveform displayed by the c.r.o.?

	frequency /Hz	amplitude /V
A	0.00375	4.0
B	0.00375	8.0
C	267	4.0
D	267	8.0



8 - (9702/11_Summer_2017_Q24) - Measurement Techniques, Waves

A sound wave is displayed on the screen of a cathode-ray oscilloscope (c.r.o.) as shown.



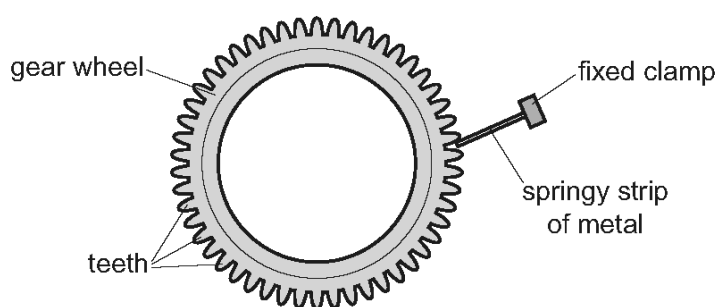
The time-base of the c.r.o. is set at 2.5 ms cm^{-1} .

What is the frequency of the sound wave?

- A** 50 Hz **B** 100 Hz **C** 200 Hz **D** 400 Hz

9 - (9702/12_Summer_2017_Q24) - Waves

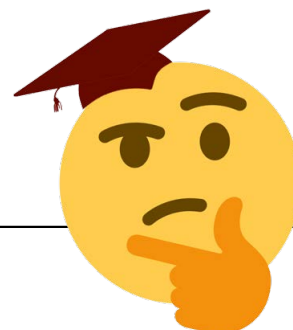
A bicycle gear wheel is a disc with 50 'teeth' equally spaced around its edge, as shown. The gear wheel is rotated 10 times each second. A springy strip of metal is vibrated by the rotating 'teeth'. The metal strip produces a sound of frequency that is equal to the frequency of vibration of the strip.



The speed of sound in air is 330 m s^{-1} .

What is the wavelength of the emitted sound?

- A** 0.66 m **B** 1.5 m **C** 6.6 m **D** 500 m



10 - (9702/13_Summer_2017_Q24) - Waves

A high-speed train approaches a stationary observer at a speed of 80 ms^{-1} . The train's horn emits a sound of frequency 250 Hz .

The speed of sound is 340 ms^{-1} .

What is the observed frequency of the sound from the horn?

- A** 190 Hz **B** 200 Hz **C** 310 Hz **D** 330 Hz

11 - (9702/11_Summer_2017_Q25) - Waves

A car travelling in a straight line at a speed of 30 ms^{-1} passes near a stationary observer while sounding its horn. The true frequency of sound from the horn is 400 Hz .

The speed of sound in air is 336 ms^{-1} .

What is the change in the frequency of the sound heard by the observer as the car passes?

- A** 39 Hz **B** 66 Hz **C** 72 Hz **D** 78 Hz

12 - (9702/12_Summer_2017_Q25) - Waves

An ambulance travels along a straight road at a speed of 30.0 ms^{-1} . Its siren emits sound of frequency 2000 Hz . The speed of sound in the air is 340 ms^{-1} . The ambulance passes a man standing at the side of the road.

What is the frequency of the sound heard by the man as the ambulance moves towards him and as the ambulance moves away from him?

	frequency heard as ambulance moves towards man / Hz	frequency heard as ambulance moves away from man / Hz
A	1820	2180
B	1840	2190
C	2180	1820
D	2190	1840



13 - (9702/13_Summer_2017_Q25) - Waves

Which row shows a correct frequency in Hz for each of the four principal radiations?

	X-rays	ultraviolet	microwaves	infra-red
A	10^{10}	10^{14}	10^{18}	10^{15}
B	10^{14}	10^{18}	10^{15}	10^{10}
C	10^{15}	10^{10}	10^{14}	10^{18}
D	10^{18}	10^{15}	10^{10}	10^{14}

14 - (9702/11_Summer_2017_Q26) - Waves

Which list shows electromagnetic waves in order of increasing frequency?

- A** radio waves → gamma rays → ultraviolet → infra-red
- B** radio waves → infra-red → ultraviolet → gamma rays
- C** ultraviolet → gamma rays → radio waves → infra-red
- D** ultraviolet → infra-red → radio waves → gamma rays

15 - (9702/12_Summer_2017_Q26) - Waves

Three different electromagnetic waves P, Q and R have the frequencies shown.

	frequency / Hz
P	3×10^{10}
Q	3×10^{13}
R	6×10^{14}

Which row identifies P, Q and R?

	P	Q	R
A	infra-red	visible	ultraviolet
B	microwave	infra-red	visible
C	ultraviolet	X-ray	gamma ray
D	visible	ultraviolet	X-ray



16 - (9702/11_Winter_2017_Q4) - Waves

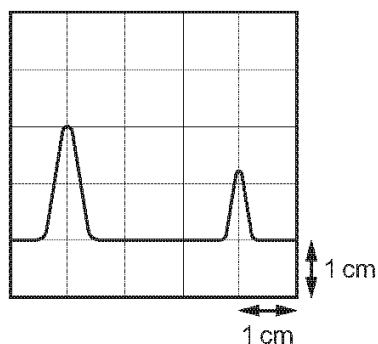
What is a typical value of the wavelength of a microwave travelling in a vacuum?

- A 3 000 000 pm
- B 30 nm
- C 30 000 μm
- D 3000 mm

17 - (9702/12_Winter_2017_Q5) - Waves

A transmitter emits a pulse of electromagnetic waves towards a reflector. The pulse is reflected and returns to the transmitter.

A detector is located at the transmitter. The emitted pulse and the reflected pulse are displayed on a cathode-ray oscilloscope (c.r.o.) as shown.



The pulse takes $6.3 \mu\text{s}$ to travel from the transmitter to the reflector.

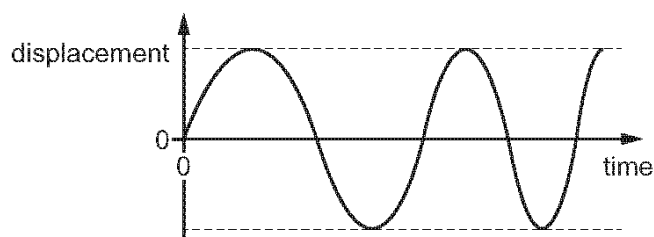
What is the time-base setting of the c.r.o.?

- A $2.1 \mu\text{s cm}^{-1}$
- B $3.2 \mu\text{s cm}^{-1}$
- C $4.2 \mu\text{s cm}^{-1}$
- D $6.3 \mu\text{s cm}^{-1}$



18 - (9702/11_Winter_2017_Q22) - Waves

The displacement-time graph for a layer of air in the path of a sound wave is shown.

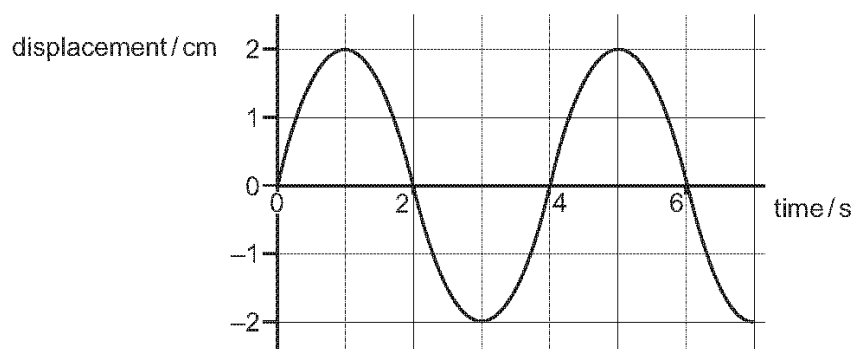


Which wave quantity is increasing?

- A amplitude
- B frequency
- C period
- D wavelength

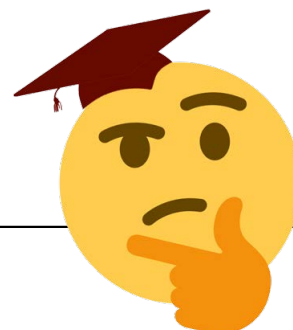
19 - (9702/13_Winter_2017_Q22) - Waves

The graph shows how the displacement of a particle in a wave varies with time.



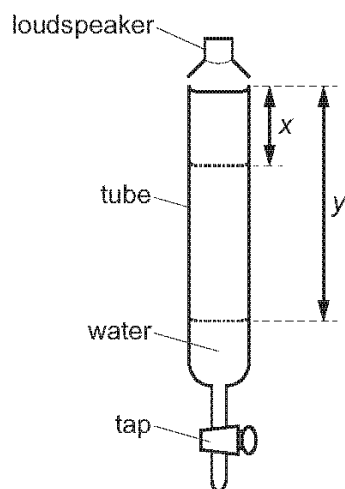
Which statement is correct?

- A The wave has a period of 2 s and could be either transverse or longitudinal.
- B The wave has a period of 2 s and must be transverse.
- C The wave has a period of 4 s and could be either transverse or longitudinal.
- D The wave has a period of 4 s and must be transverse.



20 - (9702/11_Winter_2017_Q23) - Waves

A loudspeaker emits a sound wave into a tube initially full of water.



A tap at the bottom of the tube is opened so that water slowly leaves the tube. For some lengths of the air column in the tube, the sound heard is much louder.

The first loud sound is heard when the air column in the tube has length x .

The next time that a loud sound is heard is when the air column in the tube has length y .

What is the wavelength of the sound wave from the loudspeaker?

- A $2x$ B $4y$ C $2(y - x)$ D $4(y - x)$

21 - (9702/12_Winter_2017_Q23) - Waves

Which wave is a longitudinal wave?

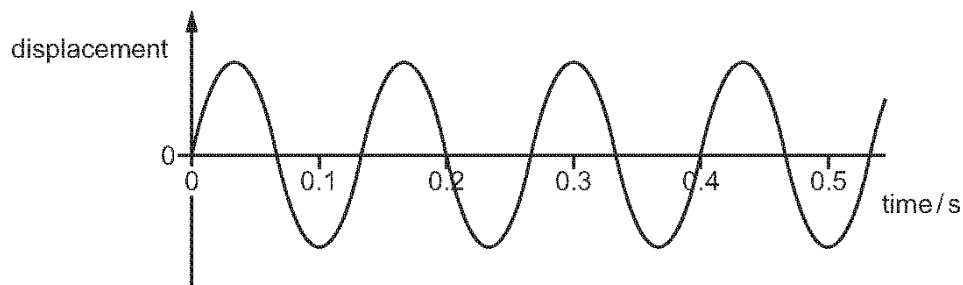
- A a light wave travelling through air
B a radio wave from a broadcasting station
C a ripple on the surface of water
D a sound wave travelling through air



22 - (9702/13_Winter_2017_Q23) - Waves

A wave travels along a coiled spring.

The graph shows the variation with time of the displacement of a point on the spring.



What is the frequency of the wave?

- A 0.13Hz B 0.20Hz C 5.0Hz D 7.5Hz

23 - (9702/11_Winter_2017_Q24) - Waves, Superposition

Diffraction can be observed when a wave passes an obstruction. The diffraction effect is greatest when the wavelength and the obstruction are similar in size.

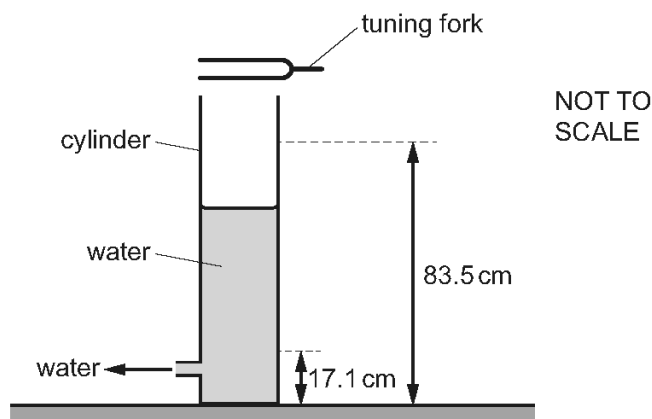
For waves travelling through air, what is the combination of wave and obstruction that could best demonstrate diffraction?

- A microwaves passing a steel post
B radio waves passing a copper wire
C sound waves passing a human hair
D visible light waves passing a gate post



24 - (9702/12_Winter_2017_Q24) - Waves, Superposition

A vibrating tuning fork is held above a glass cylinder filled to the top with water. The water level is steadily lowered. A loud sound is first heard when the water level is 83.5 cm above the bench. The next loud sound is heard when the water level is 17.1 cm above the bench.



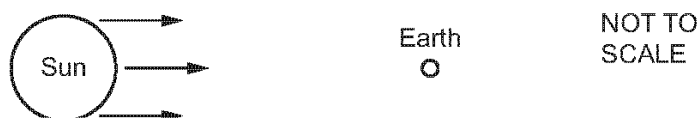
The speed of sound in air is 340 m s^{-1} .

What is the frequency of the tuning fork?

- A 128 Hz B 256 Hz C 384 Hz D 512 Hz

25 - (9702/11_Winter_2017_Q25) - Waves, Superposition

Light of a particular wavelength λ_s is emitted from the Sun. At any instant, a band of wavelengths ranging from less than λ_s to more than λ_s is observed on the Earth. This is caused by the Doppler effect.



What could be the explanation for this Doppler effect?

- A The Sun is moving at right-angles to a line joining the Sun and the Earth.
B The Sun is moving away from the Earth.
C The Sun is moving towards the Earth.
D The Sun is rotating.



26 - (9702/12_Winter_2017_Q25) - Waves, Superposition

A train that is moving in a straight line along a railway track has a whistle that continuously emits sound of frequency f .

A woman standing by the side of the track hears sound of frequency $0.85f$.

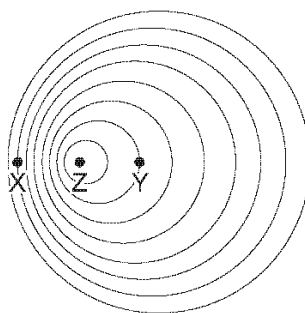
The speed of sound in the air is 340 m s^{-1} .

What is the velocity of the train?

- A 51 m s^{-1} away from the woman
- B 51 m s^{-1} towards the woman
- C 60 m s^{-1} away from the woman
- D 60 m s^{-1} towards the woman

27 - (9702/13_Winter_2017_Q25) - Waves

A source of sound of frequency F at point Z is moving at a steady speed. The pattern of the emitted wavefronts is shown.



Which row describes the frequencies of the sound heard by stationary observers at X and Y?

	frequency heard at X	frequency heard at Y
A	$<F$	$<F$
B	$<F$	$>F$
C	$>F$	$<F$
D	$>F$	$>F$

28 - (9702/11_Winter_2017_Q26) - Waves

What is the order of magnitude of the frequencies of electromagnetic waves in the visible spectrum?

- A 10^{10} Hz
- B 10^{12} Hz
- C 10^{14} Hz
- D 10^{16} Hz



29 - (9702/12_Winter_2017_Q26) - Waves

Orange light in a vacuum has a wavelength of 600 nm.

What is the frequency of this light?

- A 180 Hz B 5.0×10^5 Hz C 1.8×10^{11} Hz D 5.0×10^{14} Hz

30 - (9702/13_Winter_2017_Q26) - Waves

A car travelling at a steady speed in a straight line passes close to a stationary observer. The observer measures the frequency of the sound from the engine.

As the car approaches, the observed frequency is 220 Hz. When the car moves away, the observed frequency is 180 Hz.

The speed of sound in air is 340 m s^{-1} .

What is the speed of the car?

- A 8.5 m s^{-1} B 31 m s^{-1} C 34 m s^{-1} D 38 m s^{-1}

31 - (9702/13_Winter_2017_Q27) - Waves

Which frequency of electromagnetic radiation could be ultraviolet?

- A 1.0×10^6 Hz
B 1.0×10^9 Hz
C 1.0×10^{12} Hz
D 1.0×10^{15} Hz

32 - (9702/13_Winter_2017_Q28) - Waves

An electromagnetic wave travels in a straight line through a vacuum. The wave has a frequency of 6.0 THz.

What is the number of wavelengths in a distance of 1.0 m along the wave?

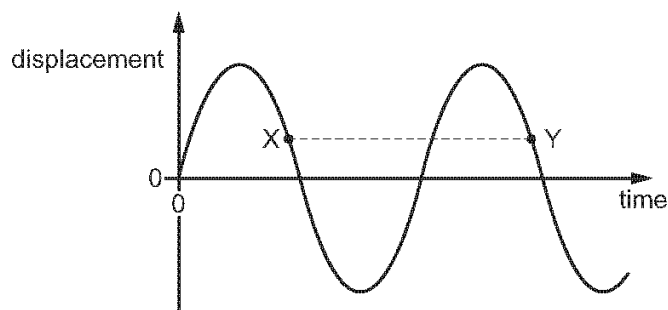
- A 5.0×10^{-5} B 2.0×10^1 C 2.0×10^4 D 5.0×10^7



33 - (9702/11_Summer_2018_Q20) - Waves

A transverse progressive wave is set up on a string.

The graph shows the variation with time of displacement for a point on this string.



The separation XY on the graph represents the1..... of the wave.

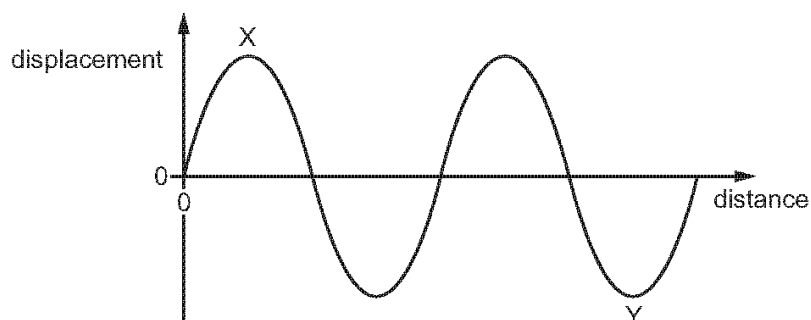
X and Y have equal2..... .

Which words correctly complete gaps 1 and 2?

	1	2
A	time period	amplitudes
B	time period	displacements
C	wavelength	amplitudes
D	wavelength	displacements

34 - (9702/13_Summer_2018_Q20) - Waves

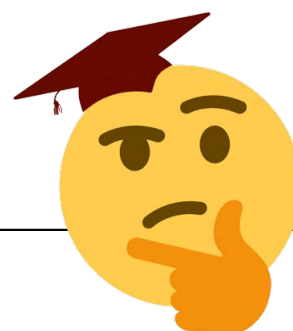
The displacement-distance graph for a transverse progressive wave is shown.



The phase difference between points X and Y can be expressed as $(180n)^\circ$.

What is the value of n ?

- A** 1.5 **B** 2.5 **C** 3.0 **D** 6.0



35 - (9702/11_Summer_2018_Q21) - Waves

Which region of the electromagnetic spectrum includes waves with a frequency of 10^7 MHz?

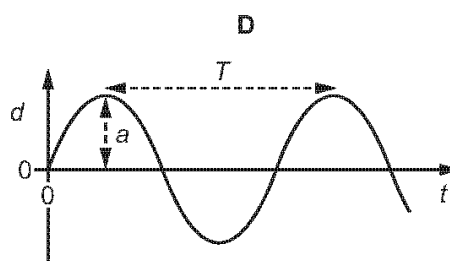
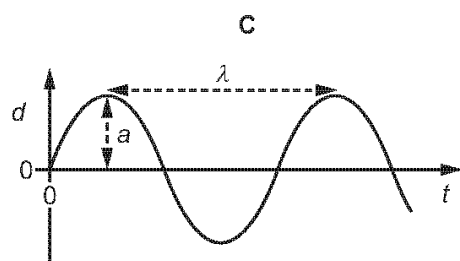
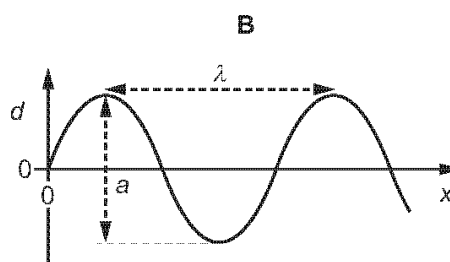
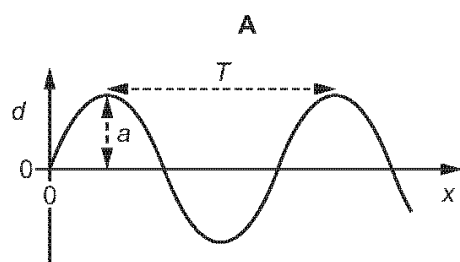
- A infra-red waves
- B radio waves
- C ultraviolet waves
- D X-rays

36 - (9702/13_Summer_2018_Q21) - Waves

The four graphs represent a progressive wave on a stretched string. Graphs A and B show how the displacement d varies with distance x along the string at one instant. Graphs C and D show how the displacement d varies with time t at a particular value of x .

The labels on the graphs are intended to show the wavelength λ , the period T and the amplitude a of the wave, but only one graph is correctly labelled.

Which graph is correctly labelled?

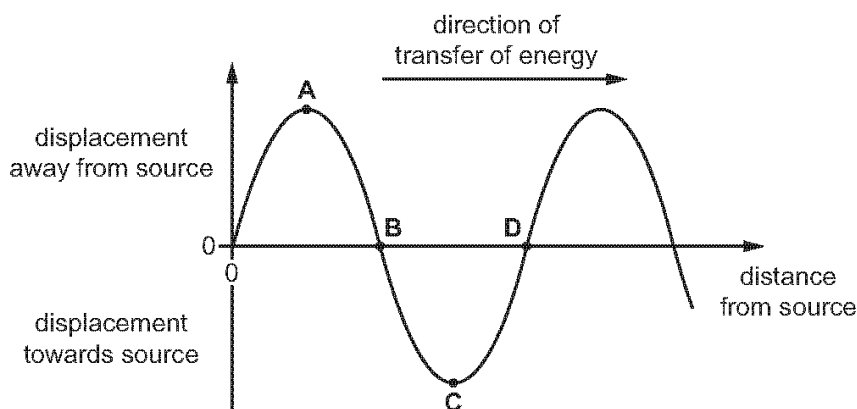


37 - (9702/11_Summer_2018_Q22) - Waves

A longitudinal wave has vibrations parallel to the direction of transfer of energy by the wave.

The wave can be represented on a graph showing the variation of the displacement of the particles with distance from the source.

Which point on the graph is the centre of a compression?



38 - (9702/12_Summer_2018_Q22) - Waves

Two lasers emit light in a vacuum. One laser emits red light and the other emits green light.

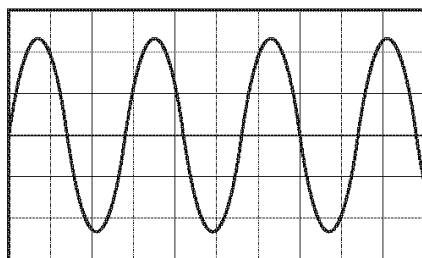
Which property of the two laser beams **must** be different?

- A amplitude
- B frequency
- C intensity
- D speed

39 - (9702/13_Summer_2018_Q22) - Waves

A cathode-ray oscilloscope (c.r.o.) is used to determine the frequency of a sound wave.

The diagram shows the waveform on the screen.



The time-base setting is 5.0 ms / div.

What is the frequency of the sound wave?

- A 57 Hz
- B 71 Hz
- C 114 Hz
- D 143 Hz



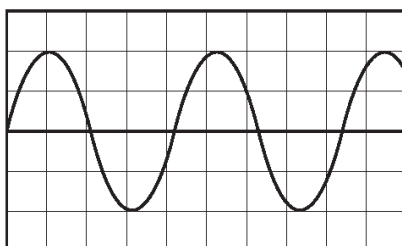
40 - (9702/11_Summer_2018_Q23) - Waves

What can be deduced from a table of wavelengths of the waves in the electromagnetic spectrum?

- A Green light has a shorter wavelength than X-rays.
- B Red light has a shorter wavelength than green light.
- C The wavelength range for radio waves is less than that for infra-red waves.
- D The wavelength range for X-rays is less than that for radio waves.

41 - (9702/12_Summer_2018_Q23) - Waves

The diagram shows the screen of a cathode-ray oscilloscope (c.r.o.) displaying a wave.



The time-base of the c.r.o. is set at 10 ms / division.

What is the frequency of the wave?

- A 0.24 Hz B 4.2 Hz C 12 Hz D 24 Hz

42 - (9702/13_Summer_2018_Q23) - Waves

A police car travels at a velocity of 30.0 m s^{-1} directly towards a stationary observer. The horn of the car emits sound of frequency 2000 Hz. The speed of sound is 340 m s^{-1} .

What is the frequency of the sound heard by the observer?

- A 1840 Hz B 2000 Hz C 2180 Hz D 2190 Hz

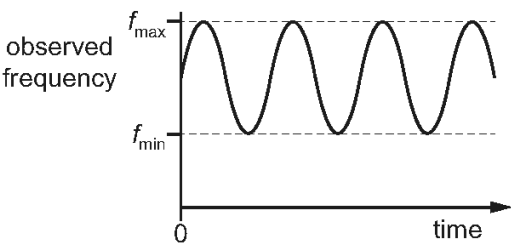


43 – (9702/11_Summer_2018_Q24) – Waves

A binary star consists of two stars rotating around a common centre. Light from one of the stars is observed on the Earth.



The observed frequency of the light varies between a minimum frequency $f_{\min}$ and a maximum frequency $f_{\max}$, as shown.



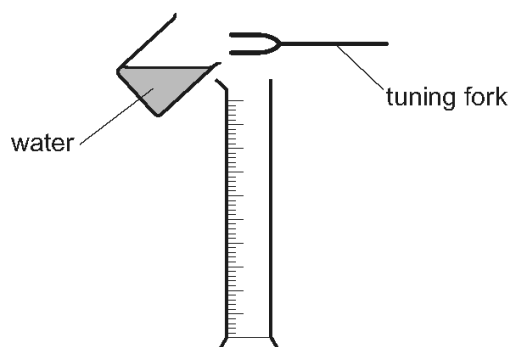
The rate of rotation of the binary star increases.

What is the change to $f_{\max}$ and the change to $f_{\min}$?

	$f_{\max}$	$f_{\min}$
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

44 - (9702/13_Summer_2018_Q24) - Waves, Superposition

A vibrating tuning fork is held over a measuring cylinder, as shown.



Water is then gradually poured into the measuring cylinder. A much louder sound is first heard when the water level is 2.9 cm above the base of the measuring cylinder. A second much louder sound is heard when the water level reaches a height of 67.3 cm above the base.

The speed of sound in air is 330 m s^{-1} .

What is the frequency of the tuning fork?

- A 128 Hz B 256 Hz C 512 Hz D 1024 Hz

45 - (9702/12_Summer_2018_Q25) - Waves

Which region of the electromagnetic spectrum has waves of wavelength 1000 times smaller than the wavelength of visible light?

- A infra-red
B microwaves
C ultraviolet
D X-rays

46 - (9702/13_Summer_2018_Q25) - Waves

A water wave in a ripple tank is diffracted as it passes through a gap in a barrier.

Which two factors affect the angle of diffraction of the wave?

- A the amplitude and frequency of the incident wave
B the amplitude of the incident wave and the width of the gap
C the wavelength and amplitude of the incident wave
D the wavelength of the incident wave and the width of the gap



47 - (9702/12_Summer_2018_Q26) - Waves, Superposition

The diagram shows apparatus for the measurement of the frequency of a sound wave.



Sound of the unknown frequency is reflected back from a metal plate. A microphone placed at a distance D from the metal plate detects the sound intensity. A minimum intensity is detected with $D = 12.0$ cm. The plate is moved further away from the microphone until the next minimum is detected with $D = 15.0$ cm.

The speed of sound in air is 336 m s^{-1} .

What is the frequency of the sound?

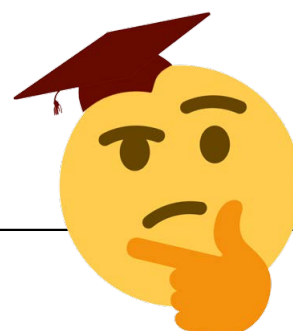
- A 56 Hz B 112 Hz C 5600 Hz D 11 200 Hz

48 - (9702/12_Summer_2018_Q27) - Waves

An astronomer observes the light from a star that is moving away from the Earth.

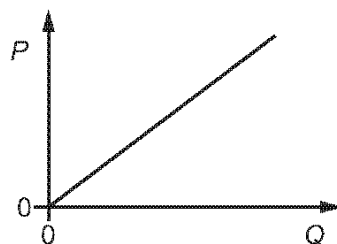
For the observed light, what has been increased due to the star's motion?

- A amplitude
B frequency
C speed
D wavelength



49 - (9702/11_Winter_2018_Q21) - Waves

The graph shows the variation of a quantity P with a quantity Q for a sound wave travelling in air.



What could P and Q be?

	P	Q
A	amplitude	intensity
B	frequency	wavelength
C	speed	frequency
D	wavelength	period

50 - (9702/13_Winter_2018_Q21) - Waves

A progressive sound wave in air has amplitude x_0 and intensity I .

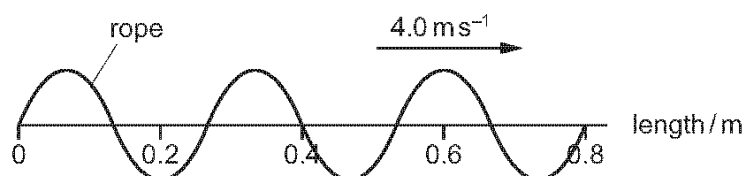
The amplitude of the wave increases to $3x_0$.

What is the new intensity of the wave?

- A $\frac{I}{9}$ B $\frac{I}{3}$ C $3I$ D $9I$

51 - (9702/11_Winter_2018_Q22) - Waves

A vibration generator produces a progressive wave on a rope. The diagram shows the rope at one instant. The wave travels at a speed of 4.0 m s^{-1} .



What are the wavelength and the frequency of the wave?

	wavelength / m	frequency / Hz
A	0.13	15
B	0.13	30
C	0.27	15
D	0.27	30



52 - (9702/12_Winter_2018_Q22) - Waves

A progressive wave on a wire has a frequency of 10 Hz. Two points on the wire, separated by a distance of 0.25 m, have a phase difference of 22.5° .

What is the maximum speed of the wave?

- A** 2.5 m s^{-1} **B** 10 m s^{-1} **C** 20 m s^{-1} **D** 40 m s^{-1}

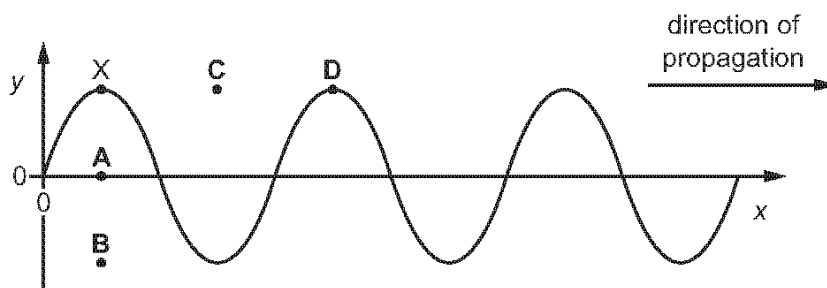
53 - (9702/13_Winter_2018_Q22) - Waves

The variation with distance x of the displacement y of a transverse wave on a rope is shown at time $t = 0$.

The wave has a frequency of 0.5 Hz.

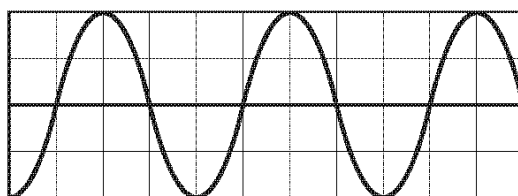
A point X on the rope is marked. The diagram shows the original position of X and four new positions.

What is the position of X at time $t = 1 \text{ s}$?



54 - (9702/11_Winter_2018_Q23) - Waves

The diagram shows the waveform of a signal displayed on a cathode-ray oscilloscope.



The time-base is set at 5.0 ms per division.

The Y-gain is set at 5.0 mV per division.

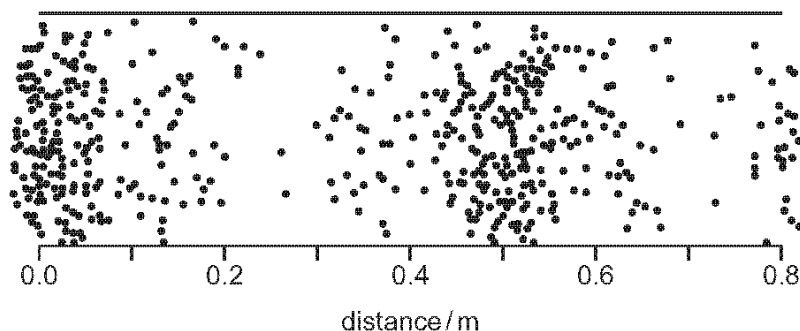
What are the amplitude and the frequency of the signal?

	amplitude / mV	frequency / Hz
A	10	50
B	10	100
C	20	50
D	20	100



55 - (9702/12_Winter_2018_Q23) - Waves

When a guitar string is plucked, it causes a longitudinal sound wave in the air, as shown.



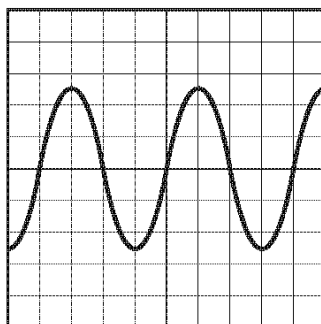
The speed of sound in the air is 340 m s^{-1} .

What is the approximate frequency of the sound wave shown?

- A 430 Hz B 680 Hz C 1100 Hz D 1400 Hz

56 - (9702/13_Winter_2018_Q23) - Waves

A sound wave is detected by a microphone. The output from the microphone is connected to the Y-input of a cathode-ray oscilloscope (c.r.o.). The trace on the c.r.o. is shown.



The time-base is set at 0.20 ms per division.

What is the frequency of the sound wave?

- A 1000 Hz B 1250 Hz C 2000 Hz D 2500 Hz

57 - (9702/11_Winter_2018_Q24) - Waves

A jet aircraft travels at a speed of $0.8v$ where v is the speed of sound. The aircraft approaches a stationary observer. The frequency of sound emitted by the aircraft is 100 Hz .

Which frequency does the observer hear?

- A 56 Hz B 180 Hz C 400 Hz D 500 Hz



58 - (9702/13_Winter_2018_Q24) - Waves

A bat flies directly towards a fixed ultrasound detector at a speed of 25.0 m s^{-1} emitting pulses of ultrasound of frequency 40.0 kHz .

The speed of sound in air is 330 m s^{-1} .

Which frequency does the ultrasound detector record?

- A 37.0 kHz B 37.2 kHz C 43.0 kHz D 43.3 kHz

59 - (9702/11_Winter_2018_Q25) - Waves

A telescope detects and analyses some electromagnetic radiation of wavelength 2 cm .

Which type of telescope is it?

- A microwave telescope
B optical telescope
C radio telescope
D X-ray telescope

60 - (9702/12_Winter_2018_Q25) - Waves

A police car has a two-tone siren emitting sound of frequencies of 700 Hz and 1000 Hz .

The police car is travelling at a speed of 40.0 m s^{-1} towards a stationary observer. The speed of sound in the air is 340 m s^{-1} .

What is the difference between the two frequencies of the sound that is heard by the observer?

- A 268 Hz B 300 Hz C 335 Hz D 340 Hz

61 - (9702/13_Winter_2018_Q25) - Waves

An electromagnetic wave has a wavelength of $1.0 \times 10^{-7} \text{ m}$.

To which region of the electromagnetic spectrum does this wave belong?

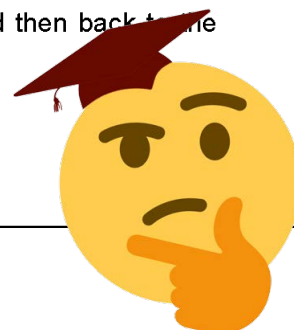
- A infra-red
B ultraviolet
C visible
D X-ray

62 - (9702/12_Winter_2018_Q26) - Waves

A surveyor's device emits a pulse of light. The light is reflected from a wall 150 m away.

What is the time taken for the pulse to travel from the device to the wall and then back to the device?

- A 0.05 ns B 0.10 ns C $0.50 \mu\text{s}$ D $1.0 \mu\text{s}$



63 - (9702/13_Winter_2018_Q27) - Waves, Superposition

In which situation does diffraction occur?

- A A wave bounces back from a surface.
- B A wave passes from one medium into another.
- C A wave passes through an aperture.
- D Waves from two identical sources are superposed.

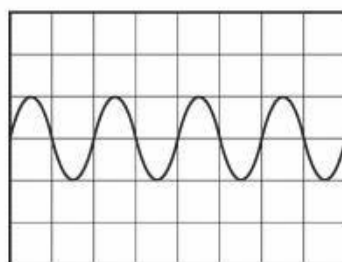
64 - (9702/12_Winter_2018_Q28) - Waves, Superposition

What happens when waves pass through a gap equal to their wavelength?

- A There is diffraction and the wavelength decreases.
- B There is diffraction and the wavelength stays the same.
- C There is no diffraction and the wavelength decreases.
- D There is no diffraction and the wavelength stays the same.

65 - (9702/11_Summer_2019_Q4) - Waves

A whale produces sound waves of frequency 5 Hz. The waves are detected by a microphone and displayed on an oscilloscope.

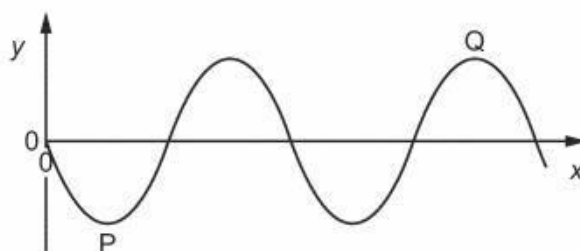


What is the time-base setting on the oscilloscope?

- A 0.1 ms div^{-1} B 1 ms div^{-1} C 10 ms div^{-1} D 100 ms div^{-1}

66 - (9702/13_Summer_2019_Q21) - Waves

The graph shows the variation of displacement y with distance x along a progressive wave at one instant in time.



What is the phase difference between points P and Q on the wave?

- A 90° B 270° C 540° D 630°

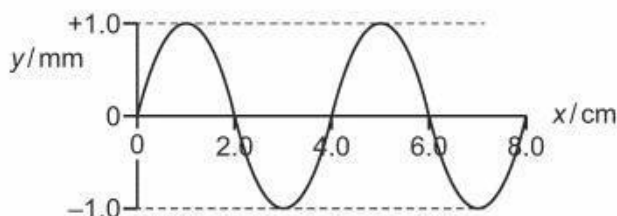


67 - (9702/11_Summer_2019_Q22) - Waves

A transverse wave in a medium has the waveform shown, where

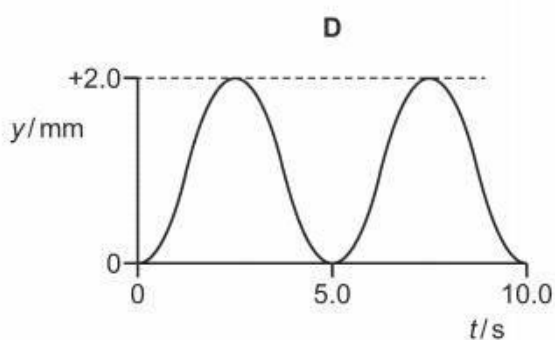
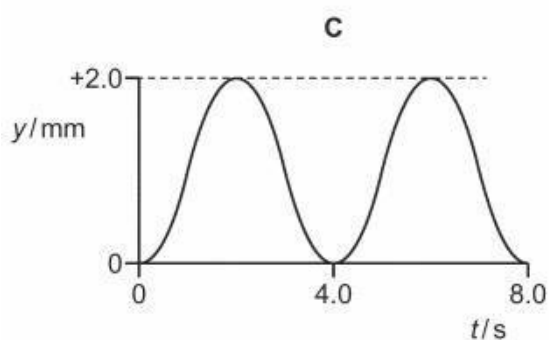
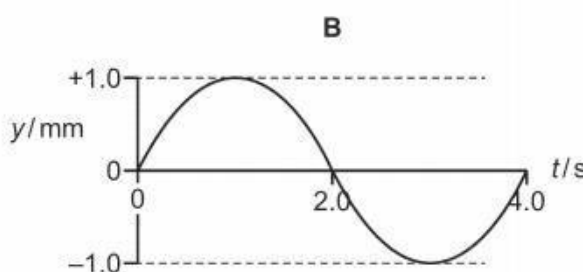
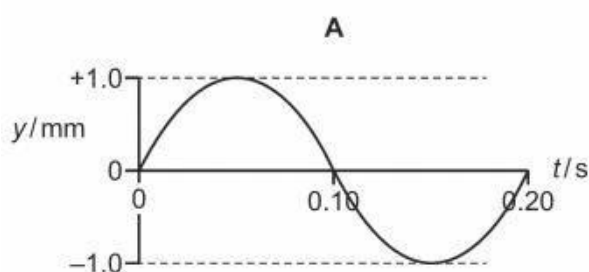
y = vertical displacement and x = horizontal distance.

The speed of the wave is 20.0 cm s^{-1} .



A particle of the medium oscillates vertically.

Which graph of vertical displacement y against time t best represents the motion of this particle?



68 - (9702/13_Summer_2019_Q22) - Waves

Wave-power generators take advantage of the energy that is transferred by the motion of waves across the surface of the oceans. The energy of a wave depends on its amplitude.

What is the correct definition of amplitude?

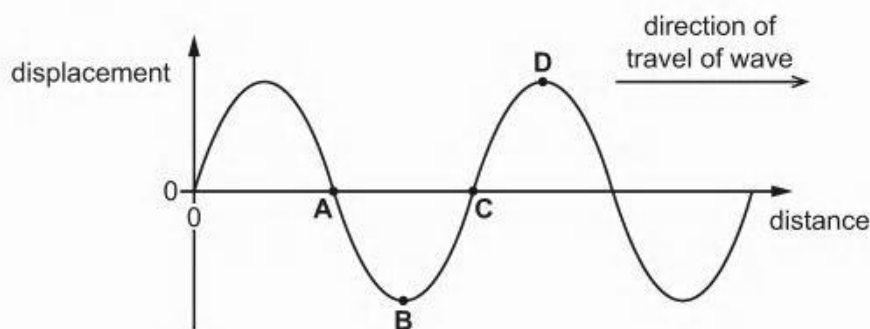
- A** the average amount of energy possessed by a wave
- B** the difference in displacement between a peak and a trough
- C** the maximum displacement of a point on the wave from equilibrium
- D** the number of oscillations of a wave that occur per second



69 - (9702/11_Summer_2019_Q23) - Waves

The graph shows the variation of the displacement of particles with distance along a transverse wave at an instant in time. The wave is moving to the right.

Which position along the wave corresponds to a point where particles in the wave are travelling the fastest upwards?



70 - (9702/12_Summer_2019_Q23) - Waves

The diagram illustrates the position of particles in a progressive sound wave at one instant in time.



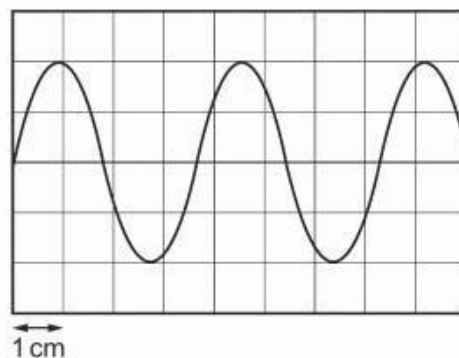
The speed of the wave is v . P and Q are two points in the wave a distance L apart.

What is an expression for the frequency of the wave?

- A $\frac{v}{2L}$ B $\frac{v}{L}$ C $\frac{2v}{L}$ D $\frac{L}{v}$

71 - (9702/13_Summer_2019_Q23) - Waves

A sound wave of frequency 270 Hz is recorded by a cathode-ray oscilloscope (CRO). The waveform on the CRO is shown.



What is the time-base setting on the CRO?

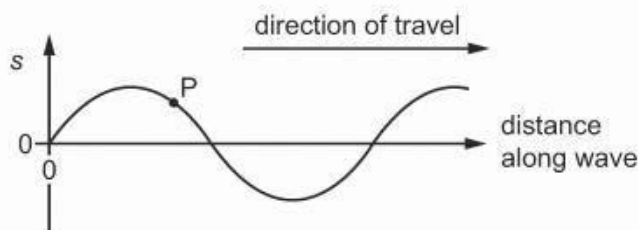
- A 0.1 ms cm^{-1} B 1 ms cm^{-1} C 10 ms cm^{-1} D 100 ms cm^{-1}



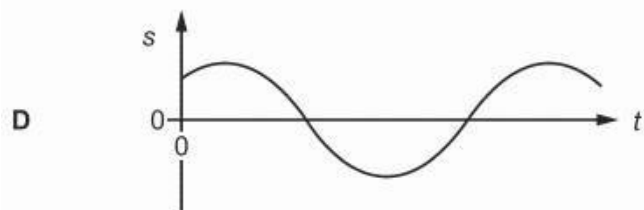
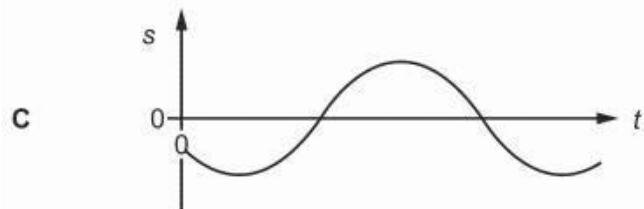
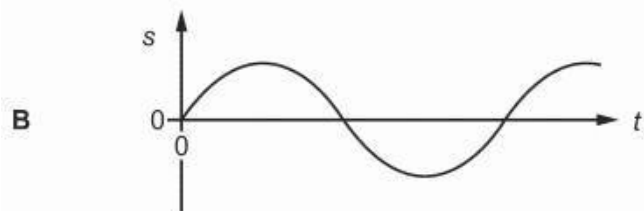
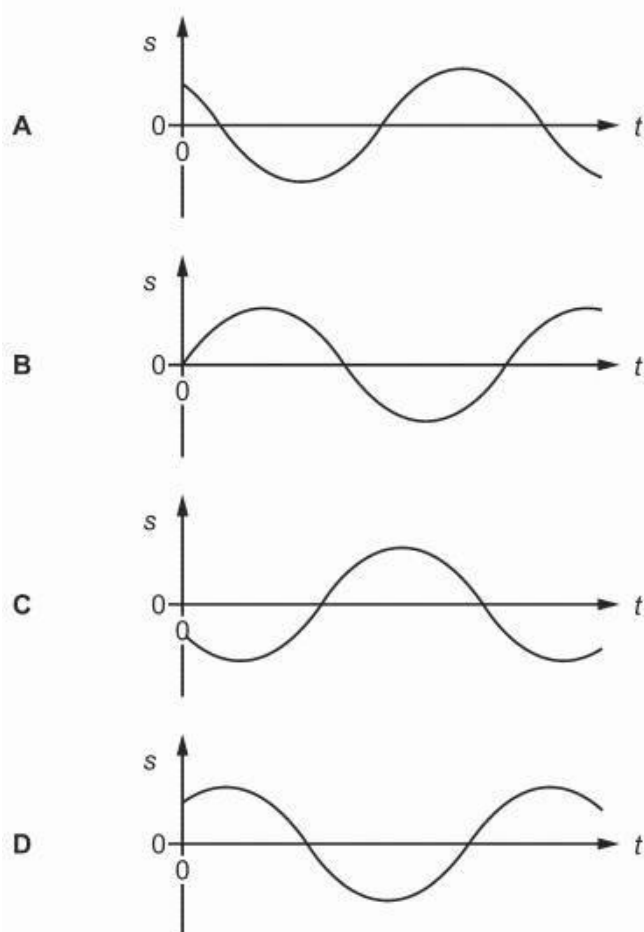
72 - (9702/12_Summer_2019_Q24) - Waves

A wave moves along the surface of water.

The diagram shows the variation of displacement s with distance along the wave at time $t = 0$.



Which graph best shows the variation with time t of the displacement s of the point P on the wave?



73 - (9702/13_Summer_2019_Q24) - Waves

A motor boat vibrates in the water so that it produces water waves of frequency 0.20 Hz . The speed of these waves in the water is 20 ms^{-1} . The motor boat moves with a speed of 5.0 ms^{-1} directly towards a stationary sailing boat.

The Doppler effect equation for sound waves also applies to water waves.

What is the frequency with which the waves hit the stationary sailing boat?

- A** 0.15 Hz **B** 0.16 Hz **C** 0.25 Hz **D** 0.27 Hz

74 - (9702/13_Summer_2019_Q25) - Waves

Infrared laser light is used for the transmission of data along optic fibres.

What is a typical wavelength of infrared radiation?

- A** $5 \times 10^{-5}\text{ m}$ **B** $5 \times 10^{-7}\text{ m}$ **C** $2 \times 10^{-9}\text{ m}$ **D** $2 \times 10^{-11}\text{ m}$

75 - (9702/11_Summer_2019_Q26) - Waves

A toy motorboat moving with constant velocity v vibrates up and down on the surface of a pond. This causes the boat to act as a source of circular water waves of frequency 2.0 Hz . The speed of the waves is 1.5 m s^{-1} .

A man, standing at the edge of the pond, observes that the waves from the boat approach him with a frequency of 3.0 Hz .

The formula for Doppler effect calculations with sound waves may also be used for water waves.

What is a possible value of v ?

	speed / m s^{-1}	direction
A	0.50	directly away from the man
B	0.50	directly towards the man
C	0.75	directly away from the man
D	0.75	directly towards the man

76 - (9702/12_Summer_2019_Q26) - Waves

In one of the first experiments to demonstrate the Doppler effect, a train was filled with trumpeters all playing a note of frequency 440 Hz . The difference in observed frequency of the note as the train directly approached a stationary observer was 22 Hz . The speed of sound was 340 m s^{-1} .

At which speed was the train moving?

- A** 15.4 m s^{-1} **B** 16.2 m s^{-1} **C** 17.0 m s^{-1} **D** 17.9 m s^{-1}



77 - (9702/12_Summer_2019_Q27) - Waves

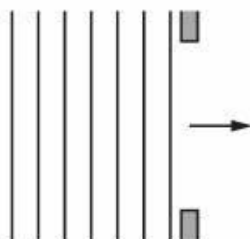
The electromagnetic spectrum consists of waves with different wavelengths.

Which row correctly identifies regions of the electromagnetic spectrum?

	10^{-10} m	10^{-8} m	10^{-5} m	10^{-2} m
A	microwaves	X-rays	ultraviolet	infrared
B	infrared	microwaves	X-rays	ultraviolet
C	microwaves	infrared	ultraviolet	X-rays
D	X-rays	ultraviolet	infrared	microwaves

78 - (9702/13_Summer_2019_Q27) - Waves

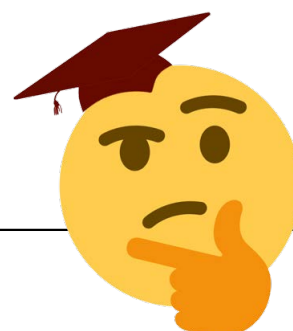
In an experiment, water waves in a ripple tank are incident on a gap, as shown.



Some diffraction of the water waves is observed.

Which change to the experiment would provide a better demonstration of diffraction?

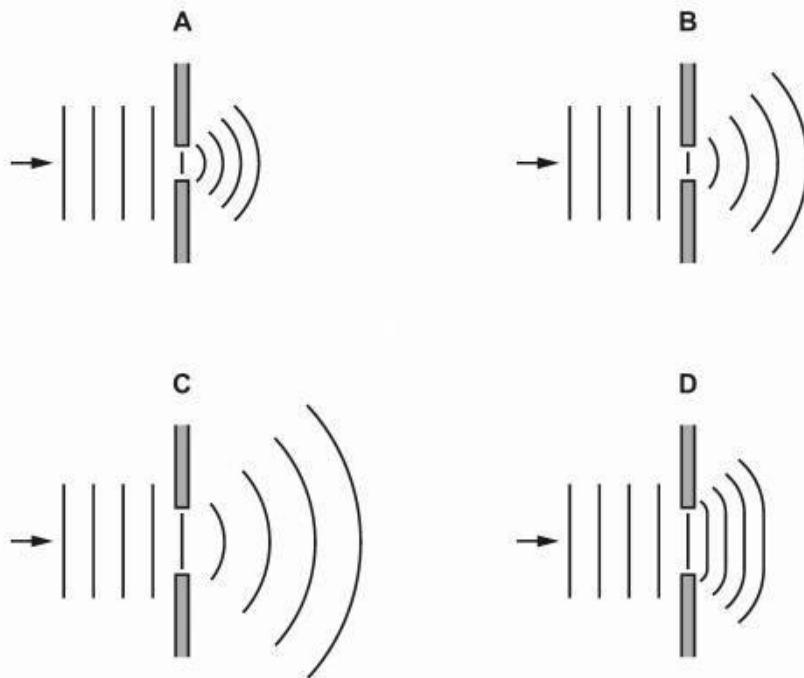
- A** Increase the amplitude of the waves.
- B** Increase the frequency of the waves.
- C** Increase the wavelength of the waves.
- D** Increase the width of the gap.



79 - (9702/11_Summer_2019_Q28) - Waves

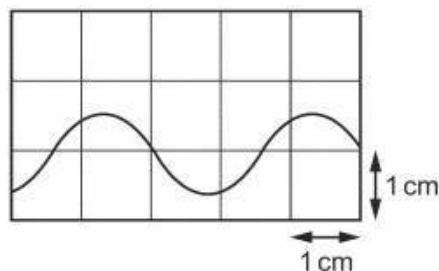
The diagrams show the diffraction of water waves in a ripple tank as they pass through a gap between two barriers.

Which diagram is correct?



80 - (9702/12_Summer_2019_Q28) - Waves

A cathode-ray oscilloscope (CRO) is used to display the trace from a sound wave. The time-base is set at $5\mu\text{s mm}^{-1}$.



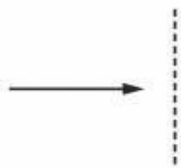
What is the frequency of the sound wave?

- A 6.7 Hz B 67 Hz C 6.7 kHz D 67 kHz



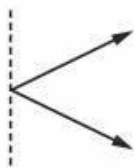
81 - (9702/12_Summer_2019_Q29) - Waves

Monochromatic light is directed at a diffraction grating, as shown.

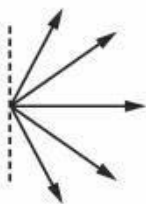


Which diagram could show all the possible directions of the light, after passing through the grating, that give maximum intensity?

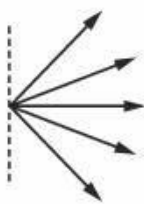
A



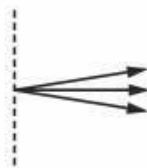
B



C

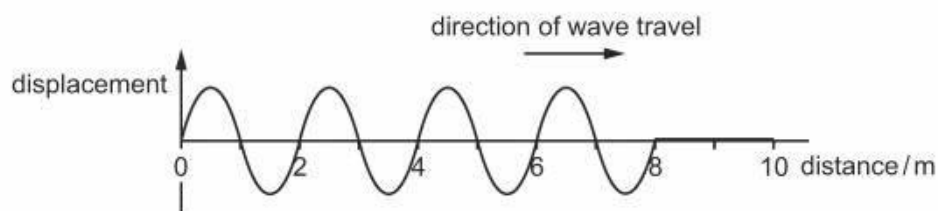


D

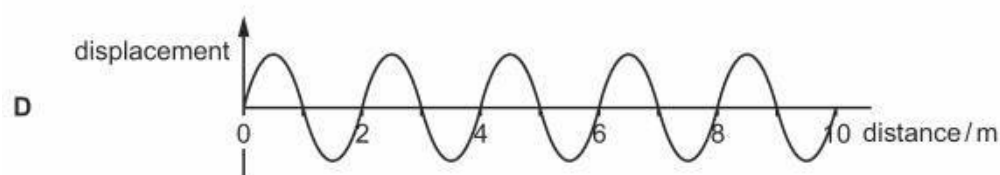
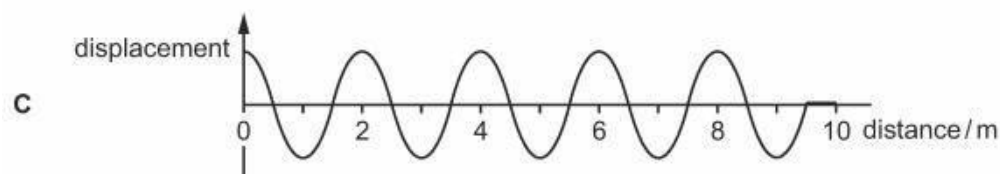
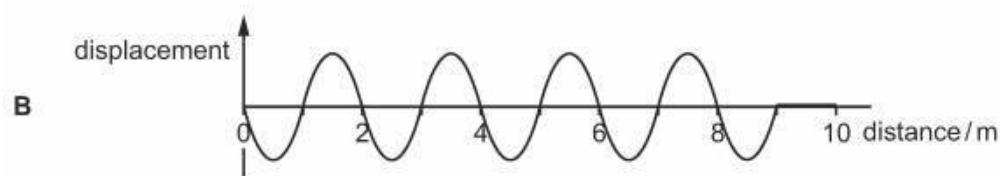
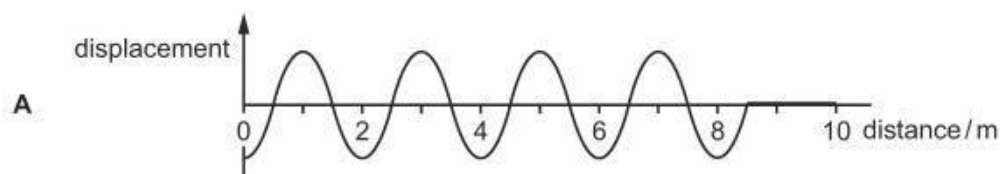


82 - (9702/12_Winter_2019_Q20) - Waves

A transverse wave is travelling along a rope. The frequency of the wave is 2.0 Hz . The graph shows the variation with distance of the displacement of the wave at time $t = 0$.



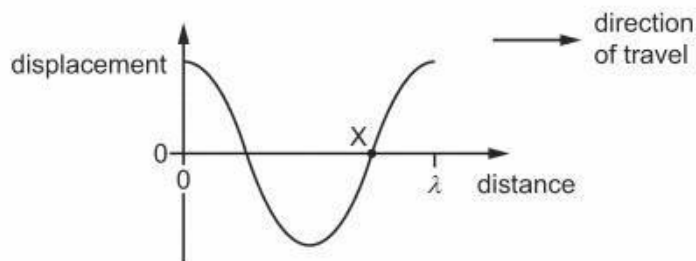
Which diagram shows the position of the wave at time $t = 0.5\text{ s}$?



83 - (9702/11_Winter_2019_Q21) - Waves

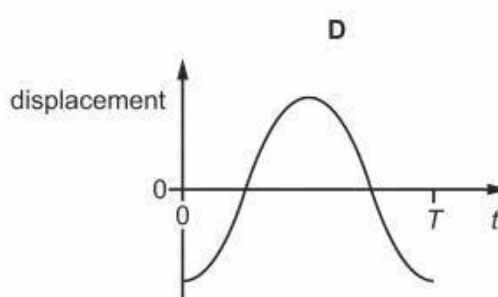
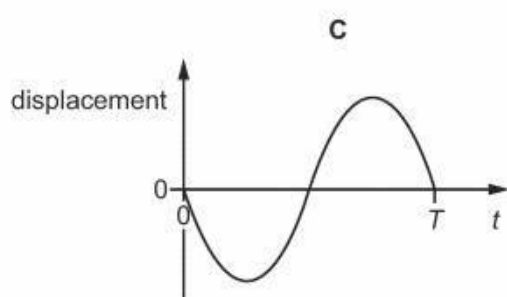
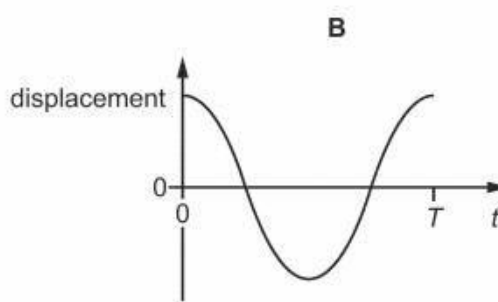
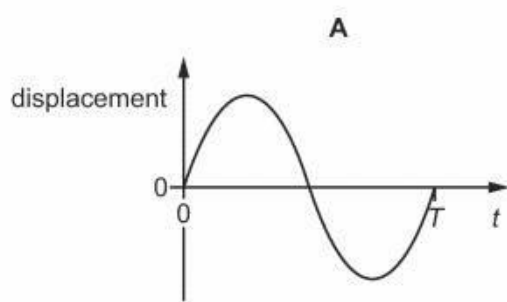
A transverse wave on a rope has wavelength λ and period T .

The graph shows the variation of the displacement of the particles of the rope with distance in the direction of travel of the wave at time $t = 0$.



A particle X is labelled.

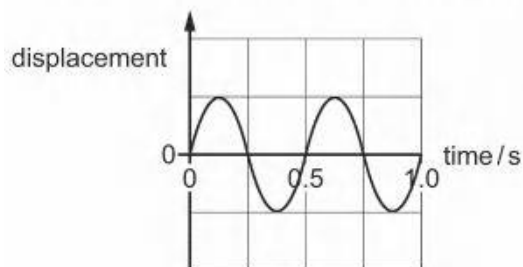
Which graph shows the variation of the displacement of particle X with time t ?



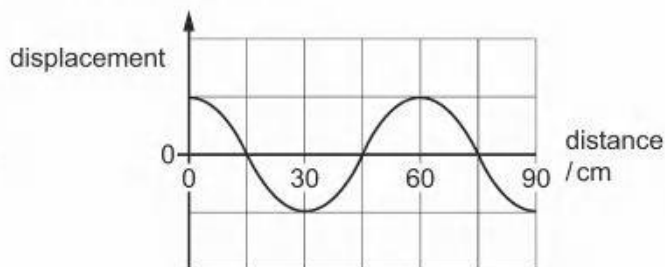
84 - (9702/12_Winter_2019_Q21) - Waves

The two graphs represent the same wave.

Graph 1 shows the variation with time of the displacement at a particular distance. Graph 2 shows the variation with distance of the displacement at one instant.



graph 1



graph 2

What is the speed of the wave?

- A 22.5 cm s^{-1} B 30.0 cm s^{-1} C 90.0 cm s^{-1} D 120 cm s^{-1}

85 - (9702/13_Winter_2019_Q21) - Waves

Which statement about light waves and sound waves is **not** correct?

- A Light waves and sound waves can both demonstrate the Doppler effect.
- B Light waves are transverse waves and sound waves are longitudinal waves.
- C Light waves can be diffracted but sound waves cannot.
- D Light waves can travel in a vacuum but sound waves cannot.

86 - (9702/11_Winter_2019_Q22) - Waves

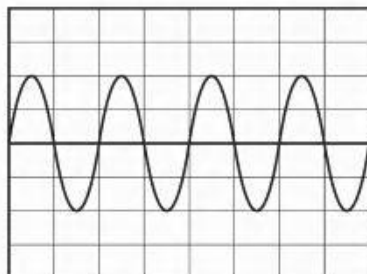
Which statement about all types of transverse waves is correct?

- A They all have the same speed.
- B They all have vibrations that are parallel to the direction of propagation of energy.
- C They can all form stationary waves.
- D They can all travel through a vacuum.



87 - (9702/12_Winter_2019_Q22) - Waves

A microphone is connected to a cathode-ray oscilloscope (CRO). When a tuning fork is struck and then held next to the microphone, the following waveform is shown on the display of the CRO.



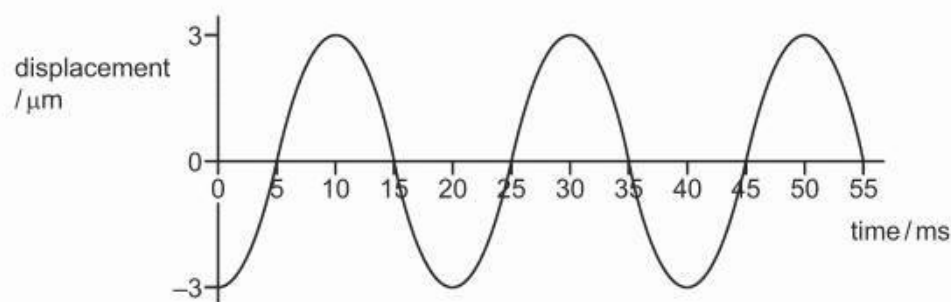
The time-base setting on the CRO is 2.00 ms per division.

What is the best estimate of the frequency of the sound produced by the tuning fork?

- A** 63 Hz **B** 170 Hz **C** 250 Hz **D** 500 Hz

88 - (9702/13_Winter_2019_Q22) - Waves

The graph represents a sound wave.



Which statement is correct?

- A** The wave is longitudinal and has a period of 25 ms.
B The wave is longitudinal and has a frequency of 50 Hz.
C The wave is transverse and has an amplitude of 3 μm .
D The wave is transverse and has a wavelength of 20 ms.

89 - (9702/12_Winter_2019_Q23) - Waves

A loudspeaker emitting a constant frequency of 2000 Hz is swung in a horizontal circle with a speed of 15.0 ms^{-1} .

A stationary observer is level with the loudspeaker and situated a long distance from the loudspeaker. The observer hears a sound of varying frequency. The maximum frequency heard is 2097 Hz.

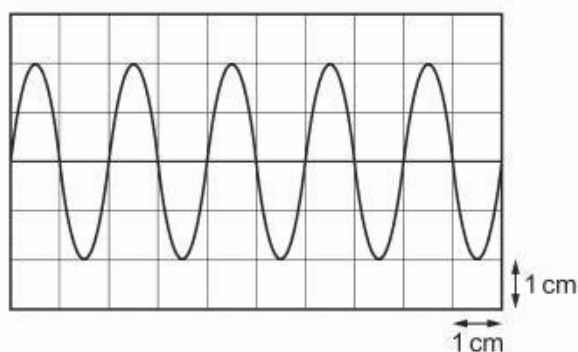
What is the speed of the sound in the air?

- A** 294 ms^{-1} **B** 309 ms^{-1} **C** 324 ms^{-1} **D** 330 ms^{-1}



90 - (9702/13_Winter_2019_Q23) - Waves

A cathode-ray oscilloscope (CRO) is used to display a wave of frequency 5.0 kHz. The display is shown.



What is the time-base setting of the CRO?

- A $10 \mu\text{s cm}^{-1}$ B $100 \mu\text{s cm}^{-1}$ C 10 ms cm^{-1} D 100 ms cm^{-1}

91 - (9702/11_Winter_2019_Q24) - Waves

The siren of a moving police car emits a sound wave with a frequency of 440 Hz. A stationary observer hears sound of frequency 494 Hz. The speed of sound in the air is 340 m s^{-1} .

What could be the speed and the direction of movement of the car?

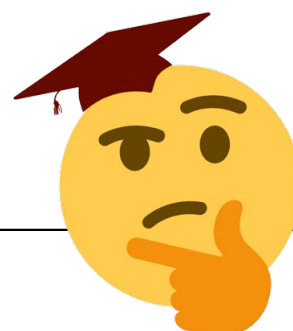
- A 37 m s^{-1} directly towards the observer
 B 37 m s^{-1} directly away from the observer
 C 42 m s^{-1} directly towards the observer
 D 42 m s^{-1} directly away from the observer

92 - (9702/12_Winter_2019_Q24) - Waves

Two electromagnetic waves have wavelengths of $5.0 \times 10^{-7} \text{ m}$ and $5.0 \times 10^{-2} \text{ m}$.

Which row identifies the regions of the electromagnetic spectrum to which the waves belong?

	wavelength $5.0 \times 10^{-7} \text{ m}$	wavelength $5.0 \times 10^{-2} \text{ m}$
A	ultraviolet	infrared
B	visible	microwave
C	ultraviolet	microwave
D	visible	infrared



93 - (9702/13_Winter_2019_Q24) - Waves

A siren emits sound of frequency 1000 Hz. The siren moves at 20 m s^{-1} towards an observer who is standing still.

The speed of sound in the air is 330 m s^{-1} .

Which expression would correctly give the frequency heard by the observer?

- A $\frac{1000 \times 330}{330 + 20}$
- B $\frac{1000 \times 330}{330 - 20}$
- C $\frac{1000 (330 + 20)}{330}$
- D $\frac{1000 (330 - 20)}{330}$

94 - (9702/11_Winter_2019_Q25) - Waves

An electromagnetic wave has a wavelength of 138 pm in a vacuum.

To which region of the electromagnetic spectrum does this wave belong?

- A radio wave
- B microwave
- C visible light
- D X-ray

95 - (9702/13_Winter_2019_Q25) - Waves

A source of sound of constant power P is situated in an open space. The intensity I of sound at distance r from this source is given by

$$I = \frac{P}{4\pi r^2}.$$

How does the amplitude a of the vibrating air molecules vary with the distance r from the source?

- A $a \propto \frac{1}{r}$ B $a \propto \frac{1}{r^2}$ C $a \propto r$ D $a \propto r^2$

96 - (9702/12_Winter_2019_Q26) - Waves

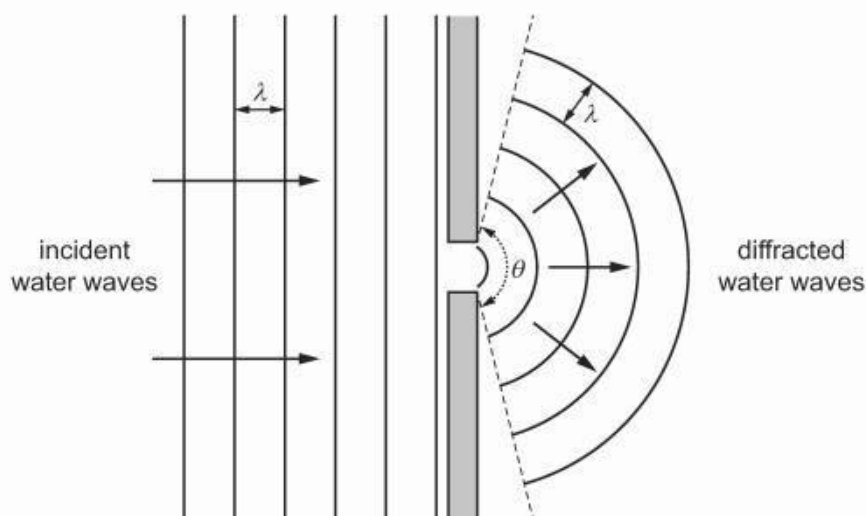
Which statement about a light wave and a sound wave is correct?

- A Both can travel through free space.
- B Both have a frequency inversely proportional to their wavelength.
- C Both have an intensity proportional to their amplitude.
- D Both have oscillations perpendicular to the direction of energy transfer.



97 - (9702/11_Winter_2019_Q27) - Waves

Water waves of wavelength λ are incident normally on an obstacle with a narrow gap. The width of the gap is equal to λ . The waves from the gap emerge over an angle θ as shown.



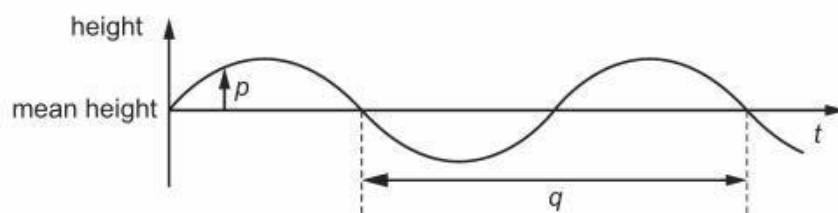
The gap is slowly widened.

Which changes, if any, occur to θ and to the wavelength of the emerging waves?

	θ	wavelength
A	decreases	remains the same
B	increases	remains the same
C	remains the same	decreases
D	remains the same	increases

98 - (9702/13_Winter_2019_Q27) - Waves

The graph shows how the height of the water surface at a point in a harbour varies with time t as waves pass the point.



What are p and q ?

	p	q
A	displacement	period
B	displacement	wavelength
C	amplitude	period
D	amplitude	wavelength



99 - (9702/11_Winter_2019_Q29) - Waves

Monochromatic light of frequency f is incident on a diffraction grating of line spacing d . The speed of light is c .

Which expression can be used to determine the highest order of intensity maximum produced by the grating?

A $n = \frac{d}{cf}$

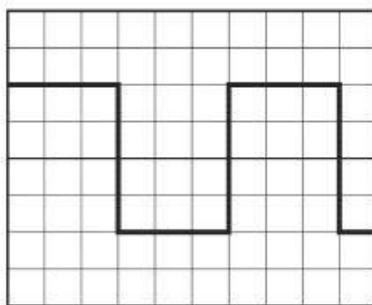
B $n = \frac{df}{c}$

C $n = \frac{dc}{f}$

D $n = \frac{c}{df}$

100 - (9702/11_Summer_2020_Q4) - Waves

A cathode-ray oscilloscope displays a square wave, as shown.



The time-base setting is 0.20 ms per division.

What is the frequency of the square wave?

A 0.83 Hz

B 830 Hz

C 1300 Hz

D 1700 Hz

101 - (9702/12_Summer_2020_Q21) - Waves

A transverse wave is moving along a rope. Two points X and Y on the rope are a quarter of a wavelength apart from each other.

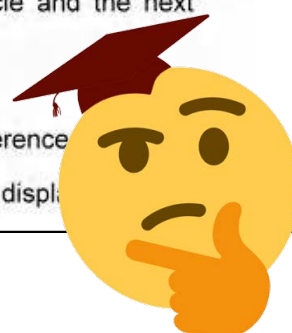
Which statement is **not** possible for the two points X and Y at any instant?

A They are both stationary.**B** They are displaced in opposite directions from their equilibrium position.**C** They are moving in opposite directions.**D** They both have displacements of the same magnitude from their equilibrium positions.

102 - (9702/11_Summer_2020_Q22) - Waves

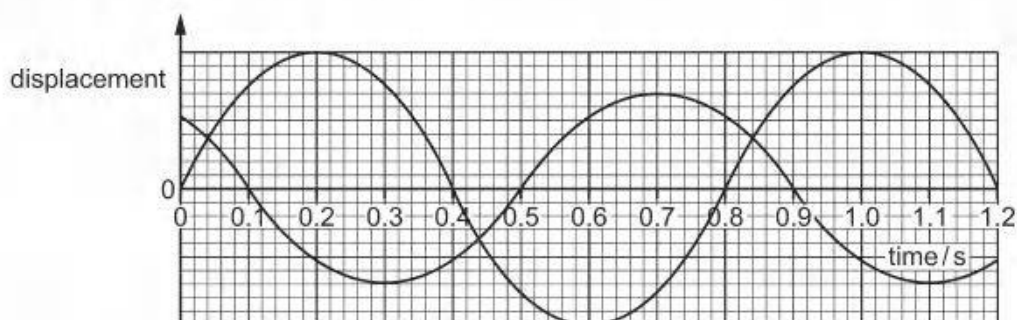
A sound wave reduces in intensity but maintains a constant frequency as it travels through air.

Which statement is correct?

A The maximum displacement of the particles changes between one particle and the next particle.**B** The phase difference between adjacent particles is zero.**C** The wavelength is the distance between two particles that have a phase difference**D** Two particles that have a phase difference of 360° have the same maximum displacement

103 - (9702/12_Summer_2020_Q22) - Waves

Two progressive waves meet at a fixed point P. The variation with time of the displacement of each wave at point P is shown in the graph.



What is the phase difference between the two waves at point P?

- A 45° B 90° C 135° D 180°

104 - (9702/13_Summer_2020_Q22) - Waves

A wave of amplitude A has an intensity I .

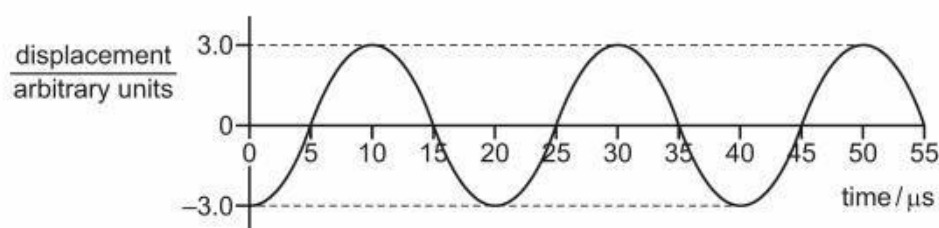
After passing through a certain medium, the wave has a new intensity of $\frac{I}{4}$.

What is the new amplitude of the wave?

- A $2A$ B $\frac{A}{2}$ C $\frac{A}{4}$ D $\frac{A}{16}$

105 - (9702/11_Summer_2020_Q23) - Waves

The graph shows the variation with time of the displacement of an electromagnetic wave at a point.



The wave is travelling in a vacuum.

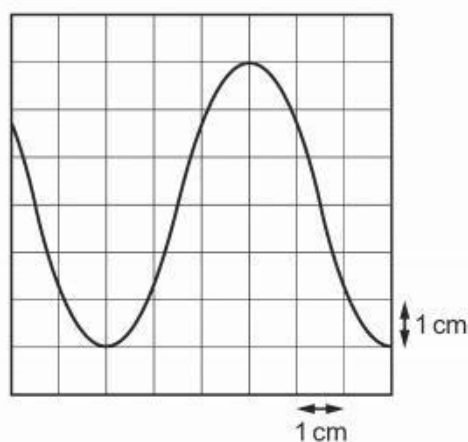
What is the amplitude and what is the wavelength of the wave?

	amplitude / arbitrary units	wavelength / m
A	3.0	6000
B	6.0	6000
C	3.0	7500
D	6.0	7500



106 - (9702/12_Summer_2020_Q23) - Waves

A microphone connected to the Y-plates of a cathode-ray oscilloscope (CRO) is placed in front of a loudspeaker. The trace on the screen of the CRO is shown.



The time-base setting is 0.5 ms cm^{-1} and the Y-plate sensitivity is 0.2 mV cm^{-1} .

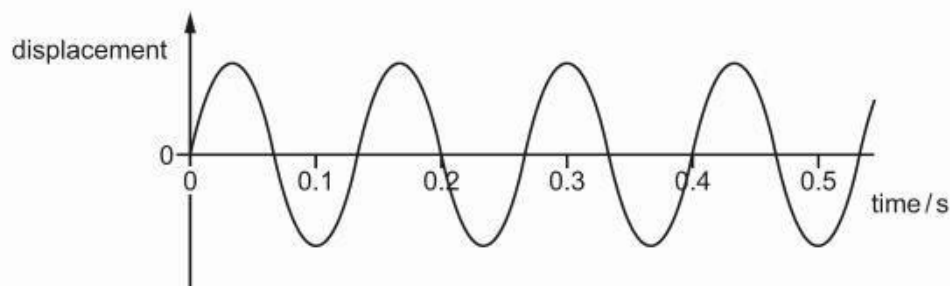
What is the frequency of the sound from the loudspeaker and what is the amplitude of the trace on the CRO?

	frequency / Hz	amplitude / mV
A	330	0.6
B	330	1.2
C	670	0.6
D	670	1.2

107 - (9702/13_Summer_2020_Q23) - Waves

A wave travels along a coiled spring.

The graph shows the variation with time of the displacement of a point on the spring.



What is the frequency of the wave?

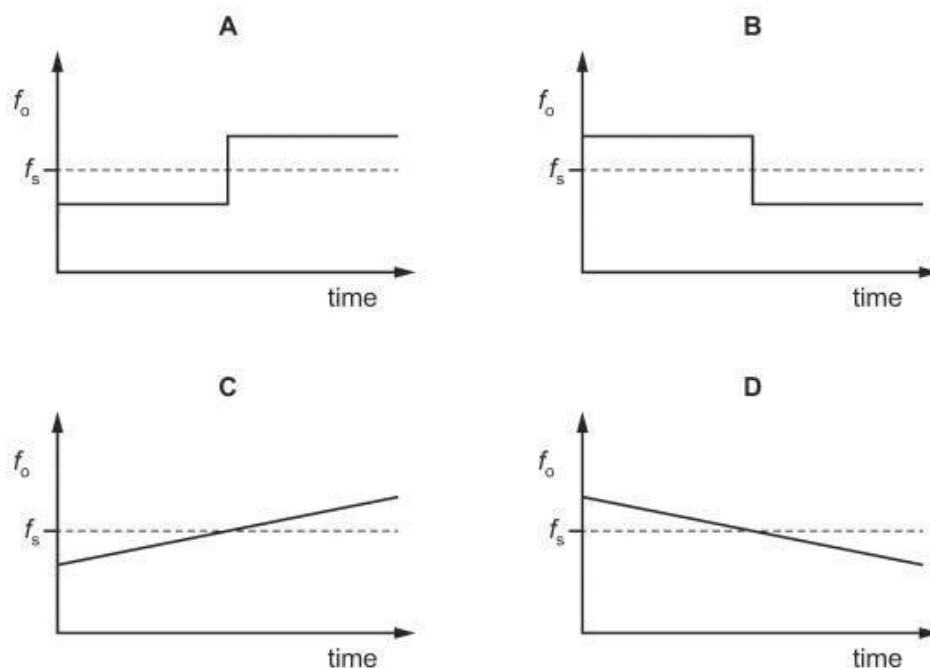
- A 0.13 Hz B 0.20 Hz C 5.0 Hz D 7.5 Hz



108 - (9702/11_Summer_2020_Q25) - Waves

A source emitting sound of a single frequency f_s travels at constant speed directly towards an observer. The source then passes the observer and continues to move directly away from the observer. The velocity of the source remains constant.

Which graph represents the variation with time of the frequency f_o of the sound heard by the observer?

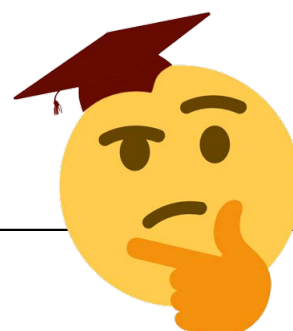


109 - (9702/12_Summer_2020_Q25) - Waves

A stationary person measures the speed and wavelength of the sound from a horn on a stationary vehicle. The person then repeats the measurements when the vehicle is approaching at a constant speed.

Which row describes the measured wavelength and the measured speed of the sound wave from the moving vehicle when compared with the sound wave from the stationary vehicle?

	wavelength of the sound wave	speed of the sound wave
A	longer	greater
B	shorter	greater
C	longer	same
D	shorter	same



110 - (9702/13_Summer_2020_Q25) - Waves

A stationary source S emits a sound wave of frequency f .

The source now moves away from a stationary observer.

Which statement is correct?

- A The frequency of the source S and the observed frequency are now both higher than f .
- B The frequency of the source S and the observed frequency are now both lower than f .
- C The frequency of the source S is now lower than f .
- D The observed frequency is now lower than f .

111 - (9702/11_Summer_2020_Q26) - Waves

What are the names of the electromagnetic waves that have wavelengths in a vacuum of 100 pm and of $100\text{ }\mu\text{m}$?

	wavelength 100 pm	wavelength $100\text{ }\mu\text{m}$
A	γ -rays	infrared
B	γ -rays	red light
C	X-rays	infrared
D	X-rays	red light

112 - (9702/12_Summer_2020_Q26) - Waves

The table shows the wavelengths of five electromagnetic waves.

Which row correctly identifies the principal radiation for each of these wavelengths?

	10^{-14} m	10^{-10} m	10^{-6} m	10^{-2} m	10^2 m
A	gamma-ray	X-ray	infrared	microwave	radio wave
B	radio wave	microwave	infrared	X-ray	gamma-ray
C	radio wave	microwave	ultraviolet	infrared	X-ray
D	X-ray	infrared	ultraviolet	microwave	radio wave



113 - (9702/13_Summer_2020_Q26) - Waves

The table lists possible wavelengths of four different electromagnetic waves.

Which row is correct?

	type of wave	approximate wavelength / m
A	infrared	10^{-5}
B	radio	10^{-3}
C	ultraviolet	10^{-12}
D	X-rays	10^{-7}

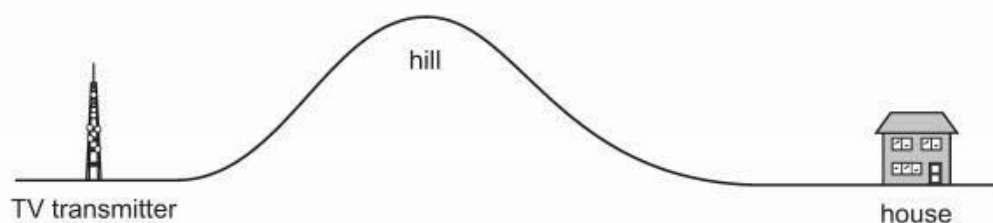
114 - (9702/11_Summer_2020_Q28) - Waves

Which statement **must** be true for diffraction to occur when a wave passes through a gap?

- A The wave is able to travel in a vacuum.
- B The wave is progressive.
- C The wave has a large amplitude.
- D The wave has a long wavelength.

115 - (9702/12_Summer_2020_Q28) - Waves

A hill separates a television (TV) transmitter from a house. The transmitter cannot be seen from the house. However, the house has good TV reception.



By which wave effect at the hill could the TV signal reach the house?

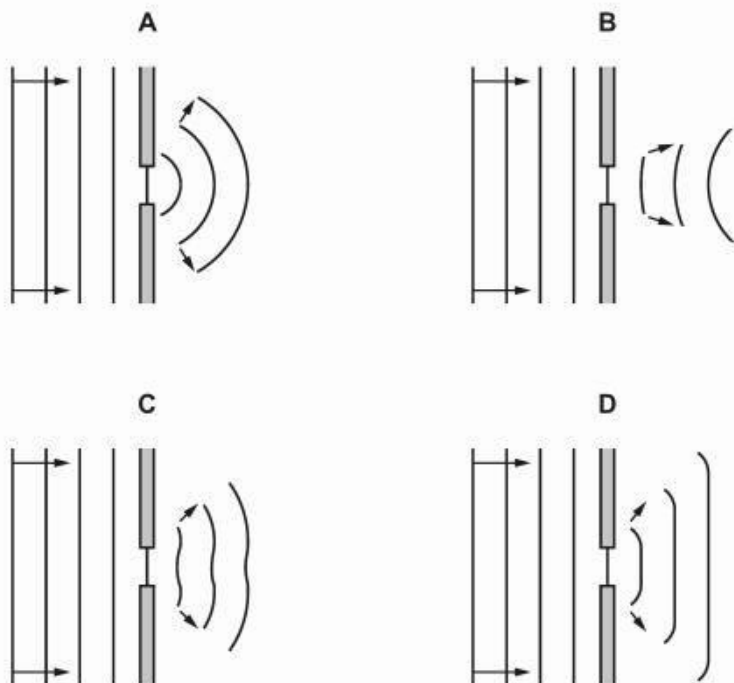
- A coherence
- B diffraction
- C interference
- D reflection



116 - (9702/13_Summer_2020_Q28) - Waves

Water waves in a ripple tank are made to pass through a small gap as shown.

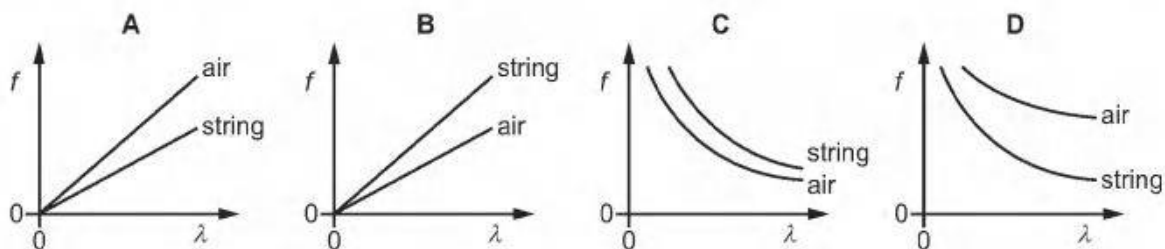
Which diagram shows the waves after they have passed through the gap?



117 - (9702/11_Winter_2020_Q21) - Waves

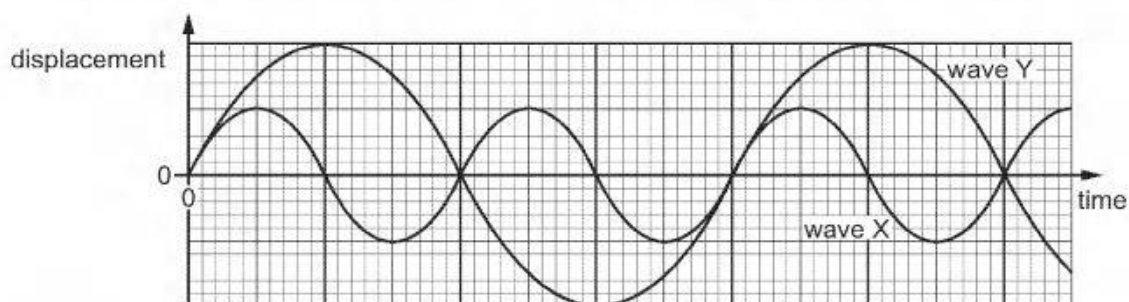
A guitar string vibrates to create a sound. The speed of the wave in the guitar string is always 440 m s^{-1} . The vibrating string creates a sound wave that moves in the air with a speed of 330 m s^{-1} .

Which graph shows the variation of frequency f with the wavelength λ for the waves in the string and in the air?



118 - (9702/11_Winter_2020_Q22) - Waves

The graph shows the variation with time of displacement for two different waves X and Y.



Wave X has frequency f and amplitude A .

What is the frequency and what is the amplitude of wave Y?

	frequency	amplitude
A	$\frac{1}{2}f$	$\frac{1}{2}A$
B	$\frac{1}{2}f$	$2A$
C	$2f$	$\frac{1}{2}A$
D	$2f$	$2A$

119 - (9702/12_Winter_2020_Q22) - Waves

The speed v of waves in deep water is given by the equation

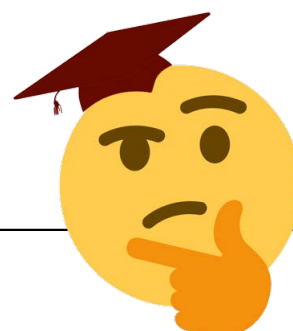
$$v^2 = \frac{g\lambda}{2\pi}$$

where λ is the wavelength of the waves and g is the acceleration of free fall.

A student measures the wavelength λ and the frequency f of a number of these waves.

Which graph should he plot to give a straight line through the origin?

- A f^2 against λ
- B f against λ^2
- C f against $\frac{1}{\lambda}$
- D f^2 against $\frac{1}{\lambda}$



120 - (9702/13_Winter_2020_Q22) - Waves

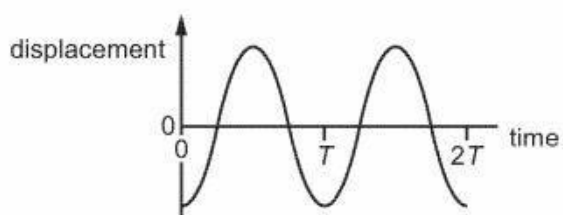
Two waves X and Y have the same frequency. The amplitude of X is $1.5A_0$ and the amplitude of Y is $2.5A_0$. The waves meet at a point and superpose to form a resultant wave.

For the resultant wave, what is the ratio $\frac{\text{maximum possible intensity}}{\text{minimum possible intensity}}$?

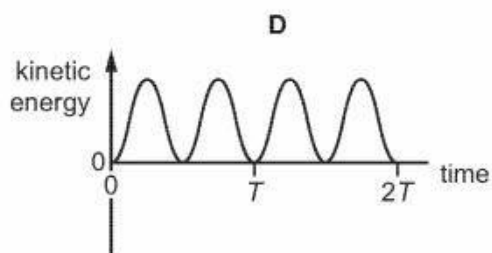
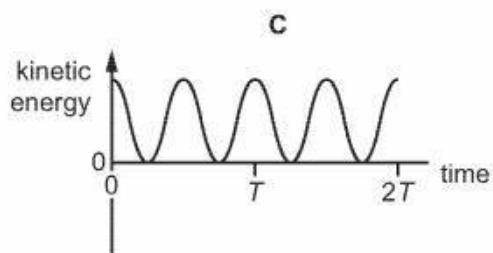
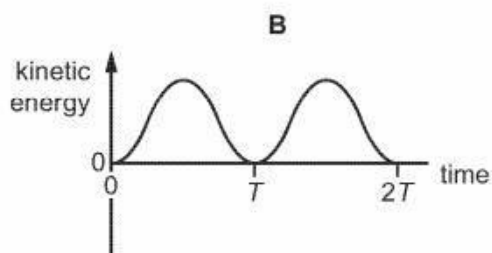
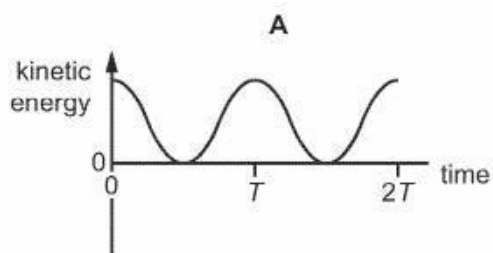
- A 1.7 B 2.8 C 4.0 D 16

121 - (9702/12_Winter_2020_Q23) - Waves

When sound travels through air, the air particles vibrate. A graph of displacement against time for a single air particle is shown.

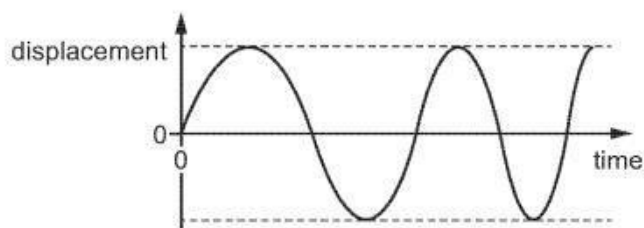


Which graph shows how the kinetic energy of the air particle varies with time?



122 - (9702/13_Winter_2020_Q23) - Waves

The displacement–time graph for an air particle in the path of a sound wave is shown.



Which property of the sound wave must be increasing?

- A amplitude
- B frequency
- C period
- D speed

123 - (9702/11_Winter_2020_Q24) - Waves

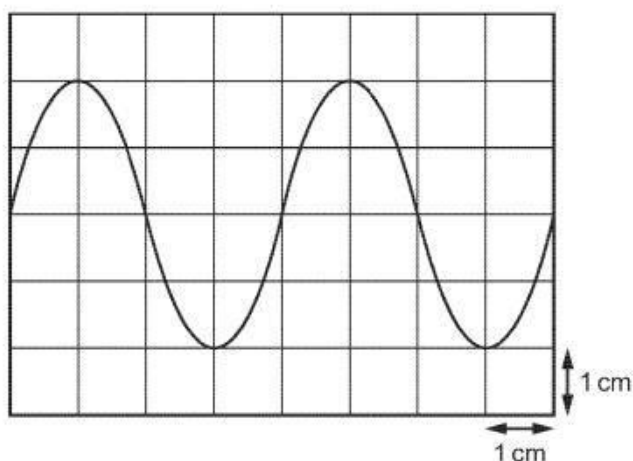
A source of sound of frequency 1000 Hz directly approaches a stationary observer. The observer measures the frequency of the received sound to be 1500 Hz . The speed of sound in still air is 330 m s^{-1} .

What is the speed of the source of sound?

- A 110 m s^{-1} B 165 m s^{-1} C 220 m s^{-1} D 330 m s^{-1}

124 - (9702/13_Winter_2020_Q24) - Waves

A sound wave is displayed on the screen of a cathode-ray oscilloscope (CRO) as shown.



The time-base of the CRO is set at 2.5 ms cm^{-1} .

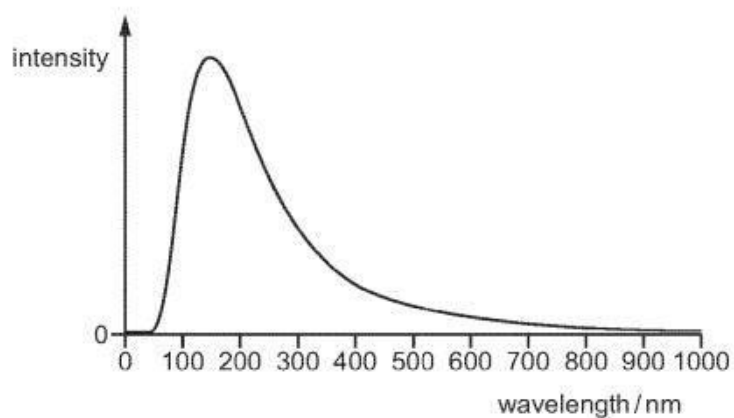
What is the frequency of the sound wave?

- A 50 Hz B 100 Hz C 200 Hz D 400 Hz



125 - (9702/11_Winter_2020_Q25) - Waves

The graph shows how the intensity of electromagnetic radiation emitted from a distant star varies with wavelength.



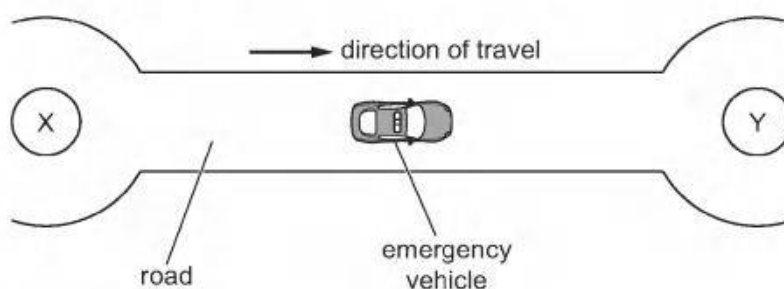
In which region of the electromagnetic spectrum is the radiation of greatest intensity?

- A infrared
- B visible light
- C ultraviolet
- D X-ray



126 - (9702/12_Winter_2020_Q25) - Waves

An emergency vehicle sounds its siren as it accelerates along a straight road between two points X and Y, as shown in the diagram.



The frequency of the sound emitted by the siren is 750 Hz.

A person stands at X and another person stands at Y.

What describes the sounds heard by the people at X and at Y as the vehicle accelerates?

	sound heard by person at X	sound heard by person at Y
A	higher than 750 Hz, increasing in frequency	lower than 750 Hz, decreasing in frequency
B	higher than 750 Hz, decreasing in frequency	lower than 750 Hz, increasing in frequency
C	lower than 750 Hz, decreasing in frequency	higher than 750 Hz, increasing in frequency
D	lower than 750 Hz, increasing in frequency	higher than 750 Hz, decreasing in frequency

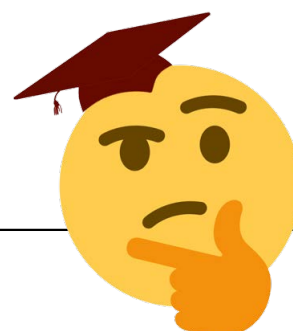
127 - (9702/13_Winter_2020_Q25) - Waves

The horn of a train emits sound of frequency f_1 . While the horn is sounding, the train moves directly towards a stationary person. The speed of the train is $0.20v$, where v is the speed of sound.

The frequency of the sound heard by the person is f_2 .

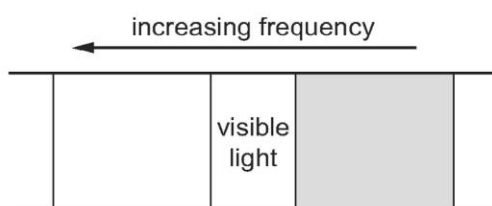
What is the ratio $\frac{f_1}{f_2}$?

- A $\frac{0.80}{1}$ B $\frac{1}{1.2}$ C $\frac{1.2}{1}$ D $\frac{1}{0.80}$



128 - (9702/12_Winter_2020_Q26) - Waves

Part of the electromagnetic spectrum is shown.



What is the name of the shaded region and what is the order of magnitude of a wavelength of a wave from this region?

	name	wavelength / m
A	infrared	10^{-5}
B	infrared	10^{-8}
C	ultraviolet	10^{-5}
D	ultraviolet	10^{-8}

129 - (9702/13_Winter_2020_Q26) - Waves

Two satellites in orbit around the Earth are at a constant distance of 100 km apart from each other.

Satellite X transmits a microwave pulse towards satellite Y. The pulse takes time T to reach Y.

Satellite Y then transmits a pulse of visible light towards satellite X.

What is the time taken for the pulse of light to reach X?

- A $10^{-5} T$ B $10^{-3} T$ C $10^{-2} T$ D T

130 - (9702/11_Winter_2020_Q27) - Waves

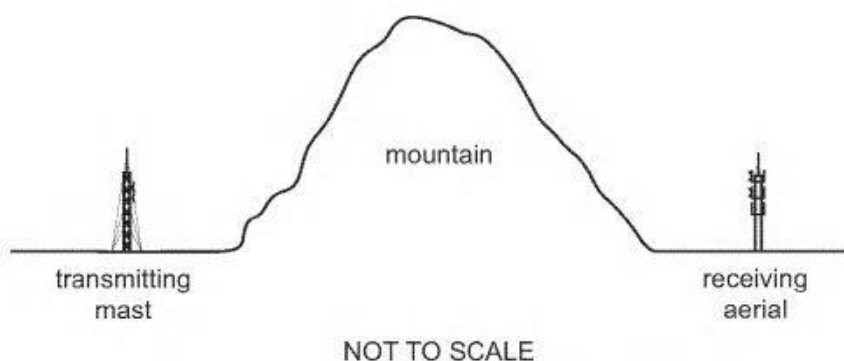
Which waves would best demonstrate diffraction through a doorway?

- A sound waves
B ultraviolet waves
C visible light waves
D X-rays



131 - (9702/12_Winter_2020_Q28) - Waves

A transmitting mast sends out microwaves of wavelength 1.5 cm and radio waves of wavelength 1.5 km.



A receiving aerial behind a mountain can detect the radio waves but not the microwaves.

What is the reason for this?

- A The radio waves are coherent but the microwaves are not.
- B The radio waves are diffracted around the mountain but the microwaves are not.
- C The radio waves are reflected by the mountain but the microwaves are not.
- D The radio waves travel at the speed of light but the microwaves do not.

132 - (9702/13_Winter_2020_Q28) - Waves

What is meant by *diffraction*?

- A the change in observed frequency when a wave source moves relative to an observer
- B the formation of nodes and antinodes by two progressive waves travelling in opposite directions
- C the spreading of a wave around the edge of an obstacle
- D the superposition of two waves when they meet

133 - (9702/11_Summer_2021_Q2) - Waves

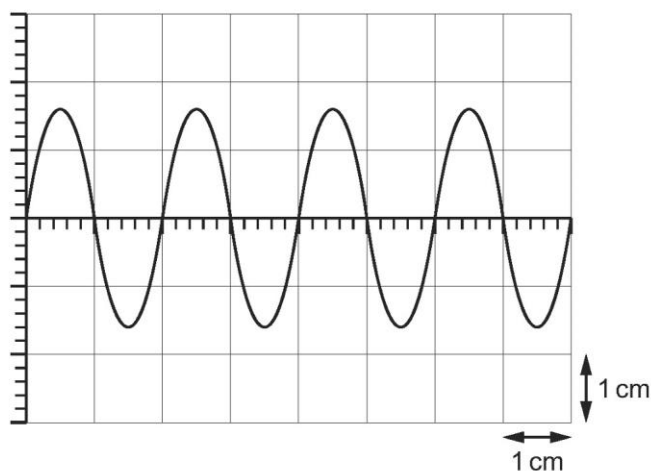
Which combination of units could be used for expressing the power dissipated in a resistor?

- A newton per second (N s^{-1})
- B newton second (N s)
- C newton metre (N m)
- D newton metre per second (N m s^{-1})



134 - (9702/11_Summer_2021_Q4) - Waves

A signal of frequency 25 Hz is displayed on the screen of a cathode-ray oscilloscope.

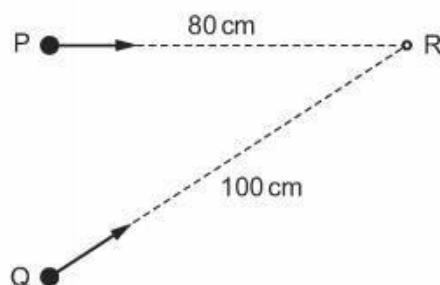


What is the time-base setting?

- A 10 ms cm^{-1} B 20 ms cm^{-1} C 25 ms cm^{-1} D 40 ms cm^{-1}

135 - (9702/11_Summer_2021_Q21) - Waves

Two identical waves are produced by sources at points P and Q. The waves travel along different paths to reach point R, as shown.



Both waves have a wavelength of 6.0 cm. The waves are in phase at point R.

What is the phase difference between the waves as they leave points P and Q?

- A 0° B 60° C 90° D 120°

136 - (9702/12_Summer_2021_Q21) - Waves

Two lasers emit light in a vacuum. One laser emits red light and the other emits green light.

Which property of the light from the two lasers **must** be different?

- A amplitude
B frequency
C intensity
D speed

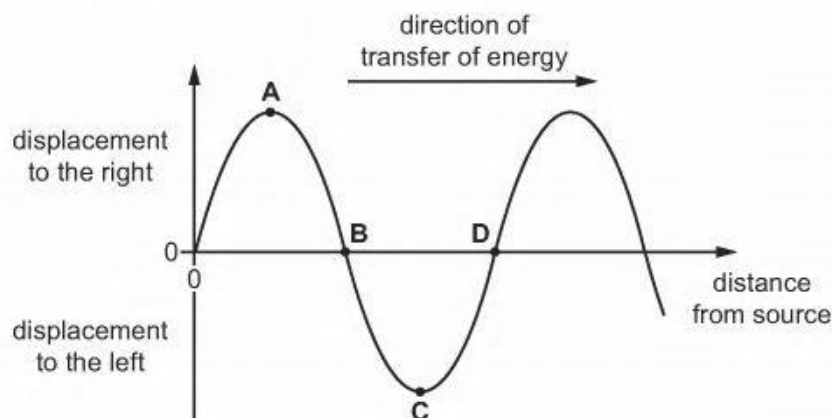


137 - (9702/11_Summer_2021_Q22) - Waves

A longitudinal wave travelling from left to right has vibrations parallel to the direction of transfer of energy by the wave.

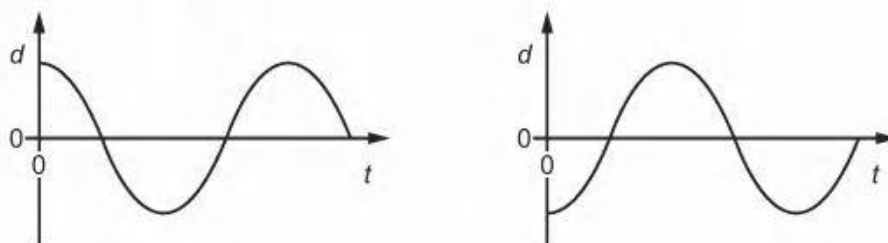
The wave can be represented on a graph showing the variation with distance of the displacement of the particles from their equilibrium positions at one instant.

Which point on the graph is the centre of a compression?



138 - (9702/12_Summer_2021_Q22) - Waves

Two particles in a progressive wave are a distance 10 cm apart. The two graphs show the variation with time t of the displacement d of the two particles.



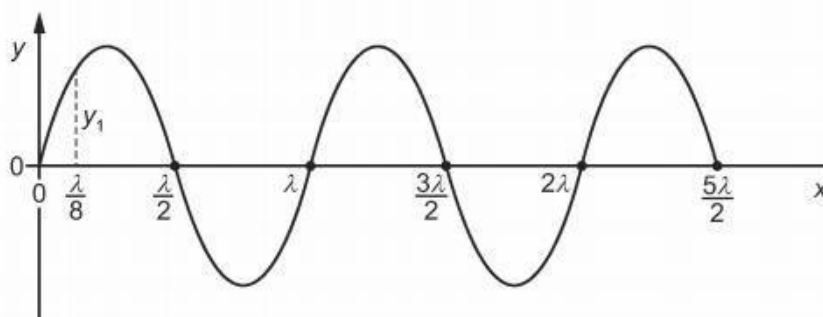
What could be represented by the two graphs?

- A particles in a longitudinal wave with a compression and the nearest rarefaction separated by 10 cm
- B particles in a longitudinal wave with a compression and the nearest rarefaction separated by 20 cm
- C particles in a transverse wave with a peak and the nearest trough separated by 20 cm
- D particles in a transverse wave with two adjacent peaks separated by 10 cm



139 - (9702/13_Summer_2021_Q22) - Waves

A transverse progressive wave of wavelength λ is set up on a stretched string. The graph shows the variation of displacement y with distance x at a particular instant of time. The wave has displacement $+y_1$ at distance $x = \frac{\lambda}{8}$.



What are the next two values of x where the displacement y is again equal to $+y_1$?

- A $\frac{3\lambda}{8}$ and $\frac{5\lambda}{8}$
B $\frac{3\lambda}{8}$ and $\frac{9\lambda}{8}$
C $\frac{5\lambda}{8}$ and $\frac{9\lambda}{8}$
D $\frac{9\lambda}{8}$ and $\frac{17\lambda}{8}$

140 - (9702/11_Summer_2021_Q23) - Waves

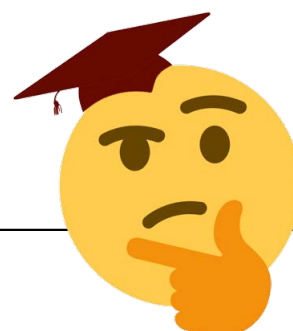
A stationary wave is formed from two identical sound waves.

A microphone is placed at a position of maximum loudness. It is then moved along the stationary wave from this first position of maximum loudness to the fourth position of maximum loudness. The microphone moves a distance of 12 cm.

The speed of sound is 330 m s^{-1} .

What is the frequency of the sound waves?

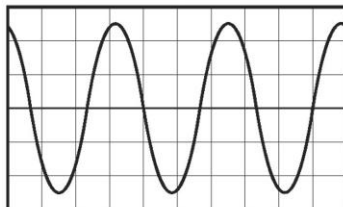
- A 4100 Hz B 5500 Hz C 8300 Hz D 11000 Hz



141 - (9702/12_Summer_2021_Q23) - Waves

A sound wave is detected by a microphone that is connected to a cathode-ray oscilloscope (CRO).

The screen of the CRO displays a waveform, as shown.



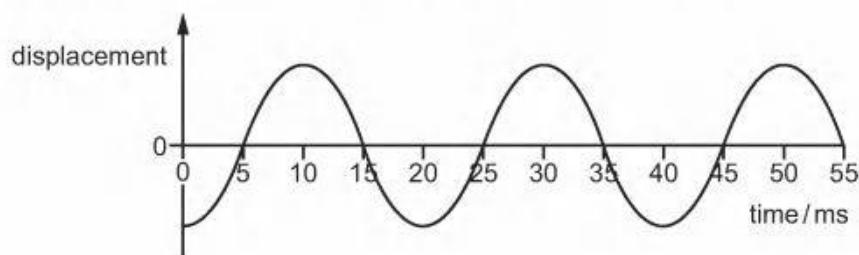
The time-base is set to $20\ \mu\text{s div}^{-1}$.

What is the frequency of the sound wave?

- A 15 Hz B 15 000 Hz C 20 000 Hz D 30 000 Hz

142 - (9702/13_Summer_2021_Q23) - Waves

The graph shows the variation with time of the displacement of an air particle as a progressive sound wave passes through the air. The speed of sound in air is $330\ \text{m s}^{-1}$.



What is the wavelength of the wave?

- A 6.6 m B 8.3 m C 20 m D 25 m



143 - (9702/11_Summer_2021_Q24) - Waves

An ambulance has a siren that emits sound of a constant frequency. The ambulance is moving directly towards a stationary observer.

The ambulance decelerates as it is approaching the observer and then accelerates after it has passed the observer.

How does the frequency of the sound heard by the observer change as the ambulance is approaching and as it is moving away from the observer?

	approaching observer	moving away from observer
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

144 - (9702/12_Summer_2021_Q24) - Waves

A person stands at the side of a straight railway track. A train moves towards the person and emits sound from its whistle. The person hears a sound of frequency 1690 Hz as the train approaches him.

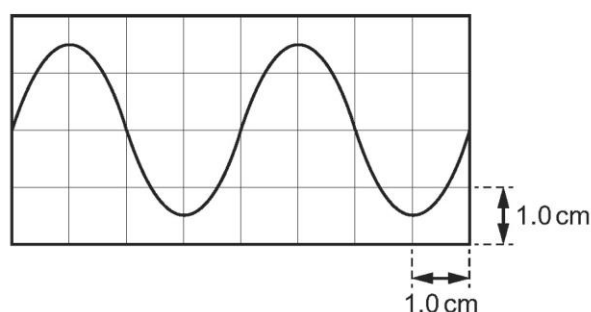
The person then hears sound of frequency 1500 Hz as the train moves away from him. The speed of sound in air is 340 m s^{-1} .

What is the speed of the train?

- A 20 m s^{-1} B 38 m s^{-1} C 41 m s^{-1} D 43 m s^{-1}

145 - (9702/13_Summer_2021_Q24) - Waves

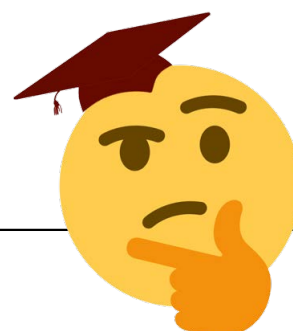
A microphone is connected to a cathode-ray oscilloscope (CRO). A sound wave of constant frequency is detected by the microphone. The screen of the CRO is shown.



The time-base is set at 1.0 ms cm^{-1} .

What is the frequency of the sound wave?

- A 250 Hz B 500 Hz C 670 Hz D 4000 Hz



146 - (9702/12_Summer_2021_Q25) - Waves

Which list shows electromagnetic waves in order of decreasing frequency?

- A gamma-rays → infrared → ultraviolet → radio waves
- B gamma-rays → ultraviolet → infrared → radio waves
- C radio waves → infrared → ultraviolet → gamma-rays
- D radio waves → ultraviolet → infrared → gamma-rays

147 - (9702/13_Summer_2021_Q25) - Waves

A train's whistle is emitting sound of frequency 500 Hz as the train moves with a speed of 20 m s^{-1} along a straight track. The train moves directly towards a stationary observer standing next to the track and then passes the observer.

The speed of sound in air is 330 m s^{-1} .

What is the difference between the frequencies of the sound heard by the observer before and after the train has passed the observer?

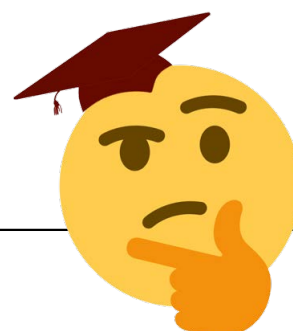
- A 29 Hz B 32 Hz C 40 Hz D 61 Hz

148 - (9702/13_Summer_2021_Q26) - Waves

Gamma-rays, microwaves, visible light and X-rays are four regions of the electromagnetic spectrum.

Which list shows these four regions in order of increasing wavelength?

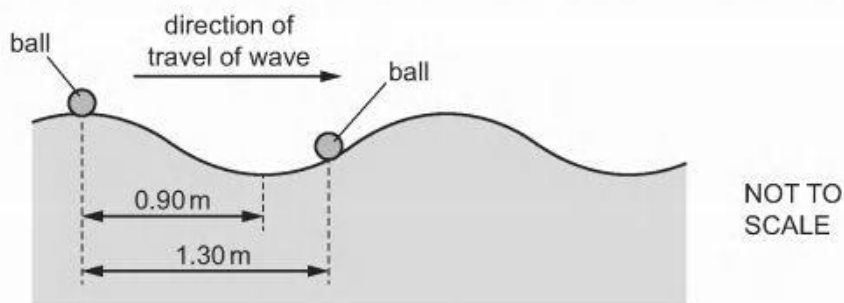
- A microwaves → visible light → X-rays → gamma-rays
- B gamma-rays → X-rays → visible light → microwaves
- C X-rays → gamma-rays → microwaves → visible light
- D microwaves → visible light → gamma-rays → X-rays



149 - (9702/11_Winter_2021_Q21) - Waves

Two balls float on the surface of the sea. The balls are separated by a distance of 1.30 m.

A wave travels on the surface of the sea so that the balls move vertically up and down.



The distance between a crest and an adjacent trough of the wave is 0.90 m.

What is the phase difference between the two balls?

- A 55° B 110° C 160° D 260°

150 - (9702/11_Winter_2021_Q22) - Waves

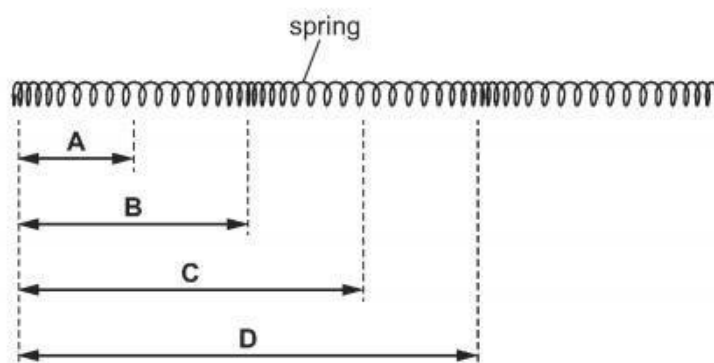
Which statement about transverse or longitudinal waves is **not** correct?

- A Longitudinal waves can be used to demonstrate diffraction.
B Longitudinal waves can travel in a vacuum.
C Transverse waves can form stationary waves.
D Transverse waves can transfer energy.

151 - (9702/13_Winter_2021_Q22) - Waves

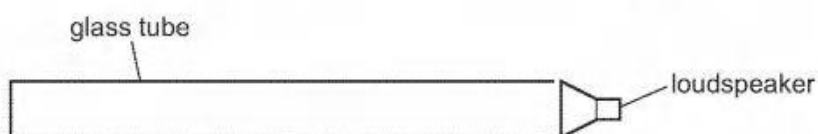
A longitudinal wave travels through a long spring. The spring is shown at one instant.

What is the wavelength of the wave?



152 - (9702/11_Winter_2021_Q23) - Waves

A glass tube is closed at one end and has a loudspeaker at the other end.



A stationary wave is formed with a node at the closed end of the tube when the sound has frequency f_0 . There are no other nodes.

The frequency of the sound is then slowly increased.

What is the frequency of the sound that produces the next stationary wave?

- A $1.25f_0$ B $1.50f_0$ C $2.00f_0$ D $3.00f_0$

153 - (9702/13_Winter_2021_Q23) - Waves

Which statement about waves is correct?

- A Both longitudinal and transverse waves can travel through a vacuum.
- B Both longitudinal and transverse waves transfer matter.
- C Longitudinal progressive waves consist of alternate nodes and antinodes.
- D The particles of a transverse wave vibrate perpendicular to the direction of energy propagation.

154 - (9702/11_Winter_2021_Q24) - Waves

With which waves can the Doppler effect be observed?

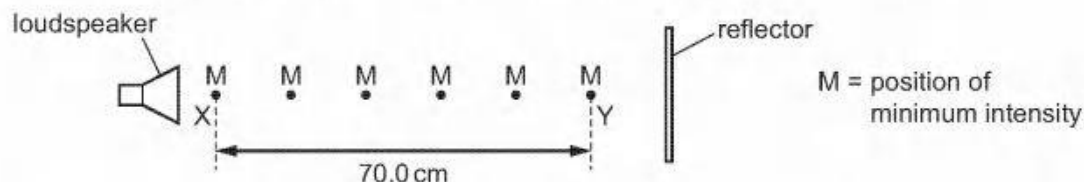
- A all waves including sound and light
- B light waves only
- C sound and light waves only
- D sound waves only



155 - (9702/12_Winter_2021_Q24) - Waves

A sound wave from a loudspeaker is reflected back along its original path by a reflector.

A microphone is initially at point X where the sound intensity is a minimum, as shown.



The microphone is moved towards the reflector and passes through four more intensity minima until reaching a fifth minimum at point Y. The distance XY is 70.0 cm.

What is the wavelength of the sound?

- A 11.7 cm B 14.0 cm C 23.3 cm D 28.0 cm

156 - (9702/13_Winter_2021_Q24) - Waves

A stationary sound wave is formed in a pipe that is closed at one end and open at the other end. The wave has two antinodes. One of these antinodes is at the open end of the pipe.

The length of the pipe is 0.600 m. The speed of sound in the air column in the pipe is 340 m s^{-1} .

What is the frequency of the sound wave?

- A 425 Hz B 850 Hz C 1130 Hz D 2270 Hz

157 - (9702/11_Winter_2021_Q25) - Waves

Which radiation could consist of waves of wavelength 0.5 nm?

- A γ -rays
B ultraviolet
C visible light
D X-rays

158 - (9702/12_Winter_2021_Q25) - Waves

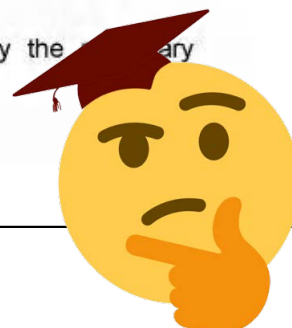
A train travels in a straight line at a constant speed of 30 m s^{-1} . The train's horn continuously emits sound of frequency 2400 Hz.

A stationary observer stands next to the train track. The train approaches the stationary observer, passes him and then moves away.

The speed of sound is 340 m s^{-1} .

What is the maximum difference in the frequencies of the sound heard by the stationary observer?

- A 190 Hz B 230 Hz C 430 Hz D 460 Hz



159 - (9702/13_Winter_2021_Q25) - Waves

A train travels at constant speed along a straight track. The train's horn emits sound of frequency 500 Hz.

A person standing by the side of the track hears sound of frequency 450 Hz.

The speed of sound in air is 340 m s^{-1} .

What is the speed of the train and in which direction is it travelling relative to the person?

	speed / m s^{-1}	direction
A	34	away from the person
B	34	towards the person
C	38	away from the person
D	38	towards the person

160 - (9702/12_Winter_2021_Q26) - Waves

Electromagnetic waves of frequency 30 THz are in a vacuum.

In which region of the electromagnetic spectrum are the waves?

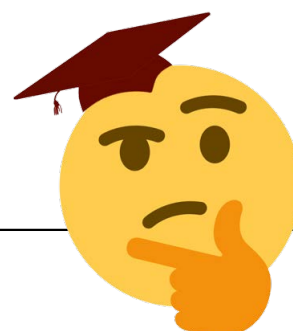
- A infrared
- B microwave
- C ultraviolet
- D visible light

161 - (9702/13_Winter_2021_Q26) - Waves

A smooth surface has bumps on the surface that are smaller than the wavelength of visible light.

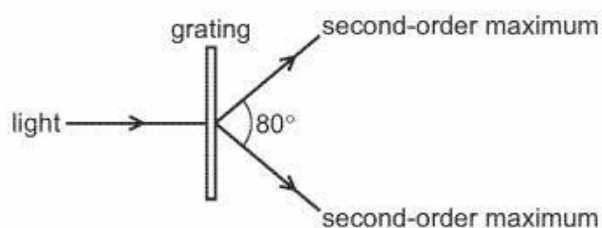
What is the approximate maximum size of the largest bumps on the surface?

- A 20 nm B 350 nm C 720 nm D $5.0 \mu\text{m}$



162 - (9702/12_Winter_2021_Q30) - Waves

Light of wavelength $5.5 \times 10^{-7} \text{ m}$ is incident normally on a diffraction grating.



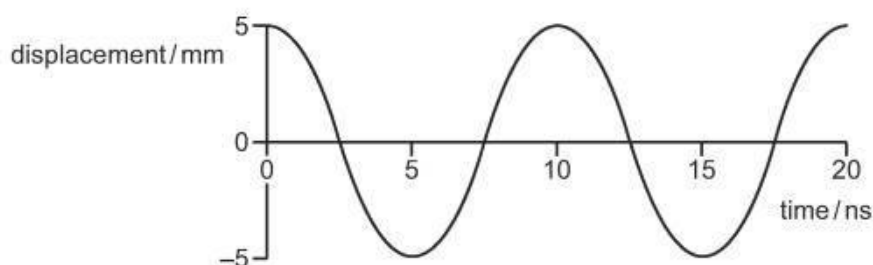
The angle between the second-order diffraction maxima is 80° , as shown.

What is the number of lines per metre of the diffraction grating?

- A 5.8×10^5 lines per metre
- B 9.0×10^5 lines per metre
- C 1.2×10^6 lines per metre
- D 2.3×10^6 lines per metre

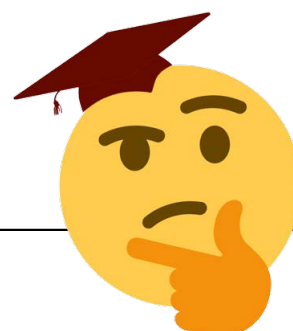
163 - (9702/11_Summer_2022_Q21) - Waves

The graph shows the variation with time of the displacement of a particle as a progressive wave passes.



What are the frequency and the amplitude of the wave?

	frequency / MHz	amplitude / mm
A	100	5
B	200	5
C	100	10
D	200	10



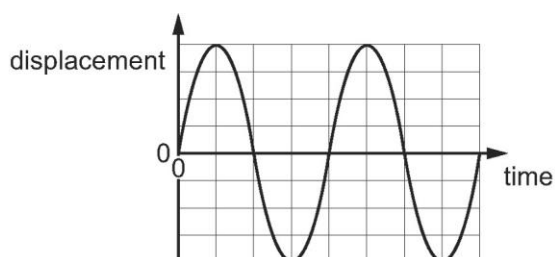
164 - (9702/12_Summer_2022_Q21) - Waves

Which statement is correct for **all** types of progressive wave?

- A The distance from a peak to the next trough is equal to a wavelength.
- B They can be demonstrated in ripple tanks.
- C They consist of vibrating atoms.
- D They transfer energy from one position to another.

165 - (9702/11_Summer_2022_Q22) - Waves

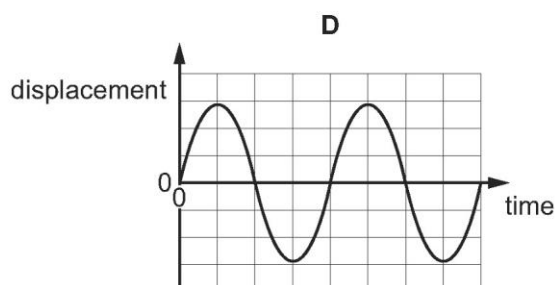
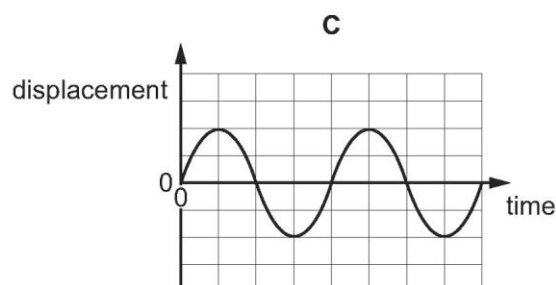
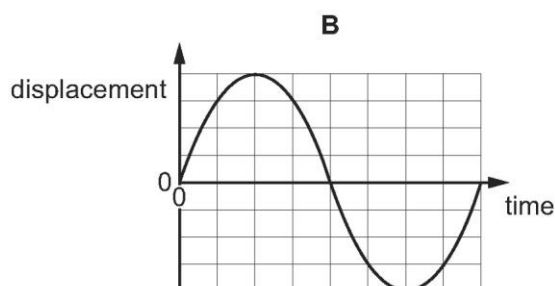
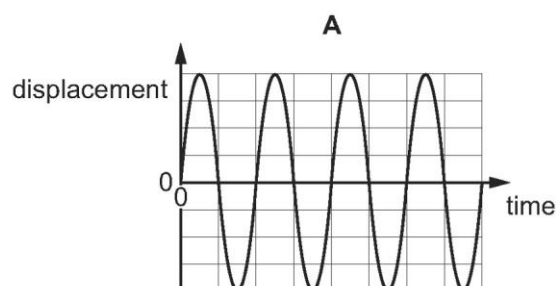
The graph shows the variation of the displacement of an air particle with time as a sound wave passes through air.



The intensity of the sound is halved while the frequency remains constant.

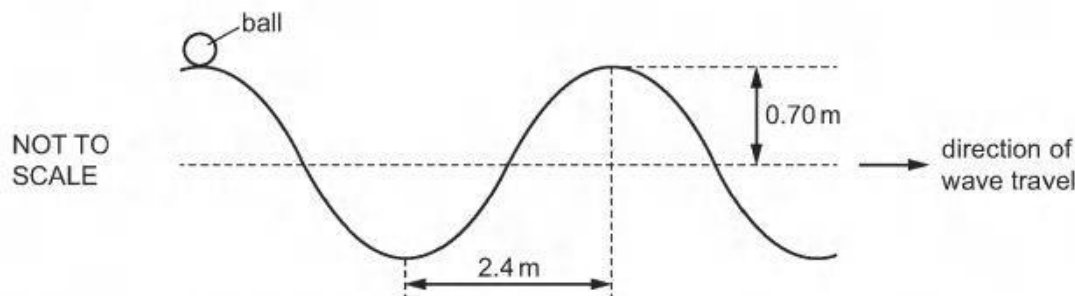
The four graphs below are drawn to the same scale as the graph above.

Which graph shows the displacement of the air particle?



166 - (9702/12_Summer_2022_Q22) - Waves

A transverse water wave is moving along the surface of some water. This causes a ball to move vertically without moving horizontally as it floats upon the surface. At one instant, the ball is at the position shown.



The wave has a frequency of 0.20 Hz and an amplitude of 0.70 m. The distance between a trough and an adjacent peak is 2.4 m.

What is the distance travelled by the ball in a time of 20 s?

- A 5.6 m B 9.6 m C 11.2 m D 19.2 m

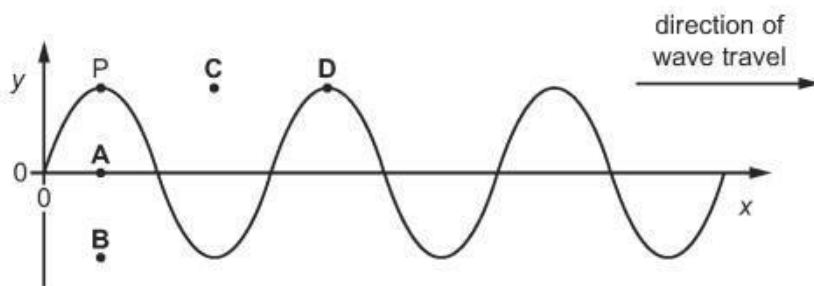
167 - (9702/13_Summer_2022_Q22) - Waves

The variation with distance x of the displacement y of a transverse wave on a rope is shown at time $t = 0$.

The wave has a frequency of 0.5 Hz.

A point P on the rope is marked. The diagram shows the original position of P and four new positions.

What is the position of P at time $t = 1$ s?



168 - (9702/11_Summer_2022_Q23) - Waves

Which statement is correct?

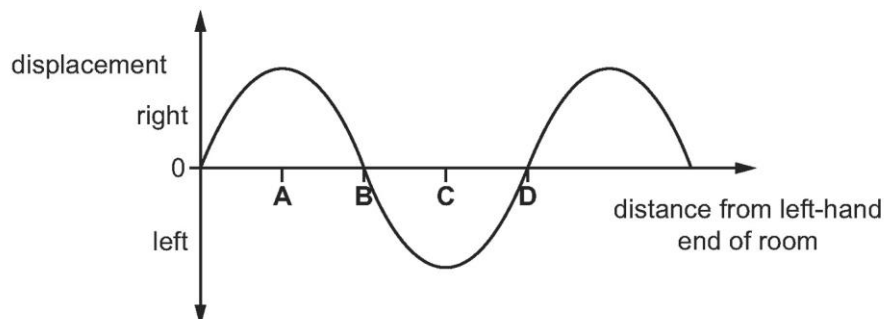
- A Gases cannot transmit longitudinal waves.
B Longitudinal sound waves cannot form stationary waves.
C Solids can transmit both transverse and longitudinal waves.
D Transverse waves cannot pass through a vacuum.



169 - (9702/12_Summer_2022_Q23) - Waves

A sound wave travels from left to right across a room. The variation with distance across the room of the displacement of the air molecules at one instant is shown.

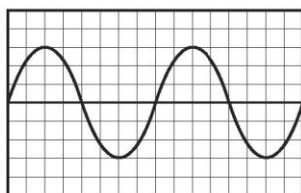
At which distance will the air pressure be lowest?



170 - (9702/13_Summer_2022_Q23) - Waves

A cathode-ray oscilloscope (CRO) is connected to a microphone which detects sound of constant frequency.

The trace on the screen of the CRO is shown.



Which property of the sound wave is measured using **only** information from the CRO?

- A amplitude
- B period
- C speed
- D wavelength



171 - (9702/11_Summer_2022_Q24) - Waves

A car is travelling at a constant velocity directly towards a man standing in the middle of the road.

The driver sounds the car's horn as a warning. The horn emits a sound wave of constant frequency.

The frequency of the sound heard by the man is different from the frequency of the sound emitted by the horn.

Which statement is correct?

- A The frequency of the sound emitted by the horn is greater than the frequency of the sound heard by the man.
- B The frequency of the sound heard by the man depends on the distance between the car and the man.
- C The sound waves continually accelerate as they move from the horn to the man.
- D The wavelength of the sound heard by the man is less than the wavelength of the sound emitted by the horn.

172 - (9702/12_Summer_2022_Q24) - Waves

A source emits a sound wave of a single frequency. The Doppler effect causes a different frequency of sound to be heard by a stationary observer.

What is a requirement for the Doppler effect to occur?

- A a source that is moving as it produces the sound wave
- B a source that produces a polarised sound wave
- C a source that produces a sound wave of changing amplitude
- D a source that produces a sound wave of changing frequency

173 - (9702/13_Summer_2022_Q24) - Waves

A transverse wave and a longitudinal wave both travel in the same direction down a long stretched spring.

Which statement is **not** correct for these two forms of wave?

- A The displacement measurements for the particles of the two waves are made at right angles to each other.
- B The energy transferred by the two waves is in the same direction.
- C The velocities of the two waves are in the same direction.
- D The wavelength measurements for the two waves are made at right angles to each other.



174 - (9702/11_Summer_2022_Q25) - Waves

Which statement about electromagnetic waves is correct?

- A A wave of wavelength $5.0 \times 10^{-6} \text{ m}$ is invisible to the human eye.
- B They can all travel at different speeds in free space.
- C They cannot be polarised.
- D They consist of vibrating atoms.

175 - (9702/12_Summer_2022_Q25) - Waves

An electromagnetic wave in free space has a frequency of $2.5 \times 10^{14} \text{ Hz}$.

Which region of the electromagnetic spectrum includes this frequency?

- A infrared
- B microwave
- C ultraviolet
- D X-ray

176 - (9702/13_Summer_2022_Q25) - Waves

A man standing next to a stationary train hears sound of frequency 400 Hz emitted from the train's horn. The train then moves directly away from the man and sounds its horn when it has a speed of 50 m s^{-1} . The speed of sound in the air is 340 m s^{-1} .

What is the difference in frequency of the sound heard by the man on the two occasions?

- A 51 Hz
- B 69 Hz
- C 350 Hz
- D 470 Hz

177 - (9702/11_Summer_2022_Q26) - Waves

A stationary wave is set up on a string that is stretched between two fixed points that are 48 cm apart.

At one instant, the appearance of the string is as shown.



What is the wavelength of the stationary wave?

- A 16 cm
- B 32 cm
- C 48 cm
- D 72 cm



178 - (9702/12_Summer_2022_Q26) - Waves

Two polarising filters are placed next to each other so that their planes are parallel.

The first polarising filter has its transmission axis at an angle of 50° to the vertical.

The second polarising filter has its transmission axis at an angle of 20° to the vertical. The angle between the transmission axes of the two polarising filters is 30° .

A beam of vertically polarised light of intensity 8.0 Wm^{-2} is incident normally on the first polarising filter.

What is the intensity of the light that is transmitted from the second polarising filter?

- A zero B 2.5 Wm^{-2} C 2.9 Wm^{-2} D 6.0 Wm^{-2}

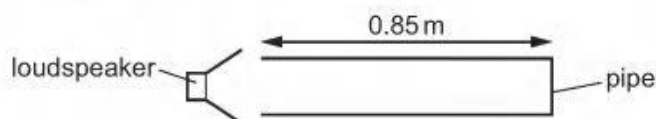
179 - (9702/13_Summer_2022_Q26) - Waves

Which list of regions of the electromagnetic spectrum is in order of increasing wavelength from left to right?

- A gamma-ray $\rightarrow$ ultraviolet $\rightarrow$ infrared
B infrared $\rightarrow$ microwave $\rightarrow$ ultraviolet
C microwave $\rightarrow$ X-ray $\rightarrow$ infrared
D X-ray $\rightarrow$ ultraviolet $\rightarrow$ gamma-ray

180 - (9702/11_Summer_2022_Q27) - Waves

A pipe, closed at one end, has a loudspeaker at the open end. For some frequencies of sound from the loudspeaker, a stationary sound wave is formed in the air within the pipe with an antinode at the open end of the pipe.



The length of the pipe is 0.85 m.

The speed of sound in air is 340 m s^{-1} .

Which frequency of sound from the loudspeaker would **not** produce a stationary wave?

- A 100 Hz B 200 Hz C 300 Hz D 500 Hz



181 - (9702/13_Summer_2022_Q27) - Waves

The principle of superposition states that a certain quantity is added when two or more waves meet at a point.

What is this quantity?

- A amplitude
- B displacement
- C intensity
- D wavelength

182 - (9702/11_Winter_2022_Q21) - Waves

A signal generator, amplifier and loudspeaker are used to produce different sound waves in the air of a room. The relationships between the properties of these waves are investigated.

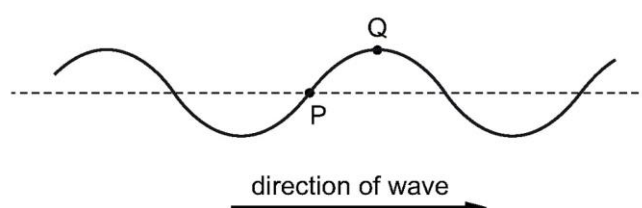
Which relationship is **not** correct?

- A Amplitude is proportional to wavelength.
- B Frequency is inversely proportional to wavelength.
- C Intensity is proportional to amplitude squared at a given frequency.
- D Period is equal to the reciprocal of frequency.

183 - (9702/13_Winter_2022_Q21) - Waves

The diagram shows a transverse wave on a rope. The wave is travelling from left to right.

At the instant shown, the points P and Q on the rope have zero displacement and maximum displacement respectively.



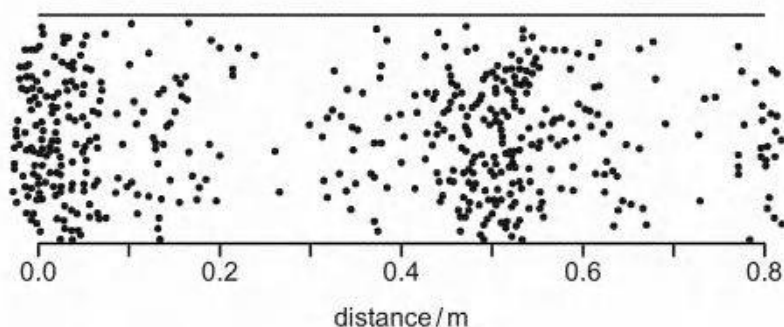
Which row describes the direction of motion, if any, of the points P and Q at this instant?

	point P	point Q
A	downwards	stationary
B	stationary	downwards
C	stationary	upwards
D	upwards	stationary



184 - (9702/11_Winter_2022_Q22) - Waves

When a guitar string is plucked, it causes a longitudinal sound wave in the air, as shown.



The speed of sound in the air is 340 m s^{-1} .

What is the approximate frequency of the sound wave shown?

- A 430 Hz B 680 Hz C 1100 Hz D 1400 Hz

185 - (9702/13_Winter_2022_Q22) - Waves

The period of an electromagnetic wave in a vacuum is 1.0 ns .

What are the frequency and wavelength of the wave?

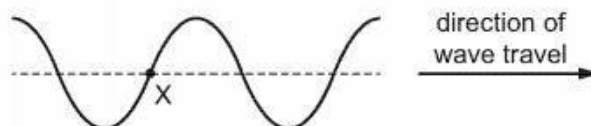
	frequency / Hz	wavelength / m
A	1.0	3.0×10^8
B	1.0×10^6	300
C	1.0×10^9	0.30
D	1.0×10^{12}	3.0×10^{-4}



186 - (9702/11_Winter_2022_Q23) - Waves

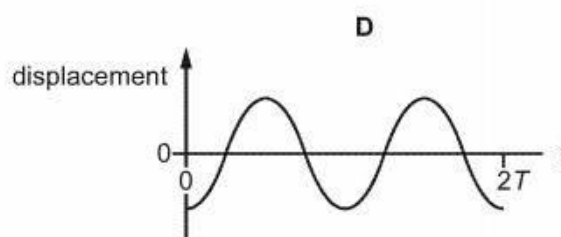
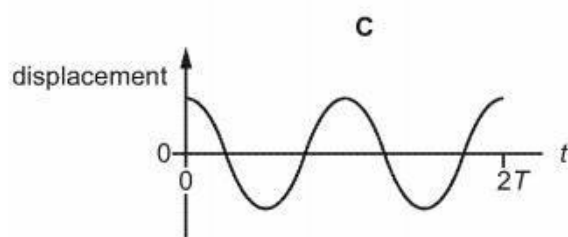
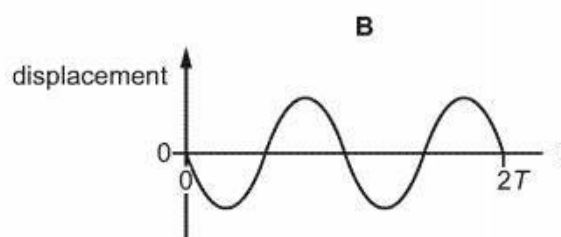
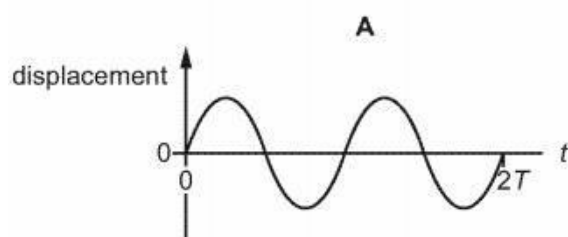
A transverse wave travels along a rope. The diagram shows the rope at time $t = 0$.

The wave is travelling from left to right. The period of the wave is T .



One particle of the rope is labelled X.

Which graph shows the variation with time of the displacement of particle X between $t = 0$ and $t = 2T$?



187 - (9702/12_Winter_2022_Q23) - Waves

Which statement about progressive transverse and longitudinal waves is correct?

- A** Particles in a transverse wave have fixed equilibrium positions but those in longitudinal waves do not.
- B** Transverse waves can be polarised but longitudinal waves cannot.
- C** Transverse waves transfer energy but longitudinal waves do not.
- D** Two-source interference can be demonstrated with transverse waves but not with longitudinal waves.



188 - (9702/13_Winter_2022_Q23) - Waves

An observer is standing on a railway platform. A train passes the observer at constant speed while emitting sound of constant frequency f from its whistle.

What does the observer hear?

- A sound of a decreasing frequency as the train approaches and of an increasing frequency as it moves away
- B sound of a higher frequency than f as the train approaches and of a lower frequency than f as the train moves away
- C sound of a lower frequency than f as the train approaches and of a higher frequency than f as the train moves away
- D sound of an increasing frequency as the train approaches and as it moves away

189 - (9702/11_Winter_2022_Q24) - Waves

A jet aircraft travels at a speed of $0.80v$, where v is the speed of sound. The aircraft directly approaches a stationary observer. The frequency of sound emitted by the aircraft is 100 Hz.

Which frequency does the observer hear?

- A 56 Hz B 180 Hz C 400 Hz D 500 Hz

190 - (9702/12_Winter_2022_Q24) - Waves

A miniature loudspeaker, initially at rest, falls vertically from a window in a high building. When the speaker has fallen a distance of 10.0 m, it emits a very short pulse of sound of constant frequency 256 Hz in all directions. The pulse of sound, travelling at a speed of 330 m s^{-1} , is heard by a person leaning out of the window.

Air resistance is negligible.

What is the frequency of the pulse of sound heard by the person?

- A 246 Hz B 249 Hz C 267 Hz D 313 Hz

191 - (9702/13_Winter_2022_Q24) - Waves

Which microorganisms have a length that is equal to the wavelength in free space of an electromagnetic wave that is visible to the human eye?

- A algae of length $0.5 \mu\text{m}$
- B bacteria of length $5.0 \mu\text{m}$
- C fungi of length $50 \mu\text{m}$
- D protozoa of length $100 \mu\text{m}$



192 - (9702/11_Winter_2022_Q25) - Waves

A telescope detects and analyses some electromagnetic radiation of wavelength 2 cm.

Which type of telescope is it?

- A microwave telescope
- B optical telescope
- C radio telescope
- D X-ray telescope

193 - (9702/12_Winter_2022_Q25) - Waves

Two electromagnetic waves have wavelengths of 5.0×10^{-7} m and 5.0×10^{-2} m in a vacuum.

Which row identifies the regions of the electromagnetic spectrum to which the waves belong?

	wavelength 5.0×10^{-7} m	wavelength 5.0×10^{-2} m
A	ultraviolet	infrared
B	visible	microwave
C	ultraviolet	microwave
D	visible	infrared

194 - (9702/12_Winter_2022_Q26) - Waves

The wavelength of sound in air may be determined by using stationary waves.

In one experiment, a loudspeaker produces a sound wave of constant frequency which is reflected directly back along its original path by a metal plate approximately 1 m away. A microphone connected to a cathode-ray oscilloscope (CRO) is moved between the loudspeaker and plate to identify regions of high sound intensity ('loud' spots) and low sound intensity ('quiet' spots).

The wavelength of the sound is determined using the **least** possible number of measured quantities.

Which row shows the quantities that are needed?

	frequency of sound	mean separation of 'quiet' spots	speed of sound in air
A	✓	✓	x
B	✓	x	✓
C	✓	x	x
D	x	✓	x

key

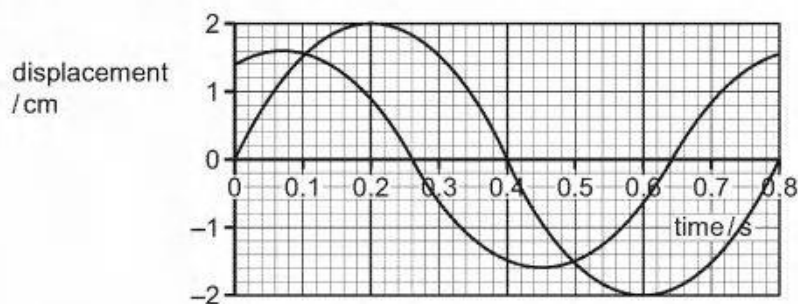
✓ = needed

x = not needed



195 - (9702/12_Winter_2022_Q27) - Waves

Two progressive waves meet at a fixed point P. The variation with time of the displacement of each wave at point P is shown.



The two waves superpose at point P.

What is the resultant displacement at time 0.38 s?

- A +1.0 cm B -1.0 cm C +1.8 cm D -1.8 cm

196 - (9702/12_Winter_2022_Q28) - Waves

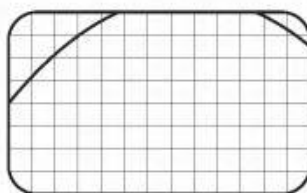
In which situation does diffraction occur?

- A A wave bounces back from a surface.
B A wave passes from one medium into another.
C A wave passes through a gap in a barrier.
D Waves from two identical sources are superposed.



197 - (9702/11_Summer_2023_Q20) - Waves

In an experiment, a student uses a microphone and a cathode-ray oscilloscope (CRO) to analyse a sound wave. The diagram shows the trace on the screen of the CRO.



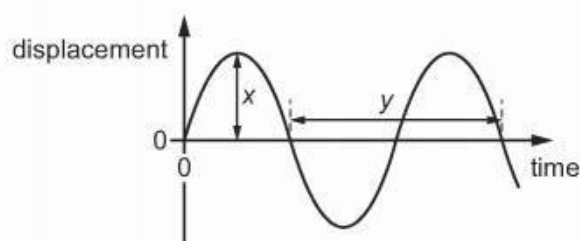
The student is expecting a sinusoidal waveform to be shown on the screen.

Which changes should the student make to the time-base and the y-gain of the CRO so that the screen shows a continuous trace for one complete cycle of the waveform?

	time-base	y-gain
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

198 - (9702/11_Summer_2023_Q21) - Waves

The graph shows the variation with time of the displacement of a particle in a progressive wave.



Two measurements, x and y , are labelled on the graph.

What do x and y represent?

	x	y
A	amplitude	period
B	frequency	period
C	amplitude	wavelength
D	frequency	wavelength



199 - (9702/11_Summer_2023_Q22) - Waves

A car travels at a constant speed along a straight line PQ.

A loudspeaker attached to the car emits sound of constant frequency f . A stationary observer is at point O.



What does the observer hear as the car moves from P towards Q?

- A a frequency less than f that decreases as the car moves from P towards Q
- B a frequency less than f that increases as the car moves from P towards Q
- C a frequency more than f that decreases as the car moves from P towards Q
- D a frequency more than f that increases as the car moves from P towards Q

200 - (9702/11_Summer_2023_Q23) - Waves

Some sources of electromagnetic waves in free space are listed.

- 1 a radio wave transmitter
- 2 a source of X-rays
- 3 a 30 mm wavelength radar transmitter
- 4 a light-emitting diode that emits red light

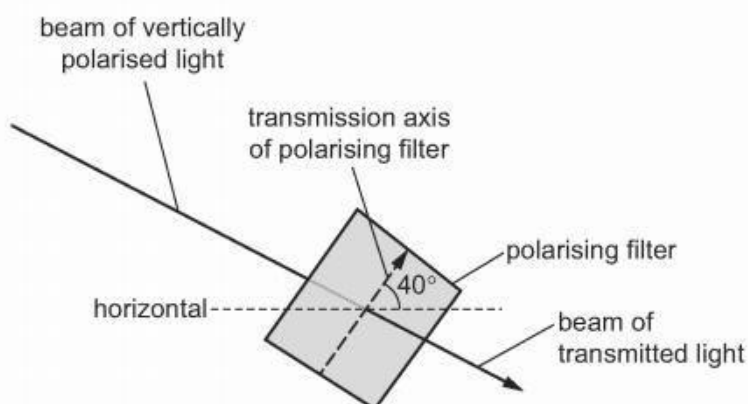
Which list gives the sources in order of increasing wavelength, from left to right, of the waves emitted by the sources?

- A 1 → 3 → 4 → 2
- B 2 → 4 → 1 → 3
- C 2 → 4 → 3 → 1
- D 3 → 1 → 4 → 2



201 - (9702/11_Summer_2023_Q24) - Waves

A vertically polarised beam of light is incident normally on a polarising filter. The transmission axis of the filter is at an angle of 40° to the horizontal.



What is the ratio $\frac{\text{amplitude of transmitted beam}}{\text{amplitude of incident beam}}$?

A 0.41

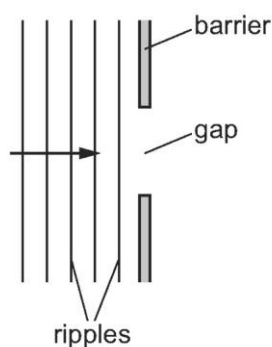
B 0.59

C 0.64

D 0.77

202 - (9702/11_Summer_2023_Q27) - Waves

A ripple tank and a barrier with a single gap are used to demonstrate the diffraction of surface ripples on water. Initially, the wavelength of the ripples is five times smaller than the gap in the barrier.



Which change increases the amount of diffraction observed?

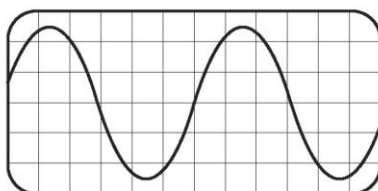
- A double the amplitude of the ripples
- B double the width of the gap
- C halve the frequency of the ripples
- D halve the wavelength of the ripples



203 - (9702/12_Summer_2023_Q20) - Waves

A microphone detects a sound wave. The microphone is connected to a cathode-ray oscilloscope (CRO).

The shape of the trace on the screen of the CRO is shown.



Which property of the sound wave can be determined by using only the measurement of a horizontal distance on the screen and the value of a control setting of the CRO?

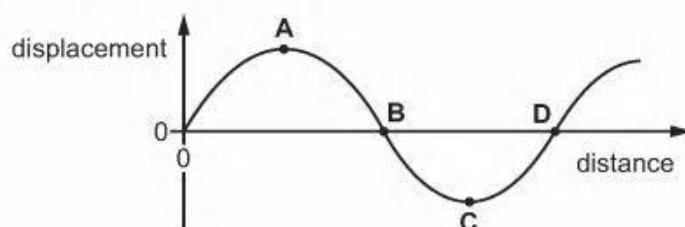
- A amplitude
- B frequency
- C speed
- D wavelength

204 - (9702/12_Summer_2023_Q21) - Waves

A longitudinal wave is travelling from left to right. The graph shows the variation of the displacement of the particles with distance along the wave at one instant in time.

Displacements to the right are positive; displacements to the left are negative.

Which labelled point represents a compression?



205 - (9702/12_Summer_2023_Q22) - Waves

A source X emits a sound wave of constant frequency f .

The wave is subsequently received at a stationary detector Y.

The frequency of the wave that is detected by Y is less than f .

What could be the reason for this?

- A Between X and Y, the wave undergoes diffraction.
- B Between X and Y, the wave undergoes reflection.
- C X is moving away from Y.
- D X is moving towards Y.



206 - (9702/12_Summer_2023_Q23) - Waves

A beam of visible light is in a vacuum.

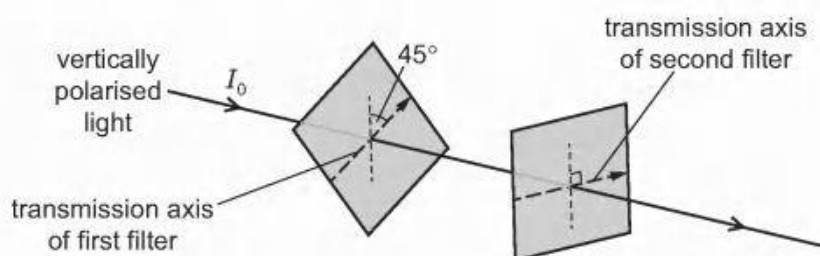
What could be the frequency of the light?

- A $5.0 \times 10^5 \text{ Hz}$ B $5.0 \times 10^8 \text{ Hz}$ C $5.0 \times 10^{11} \text{ Hz}$ D $5.0 \times 10^{14} \text{ Hz}$

207 - (9702/12_Summer_2023_Q24) - Waves

A vertically polarised beam of light of intensity I_0 is incident normally on a polarising filter.

The transmission axis of the filter is at 45° to the vertical. The beam of light transmitted by this filter is then incident normally on a second filter. The transmission axis of the second filter is horizontal.



What is the intensity of the beam of light after transmission through the second filter?

- A 0 B $\frac{1}{4} I_0$ C $\frac{1}{2} I_0$ D I_0

208 - (9702/12_Summer_2023_Q27) - Waves

A continuous progressive water wave in a ripple tank passes through a gap in a barrier and diffracts.

The width of the gap is greater than the wavelength of the wave.

Which change causes the wave to spread over a larger angle as it passes through the gap?

- A a small decrease in the wavelength of the wave
B a small decrease in the width of the gap
C a small increase in the frequency of the wave
D a small increase in the height of the barrier



209 - (9702/12_Summer_2023_Q28) - Waves

The diagram shows a view from above of a double-slit interference demonstration.

L is a monochromatic light source with a vertical filament. B is a barrier with two narrow vertical slits and S is a screen upon which interference fringes form.

NOT TO
SCALE

*
L

B

S

The intensity is I at the point on the screen where the centre of the fringe pattern forms.

When one of the slits is covered, what is the intensity at the same point on the screen?

A $\frac{I}{\sqrt{2}}$

B $\frac{I}{2}$

C $\frac{I}{2\sqrt{2}}$

D $\frac{I}{4}$

210 - (9702/13_Summer_2023_Q20) - Waves

A progressive wave of frequency 1.5 kHz travels in a medium at a speed of 340 m s^{-1} .

What is the minimum distance between two points on the wave that have a phase difference of 70° ?

A 4.4 cm

B 8.8 cm

C 18 cm

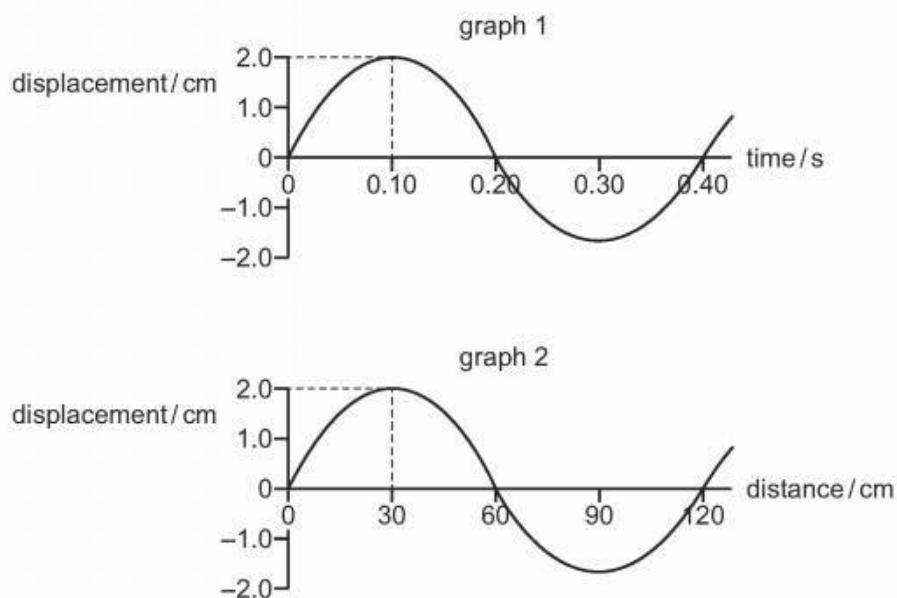
D 23 cm



211 - (9702/13_Summer_2023_Q21) - Waves

Graph 1 shows the variation with time of displacement at a fixed distance along a progressive wave.

Graph 2 represents the same wave and shows the variation with distance of displacement at an instant in time.



What is the speed of the wave?

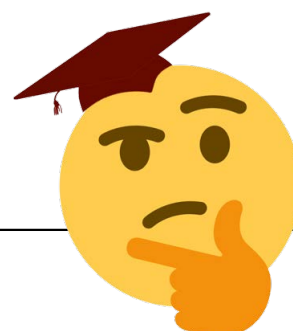
- A 5.0 cm s^{-1} B 48 cm s^{-1} C 150 cm s^{-1} D 300 cm s^{-1}

212 - (9702/13_Summer_2023_Q22) - Waves

A vehicle moves with constant velocity along a road directly towards an observer. The observed frequency of the sound from the vehicle changes as the vehicle moves past the observer.

Which phenomenon explains the change in frequency?

- A diffraction
B interference
C polarisation
D the Doppler effect



213 - (9702/13_Summer_2023_Q23) - Waves

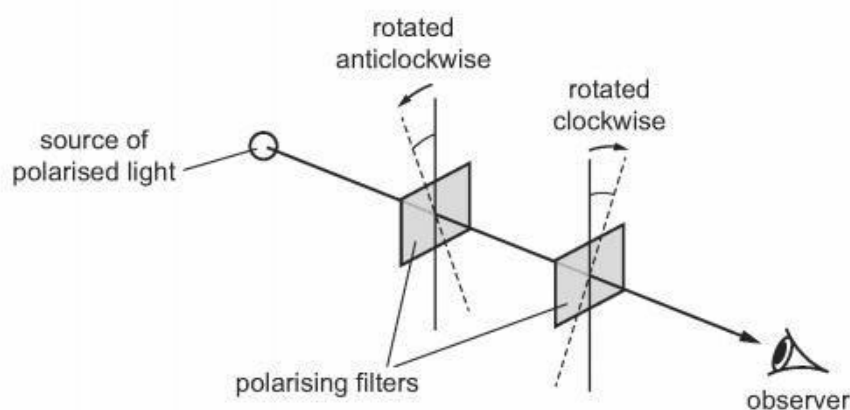
An electromagnetic wave has a wavelength of 2.1 cm in a vacuum.

Which region of the electromagnetic spectrum contains this wave?

- A infrared
- B microwave
- C radio wave
- D visible light

214 - (9702/13_Summer_2023_Q24) - Waves

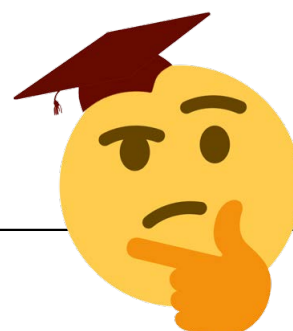
A source of plane polarised light is observed through two polarising filters.



The filters are positioned so that the source appears at its brightest. One of the filters is then rotated clockwise and the other filter is rotated anticlockwise through the same angle.

How does the source appear when both filters have been rotated 90° and 180° from their initial positions?

	90°	180°
A	brightest	brightest
B	brightest	darkest
C	darkest	brightest
D	darkest	darkest



215 - (9702/13_Summer_2023_Q27) - Waves

An experiment is set up to demonstrate the diffraction of water waves in a ripple tank.

The waves pass through a gap of width w and some diffraction of the waves is observed.

The wavelength of the waves is now doubled.

What is the new gap width needed to cause the same amount of diffraction as before?

- A $0.5w$ B w C $2w$ D $4w$

216 - (9702/13_Summer_2023_Q28) - Waves

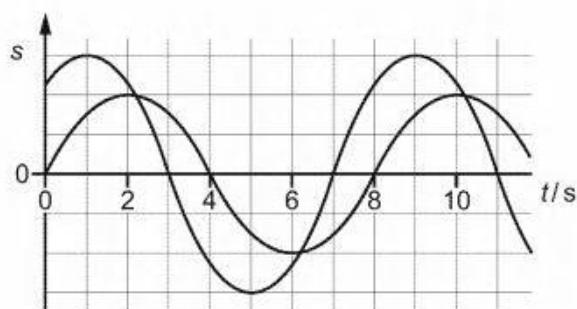
Two coherent electromagnetic waves are travelling in a vacuum. The two waves meet at a point. At this point, the two waves have different intensities.

Which statement about the waves is **not** correct?

- A They have a constant phase difference at the point.
B They have the same amplitude at the point.
C They have the same frequency.
D They travel at the same speed.

217 - (9702/11_Winter_2023_Q20) - Waves

Two waves pass through a point P. The graph shows the variation with time t of the displacement s of the two waves at point P.



What is the phase difference between the two waves at point P?

- A 0° B 45° C 90° D 180°



218 - (9702/11_Winter_2023_Q21) - Waves

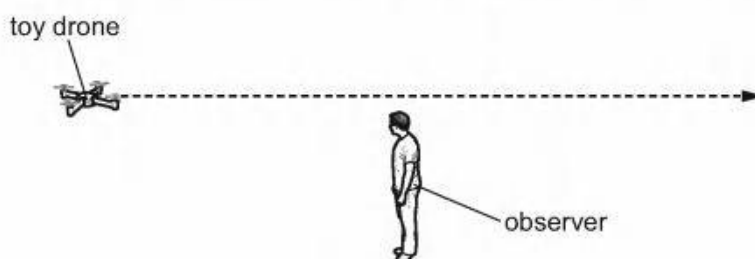
Which row is correct for both progressive transverse waves and progressive longitudinal waves?

	transverse waves	longitudinal waves
A	contain compressions and rarefactions	some can travel in a vacuum
B	can be polarised	contain compressions and rarefactions
C	vibrations are perpendicular to the direction of travel of the wave energy	can be polarised
D	some can travel in a vacuum	vibrations are perpendicular to the direction of travel of the wave energy

219 - (9702/11_Winter_2023_Q22) - Waves

A toy drone emits a sound of constant frequency 800 Hz. The speed of the sound in the air is 330 m s^{-1} .

The drone moves along a straight path directly towards an observer and then continues in a straight line directly away from the observer. The speed of the drone is constant.



What is the velocity of the drone when the frequency of the sound heard by the observer is 850 Hz?

	magnitude of velocity / m s^{-1}	direction of velocity
A	19	away from the observer
B	21	away from the observer
C	19	towards the observer
D	21	towards the observer



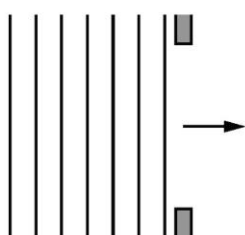
220 - (9702/11_Winter_2023_Q23) - Waves

Which statement about electromagnetic waves in a vacuum is correct?

- A Infrared waves have shorter wavelengths than visible light waves.
- B Microwaves have longer wavelengths than radio waves.
- C Ultraviolet waves have higher frequencies than visible light waves.
- D γ -rays have lower frequencies than X-rays.

221 - (9702/11_Winter_2023_Q27) - Waves

In an experiment, water waves in a ripple tank are incident on a gap, as shown.



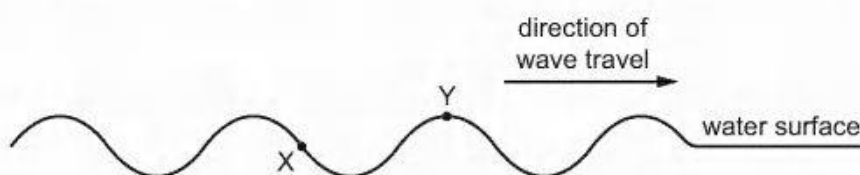
Some diffraction of the water waves is observed.

Which change to the experiment would provide a better demonstration of diffraction?

- A Increase the amplitude of the waves.
- B Increase the frequency of the waves.
- C Increase the wavelength of the waves.
- D Increase the width of the gap.

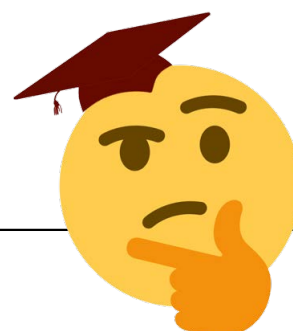
222 - (9702/12_Winter_2023_Q20) - Waves

X and Y are two points on the surface of water in a ripple tank. A source of constant frequency generates a wave which travels past X and Y, causing them to oscillate vertically.



What is the phase difference between X and Y?

- A 45°
- B 135°
- C 180°
- D 270°



223 - (9702/12_Winter_2023_Q22) - Waves

A source of sound waves is moving at a constant speed directly towards a stationary observer.

The sound waves have a speed of 340 m s^{-1} and a frequency of 480 Hz . The observer hears sound waves of frequency 650 Hz .

What is the speed of the source?

- A 89 m s^{-1} B 120 m s^{-1} C 250 m s^{-1} D 340 m s^{-1}

224 - (9702/12_Winter_2023_Q23) - Waves

A student is investigating two electromagnetic waves, X and Y, in a vacuum.

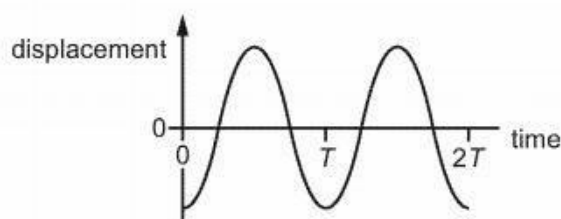
Wave X has a wavelength of $5.2 \times 10^{-7}\text{ m}$. Wave Y has a frequency of 9.4 GHz .

Which principal regions of the electromagnetic spectrum contain waves X and Y?

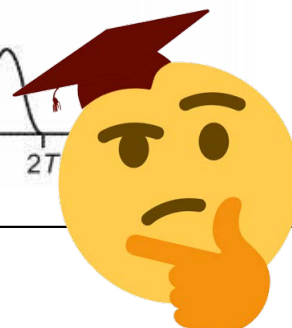
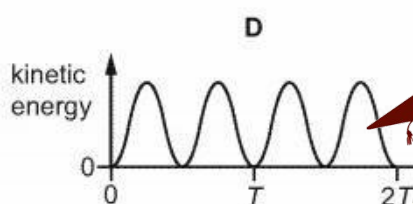
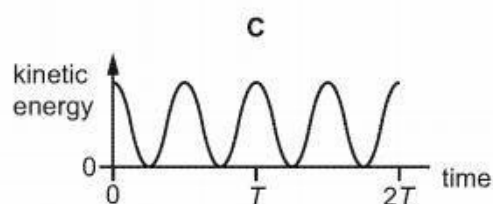
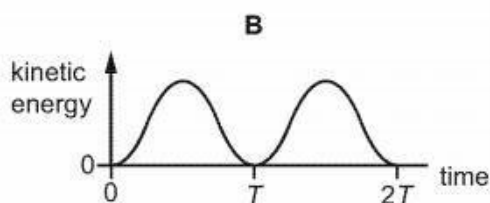
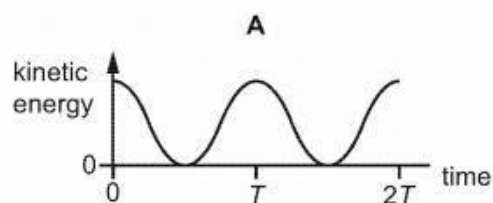
	X	Y
A	radio wave	ultraviolet
B	ultraviolet	visible
C	visible	microwave
D	microwave	radio wave

225 - (9702/13_Winter_2023_Q20) - Waves

When sound travels through air, the air particles vibrate. A graph of displacement against time for a single air particle is shown.



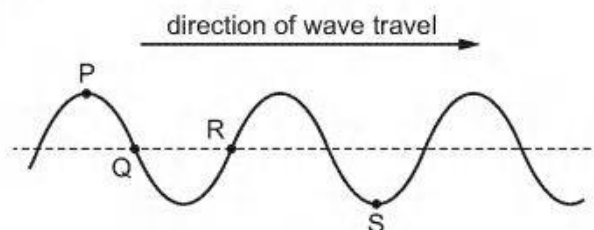
Which graph shows how the kinetic energy of the air particle varies with time?



226 - (9702/13_Winter_2023_Q21) - Waves

A wave travels on the surface of water. P, Q, R and S are four particles of water on the surface.

The diagram shows the positions of the particles at one instant. The direction of travel of the wave is from left to right.



Which two particles are about to move upwards?

- A P and R B P and S C R and S D Q and S

227 - (9702/13_Winter_2023_Q22) - Waves

A loudspeaker emits sound of frequency f_s . The loudspeaker is attached to a car that moves with increasing speed directly towards a stationary observer.

Which statement describes the frequency of the sound heard by the observer?

- A a frequency greater than f_s and increasing
B a frequency greater than f_s but decreasing
C a frequency less than f_s and decreasing
D a frequency less than f_s but increasing

228 - (9702/13_Winter_2023_Q23) - Waves

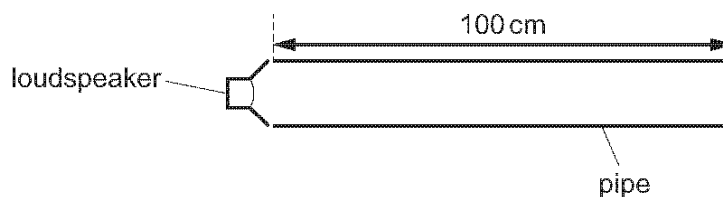
Which statement about electromagnetic waves in a vacuum is correct?

- A Amplitude is inversely proportional to velocity.
B Frequency is inversely proportional to wavelength.
C Intensity is proportional to amplitude.
D Velocity is proportional to wavelength.



1 - (9702/13_Summer_2017_Q26) - Superposition

A pipe of length 100 cm is open at both ends. A loudspeaker situated at one end of the pipe can emit sound of different wavelengths.

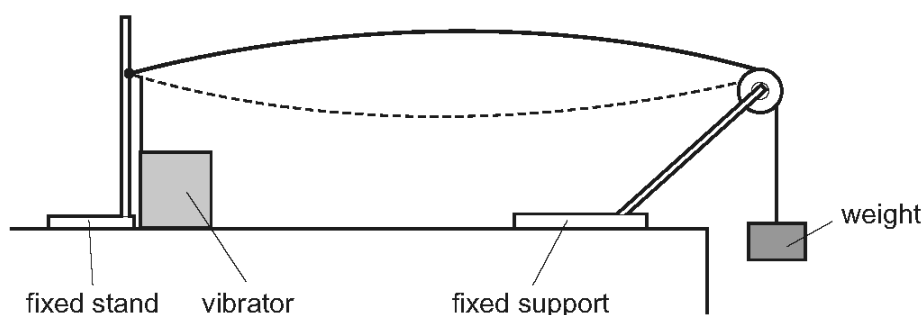


At which wavelength can a stationary wave be produced in the pipe?

- A** 50 cm **B** 75 cm **C** 150 cm **D** 300 cm

2 - (9702/11_Summer_2017_Q27) - Superposition

The diagram shows a steel wire clamped at one end. The other end is attached to a weight hanging over a pulley.



A vibrator is attached to the wire near the clamped end. A stationary wave with one loop is produced. The frequency of the vibrator is f .

Which frequency should be used to produce a stationary wave with two loops?

- A** $\frac{f}{4}$ **B** $\frac{f}{2}$ **C** $2f$ **D** $4f$

3 - (9702/12_Summer_2017_Q27) - Superposition

Which row describes the oscillations of two moving particles in a stationary wave that are separated by a distance of half a wavelength?

	phase difference	amplitude
A	90°	different
B	90°	same
C	180°	different
D	180°	same



4 - (9702/13_Summer_2017_Q27) - *Superposition*

Monochromatic light is incident on a diffraction grating and a diffraction pattern is observed.

Which row shows possible effects of replacing the grating with one that has twice as many lines per millimetre?

	number of orders of diffraction visible	angle between first and second orders of diffraction
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

5 - (9702/11_Summer_2017_Q28) - *Superposition*

A parallel beam of light of wavelength 600 nm is incident normally on a diffraction grating. The grating has 300 lines per millimetre.

What is the total number of intensity maxima from the grating?

A 1 **B** 3 **C** 11 **D** 13

6 - (9702/12_Summer_2017_Q28) - *Superposition*

A parallel beam of red light of wavelength 700 nm is incident normally on a diffraction grating that has 400 lines per millimetre.

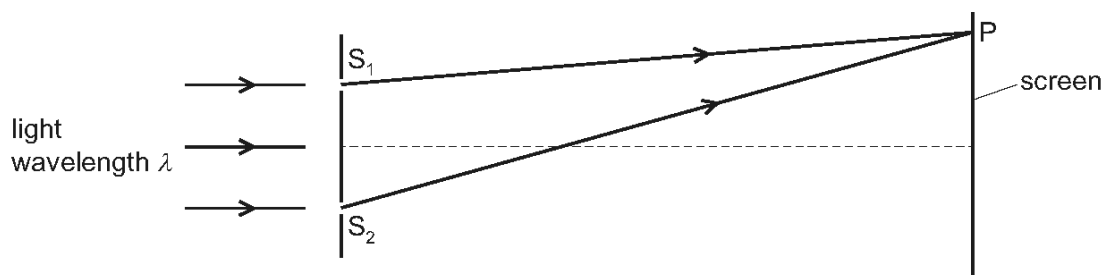
What is the total number of intensity maxima from the grating?

A 6 **B** 7 **C** 8 **D** 9



7 - (9702/13_Summer_2017_Q28) - Superposition

Monochromatic light of wavelength λ is incident on two narrow slits S_1 and S_2 , a small distance apart. A series of bright and dark fringes are observed on a screen a long distance away from the slits.



The n th **dark** fringe from the central bright fringe is observed at point P on the screen.

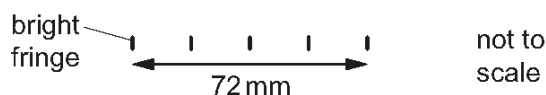
Which equation is correct for all positive values of n ?

- A** $S_2P - S_1P = \frac{n\lambda}{2}$
- B** $S_2P - S_1P = n\lambda$
- C** $S_2P - S_1P = (n - \frac{1}{2})\lambda$
- D** $S_2P - S_1P = (n + \frac{1}{2})\lambda$

8 - (9702/11_Summer_2017_Q29) - Superposition

A pattern of interference fringes is produced using a red laser, a double slit and a screen. The screen is 3.5 m from the double slit. The light from the laser has a wavelength of 640 nm.

The pattern of fringes is shown.



What is the separation of the slits?

- A** $1.2 \times 10^{-4} \text{ m}$ **B** $1.6 \times 10^{-4} \text{ m}$ **C** $3.1 \times 10^{-5} \text{ m}$ **D** $3.3 \times 10^{-9} \text{ m}$

9 - (9702/12_Summer_2017_Q29) - Superposition

Two wave sources are oscillating in phase. Each source produces a wave of wavelength λ . The two waves from the sources meet at point X with a phase difference of 90° .

What is a possible difference in the distances from the two wave sources to point X?

- A** $\frac{\lambda}{8}$ **B** $\frac{\lambda}{4}$ **C** $\frac{\lambda}{2}$ **D** λ



10 - (9702/11_Winter_2017_Q5) - *Measurement Techniques, Superposition*

A double-slit interference experiment is used to determine the wavelength of light from a monochromatic source.

The following measurements are used.

slit separation $a = 0.50 \pm 0.02$ mm

fringe separation $x = 1.7 \pm 0.1$ mm

distance between slits and screen $D = 2.000 \pm 0.002$ m

What is the percentage uncertainty in the calculated wavelength?

- A** 0.1% **B** 1% **C** 6% **D** 10%

11 - (9702/11_Winter_2017_Q24) - *Waves, Superposition*

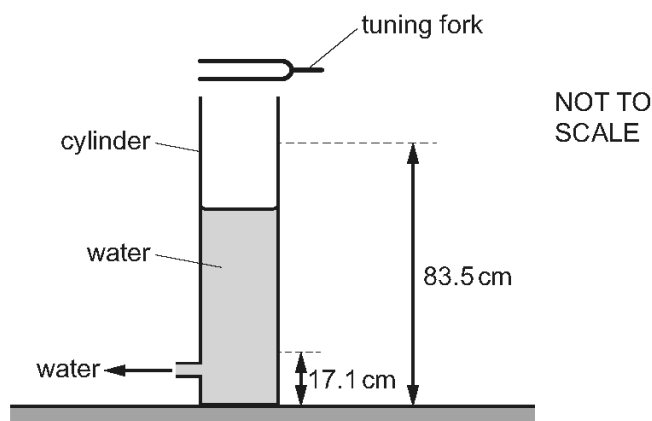
Diffraction can be observed when a wave passes an obstruction. The diffraction effect is greatest when the wavelength and the obstruction are similar in size.

For waves travelling through air, what is the combination of wave and obstruction that could best demonstrate diffraction?

- A** microwaves passing a steel post
B radio waves passing a copper wire
C sound waves passing a human hair
D visible light waves passing a gate post

12 - (9702/12_Winter_2017_Q24) - *Waves, Superposition*

A vibrating tuning fork is held above a glass cylinder filled to the top with water. The water level is steadily lowered. A loud sound is first heard when the water level is 83.5 cm above the bench. The next loud sound is heard when the water level is 17.1 cm above the bench.



The speed of sound in air is 340 m s^{-1} .

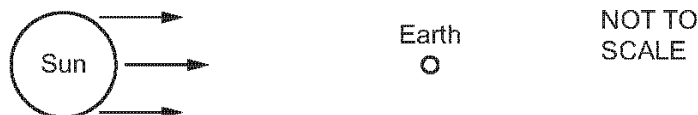
What is the frequency of the tuning fork?

- A** 128 Hz **B** 256 Hz **C** 384 Hz **D** 512 Hz



13 - (9702/11_Winter_2017_Q25) - Waves, Superposition

Light of a particular wavelength λ_s is emitted from the Sun. At any instant, a band of wavelengths ranging from less than λ_s to more than λ_s is observed on the Earth. This is caused by the Doppler effect.



What could be the explanation for this Doppler effect?

- A The Sun is moving at right-angles to a line joining the Sun and the Earth.
- B The Sun is moving away from the Earth.
- C The Sun is moving towards the Earth.
- D The Sun is rotating.

14 - (9702/12_Winter_2017_Q25) - Waves, Superposition

A train that is moving in a straight line along a railway track has a whistle that continuously emits sound of frequency f .

A woman standing by the side of the track hears sound of frequency $0.85f$.

The speed of sound in the air is 340 m s^{-1} .

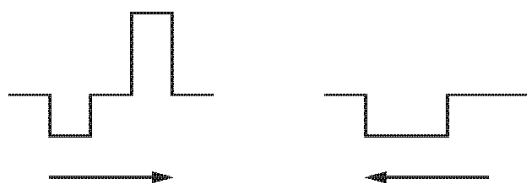
What is the velocity of the train?

- A 51 m s^{-1} away from the woman
- B 51 m s^{-1} towards the woman
- C 60 m s^{-1} away from the woman
- D 60 m s^{-1} towards the woman



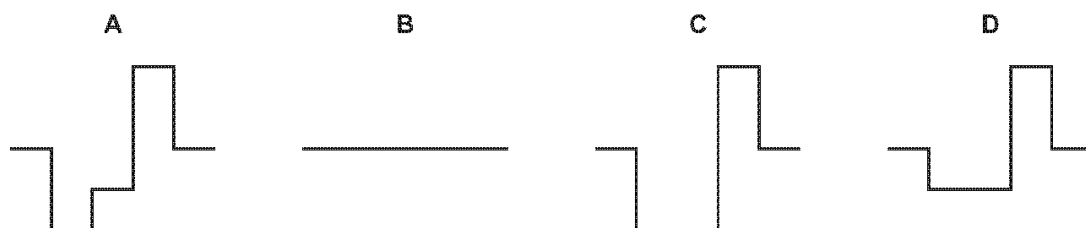
15 - (9702/11_Winter_2017_Q27) - Superposition

Two signals approach each other, as shown.



At one instant, the signals completely overlap.

According to the principle of superposition, what is the shape of the resulting signal at this instant?



16 - (9702/12_Winter_2017_Q27) - Superposition

A stationary sound wave has a series of nodes. The distance between the first and the sixth node is 30.0 cm.

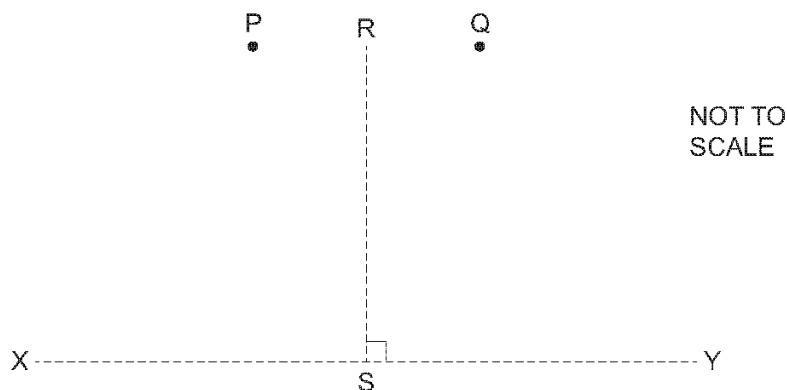
What is the wavelength of the sound wave?

- A 5.0 cm B 6.0 cm C 10.0 cm D 12.0 cm



17 - (9702/11_Winter_2017_Q28) - Superposition

Coherent waves are produced at P and at Q and travel outwards in all directions. The line RS is half-way between P and Q and perpendicular to the line joining P and Q. The distance RS is much greater than the distance PQ.

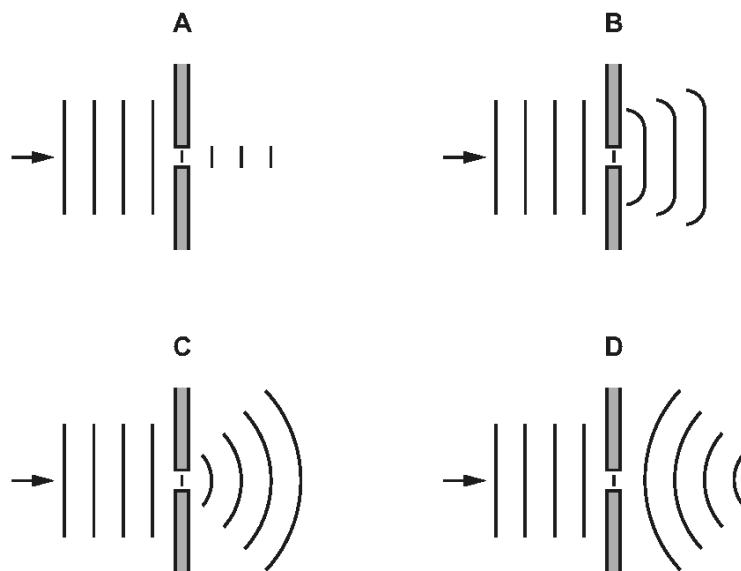


Along which of the lines shown is an interference pattern observed?

- A both RS and XY
- B RS only
- C XY only
- D neither RS nor XY

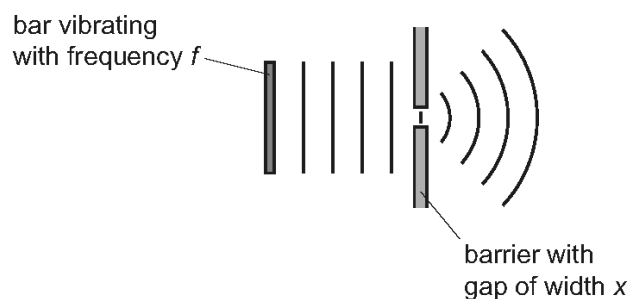
18 - (9702/12_Winter_2017_Q28) - Superposition

Which diagram shows the diffraction of water waves in a ripple tank?



19 - (9702/11_Winter_2017_Q29) - Superposition

A bar vibrates with frequency f to produce water waves in a ripple tank.



The waves pass through a gap of width x in a barrier so that diffraction occurs.

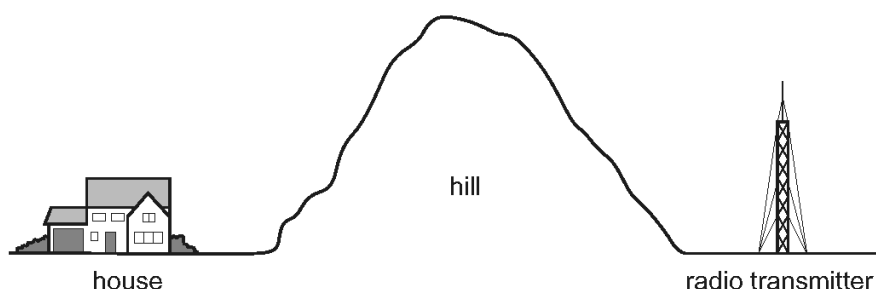
Which combination of vibration frequency and gap width will produce the smallest angle of diffraction?

	vibration frequency	gap width
A	$\frac{f}{2}$	$\frac{x}{2}$
B	$\frac{f}{2}$	$2x$
C	$2f$	$\frac{x}{2}$
D	$2f$	$2x$



20 - (9702/12_Winter_2017_Q29) - *Superposition*

A hill stands between a radio transmitter and a house, as shown.



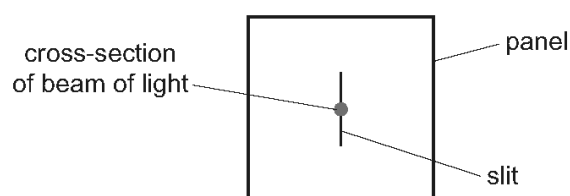
The radio transmitter cannot be seen from the house, but radio waves from the transmitter are received at the house.

Why is this?

- A The wavelength of light is longer than the wavelength of radio waves so there is more diffraction of light over the hill.
- B The wavelength of light is shorter than the wavelength of radio waves so there is more diffraction of light over the hill.
- C The wavelength of radio waves is longer than the wavelength of light so there is more diffraction of radio waves over the hill.
- D The wavelength of radio waves is shorter than the wavelength of light so there is more diffraction of radio waves over the hill.

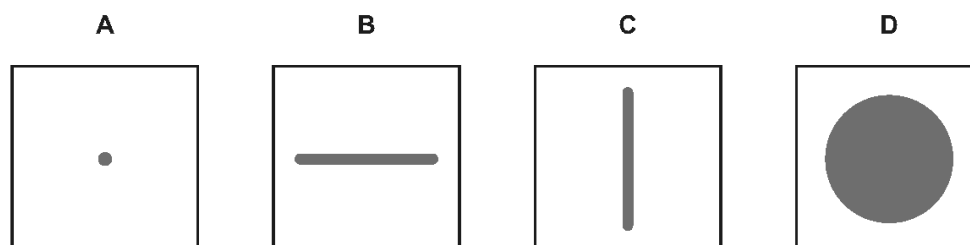
21 - (9702/13_Winter_2017_Q29) - *Superposition*

A beam of laser light is directed towards a narrow slit.



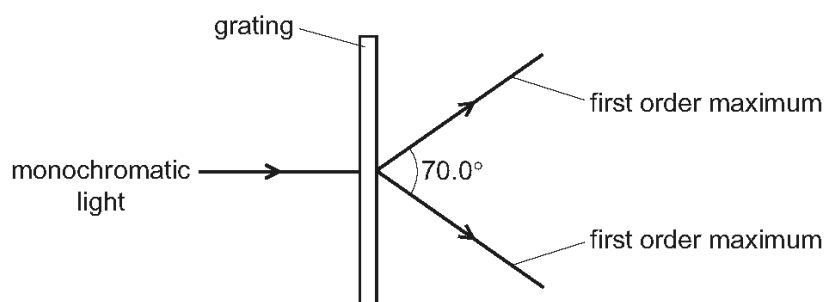
After emerging from the other side of the slit, the light then falls on a screen.

What is the pattern of light seen on the screen?



22 - (9702/11_Winter_2017_Q30) - *Superposition*

A diffraction grating is used to measure the wavelength of monochromatic light, as shown in the diagram.



The spacing of the slits in the grating is $1.00 \times 10^{-6} \text{ m}$. The angle between the first order diffraction maxima is 70.0° .

What is the wavelength of the light?

- A 287 nm B 470 nm C 574 nm D 940 nm

23 - (9702/12_Winter_2017_Q30) - *Superposition*

In an experiment to demonstrate double-slit interference using light, the distance from the slits to the screen is doubled and the slit separation is halved. The wavelength of the light is kept constant.

By which factor does the separation of adjacent bright fringes change?

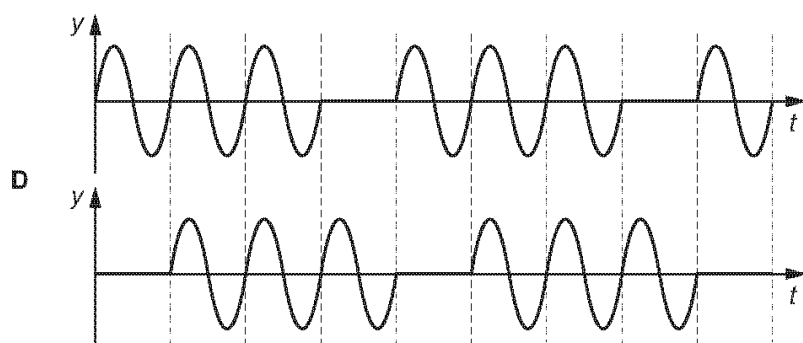
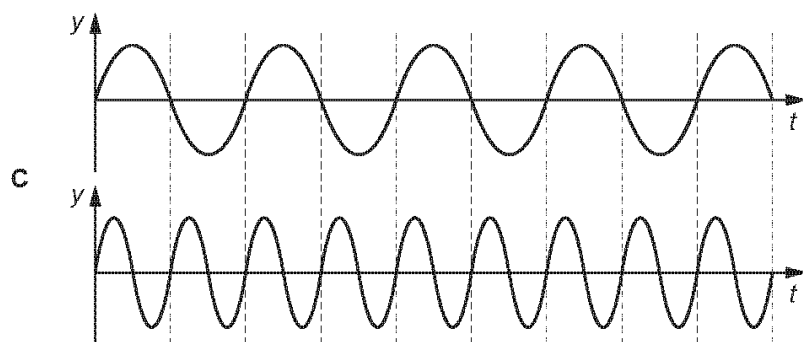
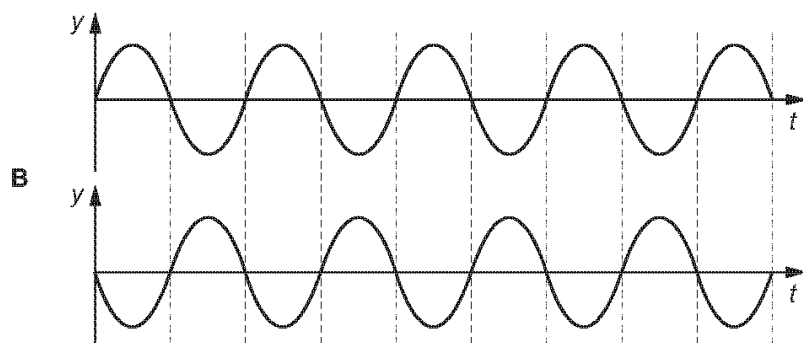
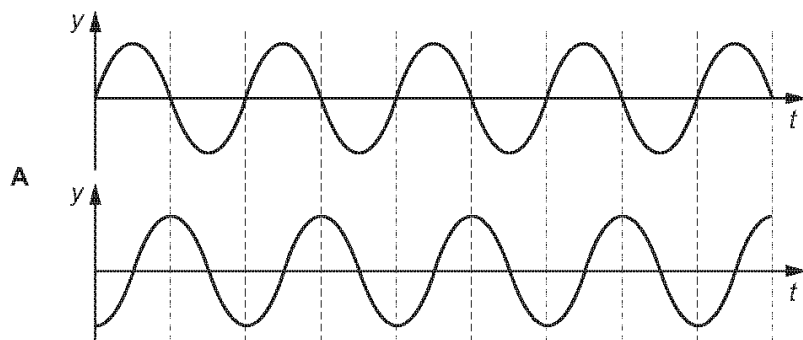
- A $\frac{1}{4}$ B $\frac{1}{2}$ C 2 D 4



24 - (9702/13_Winter_2017_Q30) - Superposition

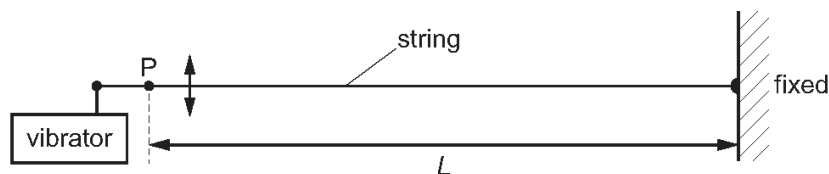
The diagrams show four pairs of waves. In each case the displacement y measured at a fixed point is plotted against time t .

Which pair of waves is **not** coherent?



25 - (9702/12_Summer_2018_Q24) - Superposition

A string is fixed at one end and the other end is attached to a vibrator. The frequency of the vibrator is slowly increased from zero. A series of stationary waves is formed. Assume that for a stationary wave there is a node at point P.

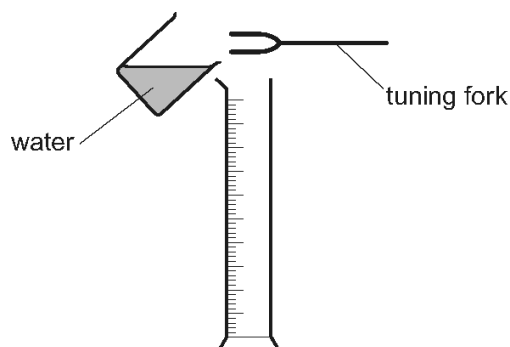


What are the first five wavelengths of the stationary waves that could be formed?

- A $2\frac{L}{1}, 2\frac{L}{2}, 2\frac{L}{3}, 2\frac{L}{4}, 2\frac{L}{5}$
- B $2\frac{L}{2}, 2\frac{L}{3}, 2\frac{L}{4}, 2\frac{L}{5}, 2\frac{L}{6}$
- C $4\frac{L}{1}, 4\frac{L}{2}, 4\frac{L}{3}, 4\frac{L}{4}, 4\frac{L}{5}$
- D $4\frac{L}{1}, 4\frac{L}{3}, 4\frac{L}{5}, 4\frac{L}{7}, 4\frac{L}{9}$

26 - (9702/13_Summer_2018_Q24) - Waves, Superposition

A vibrating tuning fork is held over a measuring cylinder, as shown.



Water is then gradually poured into the measuring cylinder. A much louder sound is first heard when the water level is 2.9 cm above the base of the measuring cylinder. A second much louder sound is heard when the water level reaches a height of 67.3 cm above the base.

The speed of sound in air is 330 m s^{-1} .

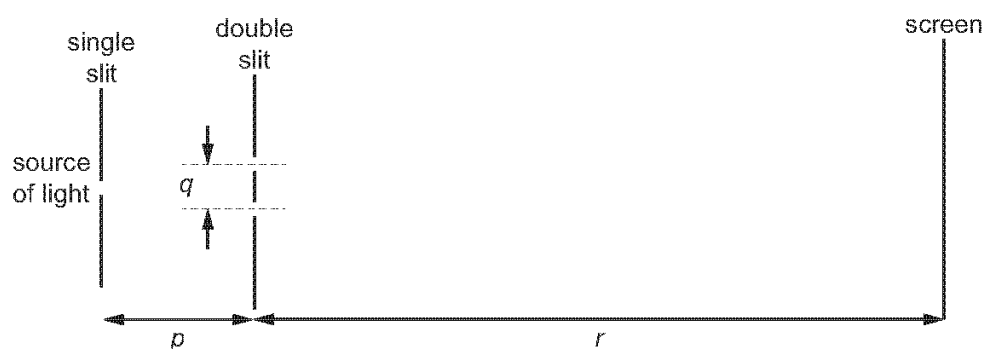
What is the frequency of the tuning fork?

- A 128 Hz B 256 Hz C 512 Hz D 1024 Hz



27 - (9702/11_Summer_2018_Q25) - Superposition

A teacher sets up the apparatus shown to demonstrate a double-slit interference pattern on the screen.

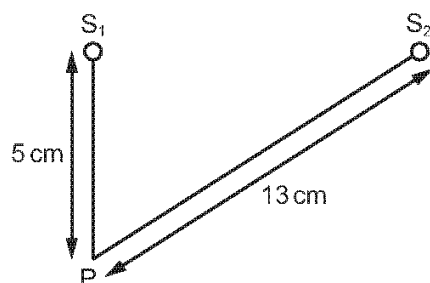


Which change to the apparatus will increase the fringe spacing?

- A decreasing the distance p
- B decreasing the distance q
- C decreasing the distance r
- D decreasing the wavelength of the light

28 - (9702/11_Summer_2018_Q26) - Superposition

The diagram shows two sources of waves S_1 and S_2 . The sources oscillate with a phase difference of 180° .



The sources each generate a wave of wavelength 2.0 cm . Each source produces a wave that has amplitude x_0 when it reaches point P .

What is the amplitude of the oscillation at P ?

- A 0
- B $\frac{x_0}{2}$
- C x_0
- D $2x_0$



29 - (9702/12_Summer_2018_Q26) - Waves, Superposition

The diagram shows apparatus for the measurement of the frequency of a sound wave.



Sound of the unknown frequency is reflected back from a metal plate. A microphone placed at a distance D from the metal plate detects the sound intensity. A minimum intensity is detected with $D = 12.0$ cm. The plate is moved further away from the microphone until the next minimum is detected with $D = 15.0$ cm.

The speed of sound in air is 336 m s^{-1} .

What is the frequency of the sound?

- A 56 Hz B 112 Hz C 5600 Hz D 11 200 Hz

30 - (9702/13_Summer_2018_Q26) - Superposition

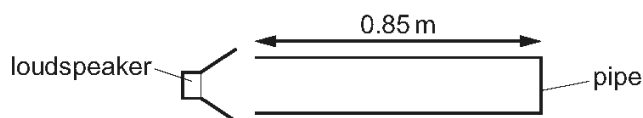
A double-slit interference pattern using red light of wavelength $7.0 \times 10^{-7} \text{ m}$ has a fringe spacing of 3.5 mm.

Which fringe spacing would be observed for the same arrangement of apparatus but using blue light of wavelength $4.5 \times 10^{-7} \text{ m}$?

- A 2.3 mm B 3.5 mm C 5.4 mm D 9.0 mm

31 - (9702/11_Summer_2018_Q27) - Superposition

A pipe, closed at one end, has a loudspeaker at the open end. A stationary sound wave is formed in the air within the pipe with an antinode at the open end of the pipe.



The length of the pipe is 0.85 m.

The speed of sound in air is 340 m s^{-1} .

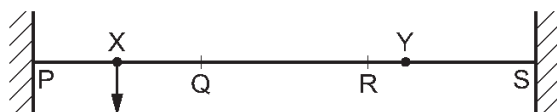
Which frequency of sound from the loudspeaker would **not** produce a stationary wave?

- A 100 Hz B 200 Hz C 300 Hz D 500 Hz



32 - (9702/12_Summer_2018_Q28) - Superposition

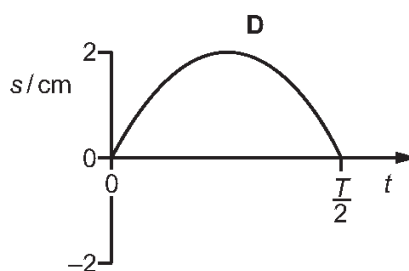
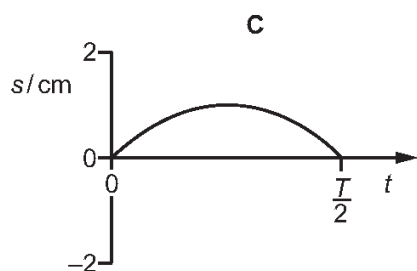
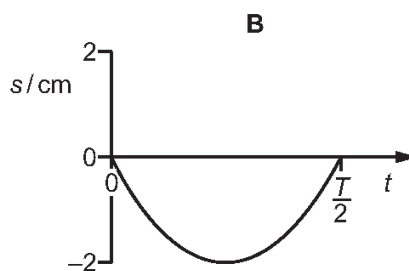
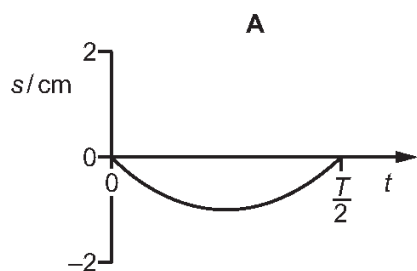
The diagram shows a stationary wave, at time $t = 0$, that has been set up on a string fixed between points P and S.



The nodes of the stationary wave occur on the string at P, Q, R and S. Point X is moving down at time $t = 0$. The points on the string vibrate with time period T and maximum amplitude 2 cm.

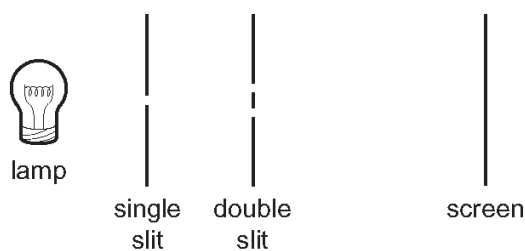
The displacement s is positive in the upward direction.

Which graph best shows the variation with t of the displacement s of point Y on the string?



33 - (9702/12_Summer_2018_Q29) - Superposition

A two-source interference experiment uses the apparatus shown.



What is the main purpose of the single slit?

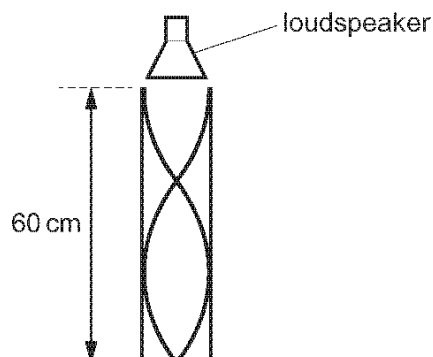
- A** to make a narrow beam of light
- B** to make the same amplitude of light incident on each slit
- C** to provide coherent light
- D** to provide monochromatic light



34 - (9702/12_Winter_2018_Q24) - *Superposition*

The sound from a loudspeaker placed above a tube causes resonance of the air in the tube.

A stationary wave is formed with two nodes and two antinodes as shown.



The speed of sound in the air is 340 m s^{-1} .

What is the frequency of the sound?

- A 430 Hz B 570 Hz C 850 Hz D 1700 Hz

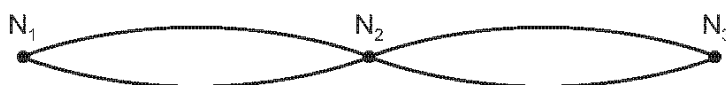
35 - (9702/11_Winter_2018_Q26) - *Superposition*

What may be used to produce stationary waves?

- A blowing air over the top of an empty bottle
B making a loud sound near a mountain
C passing monochromatic light through a double slit
D passing water waves through a narrow slit

36 - (9702/13_Winter_2018_Q26) - *Superposition*

The diagram shows a stationary wave on a string. The stationary wave has three nodes N_1 , N_2 and N_3 .



Which statement is correct?

- A All points on the string vibrate in phase.
B All points on the string vibrate with the same amplitude.
C Points equidistant from N_2 vibrate with the same frequency and in phase.
D Points equidistant from N_2 vibrate with the same frequency and the same amplitude.



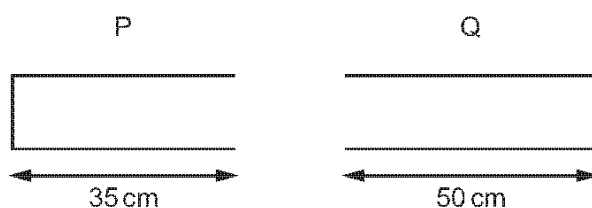
37 - (9702/11_Winter_2018_Q27) - *Superposition*

What is an example of the diffraction of a wave?

- A laser light travelling along an optic fibre
- B light waves forming images on a cinema screen
- C microwaves passing the edge of a metal plate
- D sound waves diverging as they pass through air

38 - (9702/12_Winter_2018_Q27) - *Superposition*

Progressive sound waves of wavelength 20cm enter the air columns in a closed pipe P and an open pipe Q. The lengths of the pipes are shown.



In which pipe or pipes are stationary waves formed?

- A P and Q
- B P only
- C Q only
- D neither P nor Q

39 - (9702/13_Winter_2018_Q27) - *Waves, Superposition*

In which situation does diffraction occur?

- A A wave bounces back from a surface.
- B A wave passes from one medium into another.
- C A wave passes through an aperture.
- D Waves from two identical sources are superposed.

40 - (9702/11_Winter_2018_Q28) - *Superposition*

When the light from two lamps falls on a screen, no interference pattern can be obtained.

Why is this?

- A The lamps are not point sources.
- B The lamps emit light of different amplitudes.
- C The light from the lamps is not coherent.
- D The light from the lamps is white.



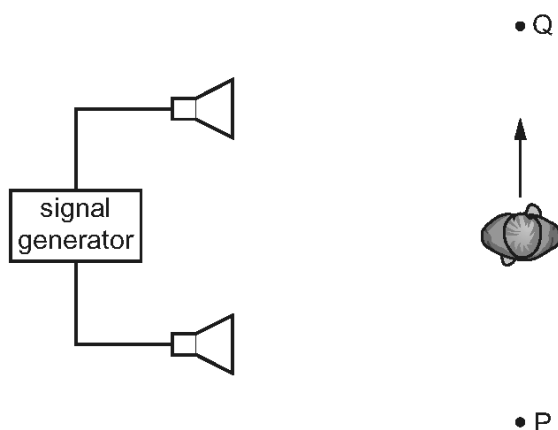
41 - (9702/12_Winter_2018_Q28) - *Waves, Superposition*

What happens when waves pass through a gap equal to their wavelength?

- A There is diffraction and the wavelength decreases.
- B There is diffraction and the wavelength stays the same.
- C There is no diffraction and the wavelength decreases.
- D There is no diffraction and the wavelength stays the same.

42 - (9702/13_Winter_2018_Q28) - *Superposition*

A student connects two loudspeakers to a signal generator.



As the student walks from P to Q, he notices that the loudness of the sound rises and falls repeatedly.

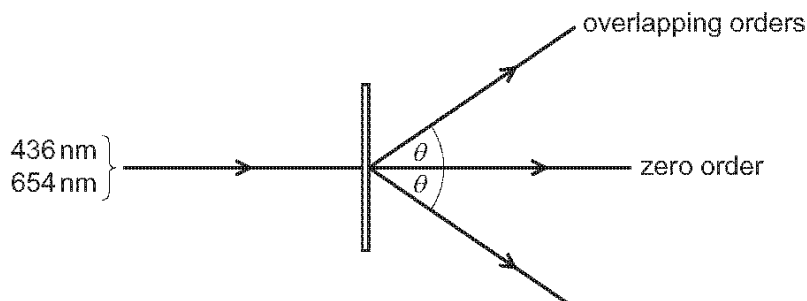
What causes the loudness of the sound to vary?

- A diffraction of the sound waves
- B Doppler shift of the sound waves
- C interference of the sound waves
- D reflection of the sound waves



43 - (9702/11_Winter_2018_Q29) - Superposition

A beam of light consists of two wavelengths of 436 nm and 654 nm. A diffraction grating of $5.00 \times 10^5 \text{ lines m}^{-1}$ produces a diffraction pattern in which the second order of one of these wavelengths occurs at the same angle θ as the third order of the other wavelength.

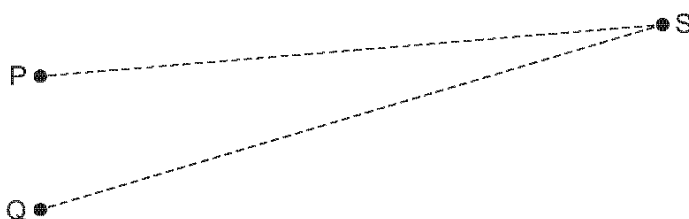


What is the angle θ ?

- A 19.1° B 25.8° C 40.8° D 78.8°

44 - (9702/12_Winter_2018_Q29) - Superposition

Two sources of microwaves P and Q produce coherent waves with a phase difference of 180° . The waves have the same wavelength λ .



At the point S there is a minimum in the interference pattern produced by waves from the two sources. The distance $(QS - PS)$ is called the path difference.

In the expressions shown, n is an integer.

Which expression represents the path difference?

- A $n\lambda$ B $\frac{1}{2}n\lambda$ C $(n + \frac{1}{2})\lambda$ D $(2n + \frac{1}{2})\lambda$

45 - (9702/13_Winter_2018_Q29) - Superposition

A parallel beam of white light is incident normally on a diffraction grating. The second-order and third-order spectra partially overlap.

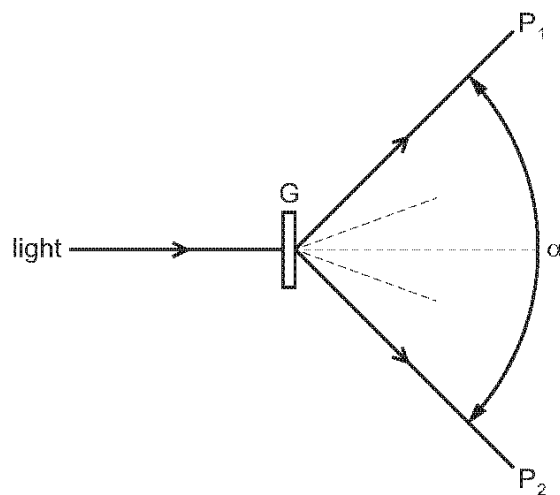
Which wavelength in the third-order spectrum appears at the same angle as the wavelength of 600 nm in the second-order spectrum?

- A 300 nm B 400 nm C 600 nm D 900 nm



46 - (9702/12_Winter_2018_Q30) - Superposition

A parallel beam of monochromatic light of wavelength λ is incident normally on a diffraction grating G. The angle between the directions of the two second-order diffracted beams at P_1 and at P_2 is α , as shown.



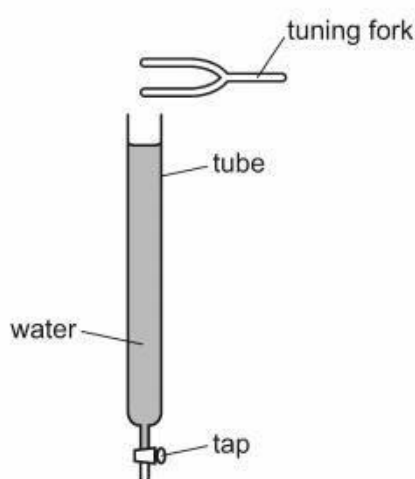
What is the spacing of the lines on the grating?

- A $\frac{2\lambda}{\sin \alpha}$ B $\frac{\lambda}{\sin \alpha}$ C $\frac{2\lambda}{\sin(\alpha/2)}$ D $\frac{\lambda}{\sin(\alpha/2)}$

47 - (9702/11_Summer_2019_Q24) - Superposition

A long tube, filled with water, has a tap fitted at its base, as shown.

A tuning fork is sounded above the tube and the water is allowed to run gradually out of the tube.



A louder sound is heard at intervals as the water runs out of the tube. The change in water level between louder sounds is 32 cm.

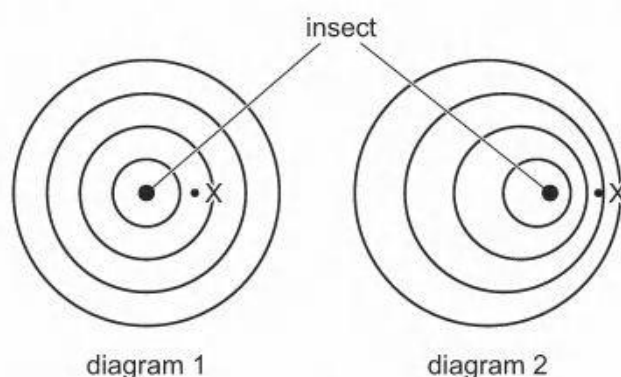
What is the wavelength of the sound in the tube?

- A 16 cm B 32 cm C 64 cm D 128 cm



48 - (9702/11_Summer_2019_Q25) - *Superposition*

A stationary insect on the surface of water creates circular waves with its legs, as shown in diagram 1. The insect begins to travel to the right as shown in diagram 2.



Which row describes the change to the waves at X caused by the movement of the insect?

	frequency	wave speed
A	decreases	increases
B	decreases	stays the same
C	increases	increases
D	increases	stays the same

49 - (9702/12_Summer_2019_Q25) - *Superposition*

In an experiment to determine the wavelength of sound in air, a stationary wave is set up in an air column.

The distance between a node and an adjacent antinode is L .

What is the wavelength of the sound?

- A** $\frac{1}{2}L$ **B** L **C** $2L$ **D** $4L$

50 - (9702/13_Summer_2019_Q26) - *Superposition*

An elastic string is attached to an oscillator at one end and clamped at the other end so that the string is horizontal and in tension.

The oscillator is made to oscillate vertically. The frequency of oscillation is gradually increased from zero until a stationary wave is set up in the string. The frequency is then increased further to frequency f , when a second stationary wave is set up in the string.

The frequency is then increased further.

At which frequency does a third stationary wave occur?

- A** $1.2f$ **B** $1.5f$ **C** $2.0f$ **D** $3.0f$



51 - (9702/11_Summer_2019_Q27) - *Superposition*

Two progressive waves of frequency 300 Hz superpose to produce a stationary wave in which adjacent nodes are 1.5 m apart.

What is the speed of the progressive waves?

- A** 100 ms⁻¹ **B** 200 ms⁻¹ **C** 450 ms⁻¹ **D** 900 ms⁻¹

52 - (9702/13_Summer_2019_Q28) - *Superposition*

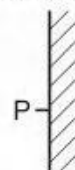
Light of wavelength λ is emitted from two point sources R and S and falls onto a distant screen.

R •

S •

(not to scale)

screen



At point P on the screen, the light intensity is zero.

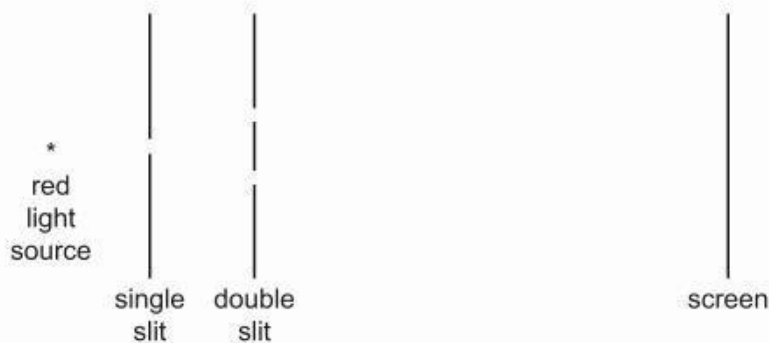
What could explain the zero intensity at P?

- A** Light from the two sources is emitted 180° out of phase and the path difference to P is $\frac{1}{2}\lambda$.
B Light from the two sources is emitted in phase and the path difference to P is λ .
C Light from the two sources is emitted 90° out of phase and the path difference to P is λ .
D Light from the two sources is emitted in phase and the path difference to P is $\frac{1}{2}\lambda$.



53 - (9702/11_Summer_2019_Q29) - *Superposition*

A double-slit interference experiment is set up as shown.



not to scale

Fringes are formed on the screen. The distance between successive bright fringes is found to be 4 mm.

Two changes are then made to the experimental arrangement. The double slit is replaced by another double slit which has half the spacing. The screen is moved so that its distance from the double slit is twice as great.

What is now the distance between successive bright fringes?

- A** 1 mm **B** 4 mm **C** 8 mm **D** 16 mm

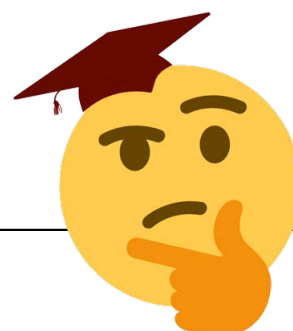
54 - (9702/13_Summer_2019_Q29) - *Superposition*

Apparatus is arranged to show double-slit interference using monochromatic light. The slit separation is 0.10 mm. The distance from the double slit to the screen where the interference pattern is observed is 2.4 m and the fringe width is 12 mm.

The distance to the screen is now changed to 1.8 m and the slit separation is doubled.

What is the new fringe width?

- A** 1.5 mm **B** 4.5 mm **C** 6.0 mm **D** 9.0 mm



55 - (9702/11_Summer_2019_Q30) - *Superposition*

The interference patterns from a diffraction grating and a double slit are compared.

Using the diffraction grating, yellow light of the first order is seen at 30° to the normal to the grating.

The same light produces interference fringes on a screen 1.0 m from the double slit. The slit separation is 500 times greater than the line spacing of the grating.

What is the fringe separation on the screen?

- A $2.5 \times 10^{-7} \text{ m}$
- B $1.0 \times 10^{-5} \text{ m}$
- C $1.0 \times 10^{-3} \text{ m}$
- D $1.0 \times 10^{-1} \text{ m}$

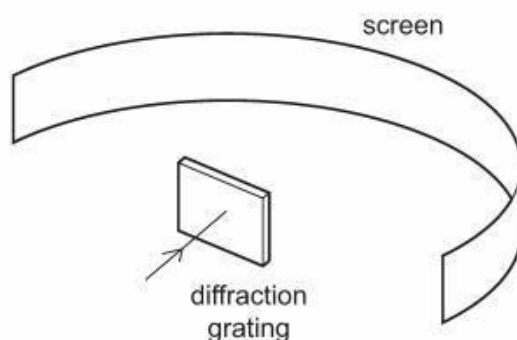
56 - (9702/12_Summer_2019_Q30) - *Superposition*

Why can an observable interference pattern **never** be obtained between two monochromatic beams of light from different lamps?

- A The frequency of the light from the two lamps can never be the same.
- B The light from the two lamps can never be coherent.
- C The temperature of the filaments of the two lamps used can never be the same.
- D The wavelength of the light from the two lamps must always be different.

57 - (9702/13_Summer_2019_Q30) - *Superposition*

Monochromatic light of wavelength 690 nm passes through a diffraction grating with 300 lines per mm, producing a series of maxima (bright spots) on a screen.



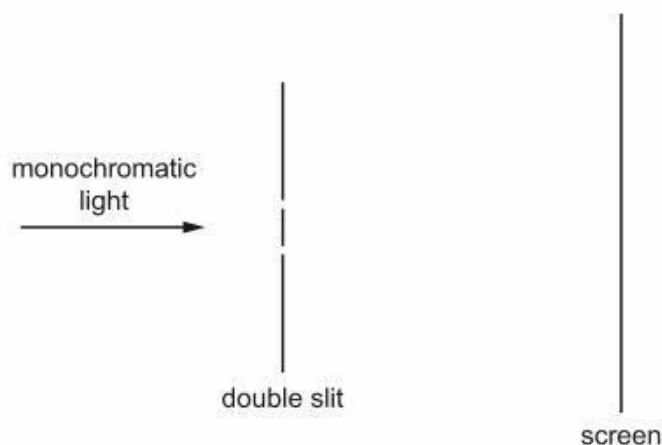
What is the greatest number of maxima that can be observed?

- A 4
- B 5
- C 8
- D 9



58 - (9702/12_Summer_2019_Q31) - Superposition

A student sets up apparatus to observe the double-slit interference of monochromatic light, as shown.



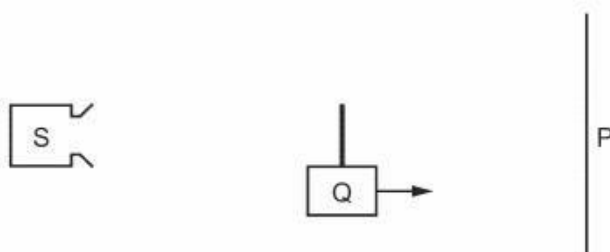
Interference fringes are formed on the screen.

Which change would increase the distance between adjacent fringes?

- A Decrease the distance between the two slits.
- B Decrease the width of each slit.
- C Move the screen closer to the double slit.
- D Use light of a higher frequency.

59 - (9702/11_Winter_2019_Q23) - Superposition

Source S emits microwaves with a constant amplitude. The microwaves hit a metal screen P and are reflected. A stationary wave is formed between S and P. The wavelength of the microwaves is much smaller than the distance between S and P.



A detector Q is moved at a slow, constant speed from S to P.

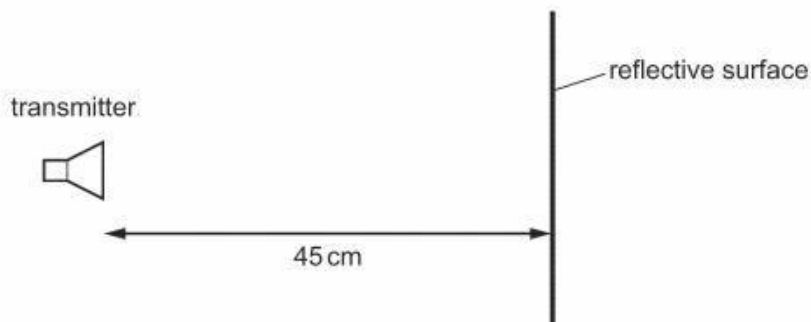
What happens to the amplitude of the signal detected by Q?

- A decreases steadily
- B increases and decreases regularly
- C increases steadily
- D remains constant



60 - (9702/12_Winter_2019_Q25) - Superposition

A transmitter of electromagnetic waves is placed 45 cm from a reflective surface.



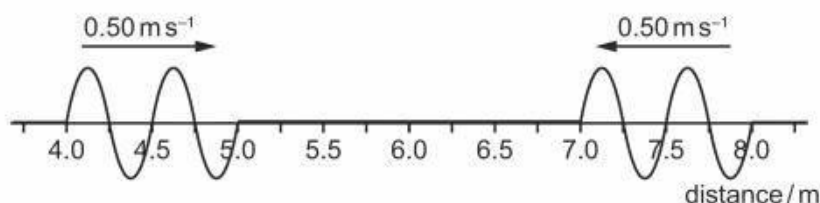
The emitted waves have a frequency of 1.00 GHz. A stationary wave is produced with a node at the transmitter and a node at the surface.

How many antinodes are in the space between the transmitter and the surface?

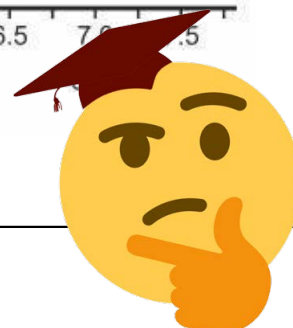
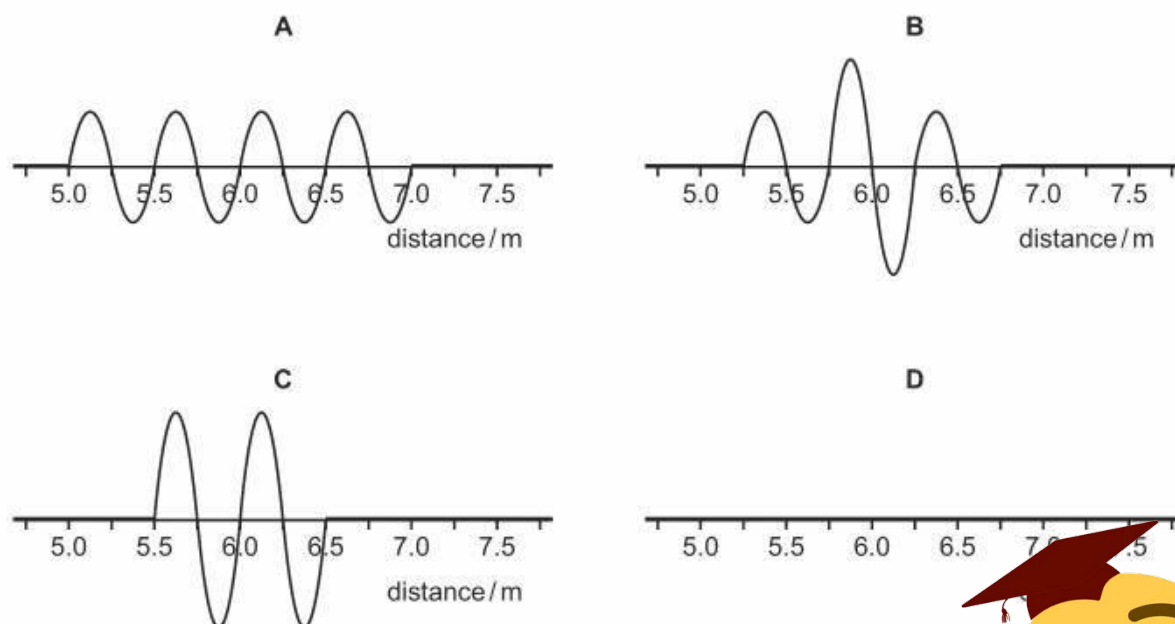
- A** 1 **B** 2 **C** 3 **D** 4

61 - (9702/11_Winter_2019_Q26) - Superposition

Two wave pulses are travelling towards each other on a long rope. The pulses have the same amplitude and wavelength and are travelling at a speed of 0.50 ms^{-1} . The diagram shows the rope at time $t = 0$.



Which diagram shows the rope at time $t = 3.0 \text{ s}$?



62 - (9702/13_Winter_2019_Q26) - Superposition

In an experiment to demonstrate a stationary wave, two microwave transmitters, emitting waves of wavelength 4 cm, are set facing each other, as shown.



A detector is moved along a straight line between the transmitters. It detects positions of maximum and minimum signal. The detector is a distance d from the left-hand transmitter.

Assume that both transmitters are at antinodes of the stationary wave.

Which row gives a value of d for a maximum and for a minimum?

	value of d for a maximum / cm	value of d for a minimum / cm
A	46	48
B	47	48
C	48	47
D	49	47

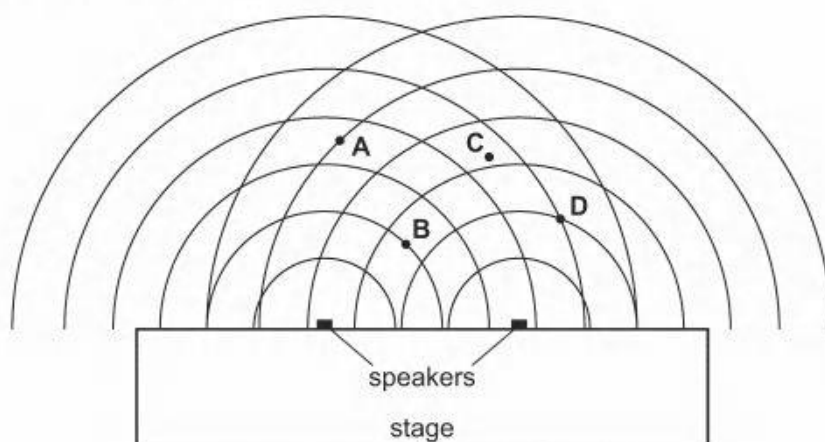
63 - (9702/12_Winter_2019_Q27) - Superposition

An outdoor concert has two large speakers beside the stage for broadcasting music.

In order to test the speakers, they are made to emit sound of the same wavelength and the same amplitude.

The curved lines in the diagram represent wavefronts.

Where is the loudest sound heard?



64 - (9702/11_Winter_2019_Q28) - *Superposition*

Light of wavelength 720 nm from a laser X is incident normally on a diffraction grating and a diffraction pattern is observed. Light from a laser Y is then also incident normally on the same grating. The third-order maximum due to laser Y is seen at the same place as the second-order maximum due to laser X.

What is the wavelength of the light from laser Y?

- A 480 nm B 540 nm C 720 nm D 1080 nm

65 - (9702/12_Winter_2019_Q28) - *Superposition*

An electromagnetic wave is incident normally on a diffraction grating.

A second-order maximum is produced at an angle of 30° to a normal to the grating.

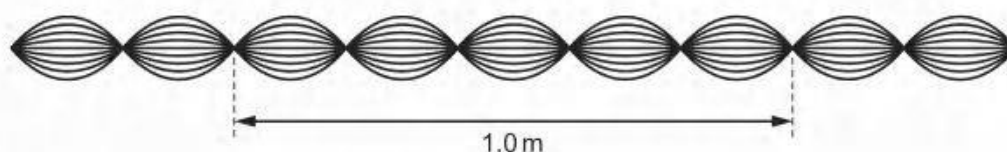
The grating has 5000 lines per cm.

What is the wavelength of the wave?

- A 2.5×10^{-7} m B 5.0×10^{-7} m C 1.0×10^{-6} m D 5.0×10^{-5} m

66 - (9702/13_Winter_2019_Q28) - *Superposition*

The diagram shows a sketch of a wave pattern over a short period of time.



Which description of this wave is correct?

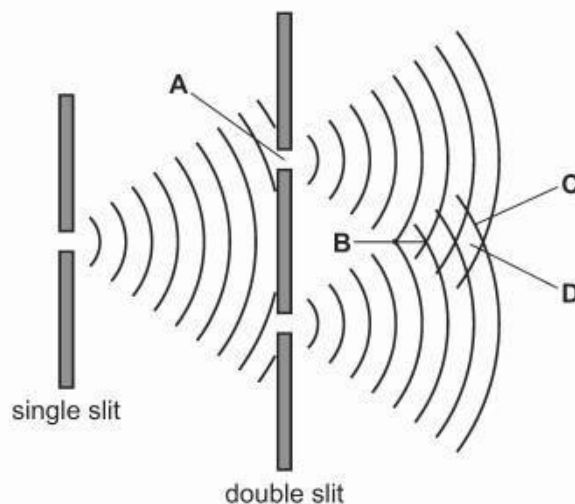
- A The wave is longitudinal, has a wavelength of 20 cm and is stationary.
B The wave is transverse, has a wavelength of 20 cm and is stationary.
C The wave is transverse, has a wavelength of 40 cm and is progressive.
D The wave is transverse, has a wavelength of 40 cm and is stationary.



67 - (9702/13_Winter_2019_Q29) - Superposition

The double-slit experiment demonstrates interference between two coherent sources of light waves. In the diagram, the curved lines represent wavefronts.

At which point does complete destructive interference (a minimum) occur?



68 - (9702/13_Winter_2019_Q30) - Superposition

Light of wavelength 567 nm is incident normally on a diffraction grating. The grating has 400 lines per mm. A number of diffraction maxima are observed on the far side of the grating.

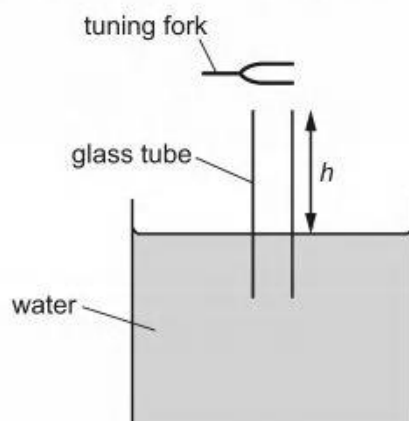
What is the angle between the second-order maximum and the third-order maximum?

- A 13.1° B 13.9° C 15.9° D 27.0°

69 - (9702/11_Summer_2020_Q24) - Superposition

A long glass tube is almost completely immersed in a large tank of water. A tuning fork is struck and held just above the open end of the tube as it is slowly raised.

A louder sound is first heard when the height h of the end of the tube above the water is 18.8 cm. A louder sound is next heard when h is 56.4 cm. The speed of sound in air is 330 m s^{-1} .



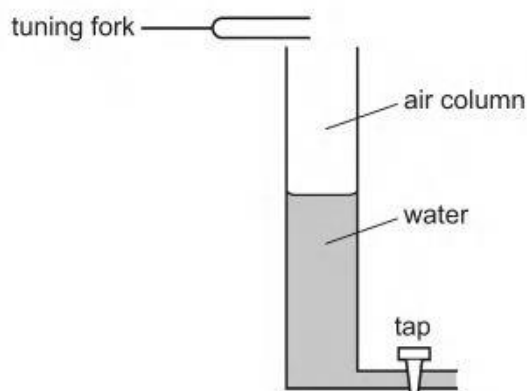
What is the frequency of the sound produced by the tuning fork?

- A 220 Hz B 440 Hz C 660 Hz D 880 Hz



70 - (9702/12_Summer_2020_Q24) - Superposition

The diagram shows an experiment to produce a stationary wave in an air column. A tuning fork, placed above the column, vibrates and produces a sound wave. The length of the air column can be varied by altering the volume of the water in the tube.



The tube is filled and then water is allowed to run out of it. The first two stationary waves occur when the air column lengths are 0.14 m and 0.42 m.

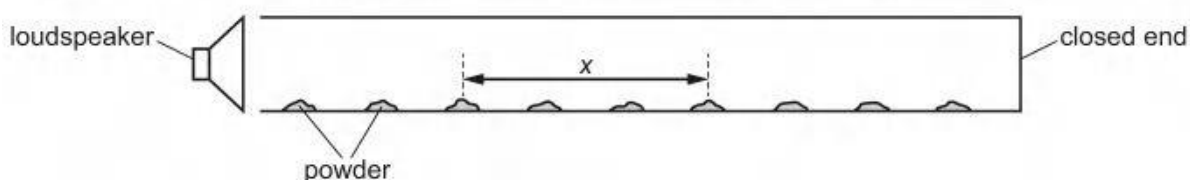
What is the wavelength of the sound wave?

- A** 0.14 m **B** 0.28 m **C** 0.42 m **D** 0.56 m

71 - (9702/13_Summer_2020_Q24) - Superposition

A loudspeaker is set up at the open end of a closed tube containing powder.

When the loudspeaker produces sound of frequency 1200 Hz, a stationary wave is produced in the tube. The powder gathers at the nodes of the stationary wave as shown.



The speed of sound in the air is 336 m s^{-1} .

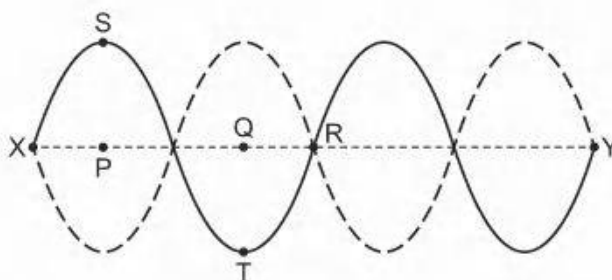
What is the value of distance x ?

- A** 28 cm **B** 42 cm **C** 84 cm **D** 112 cm



72 - (9702/11_Summer_2020_Q27) - *Superposition*

The diagram shows a string stretched between fixed points X and Y. There is a stationary wave on the string.



The solid curve shows the string at a position of maximum displacement. The dashed curve shows the other position of maximum displacement. The straight central dashed line shows the mean position of the string. Point S on the string is directly above point P. Point T on the string is directly below Q.

Which statement is correct?

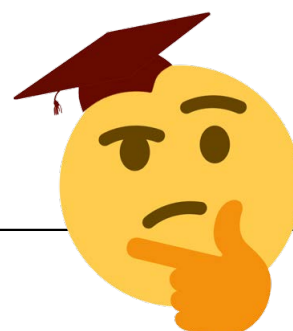
- A A short time later, point R on the string will be displaced.
- B Points S and T on the string move in opposite directions.
- C The distance between P and Q is one wavelength.
- D Two points on the string that are equal distances from point R vibrate in phase.

73 - (9702/12_Summer_2020_Q27) - *Superposition*

Two progressive waves meet at a point.

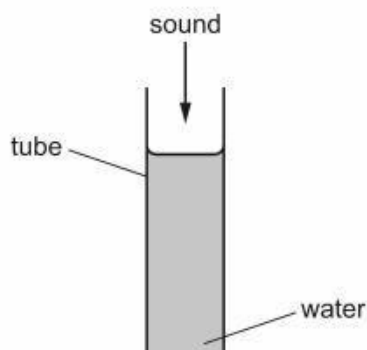
Which condition must be met for superposition of the waves to occur?

- A The waves must be coherent.
- B The waves must be of the same type.
- C The waves must be travelling in opposite directions.
- D The waves must meet in phase.



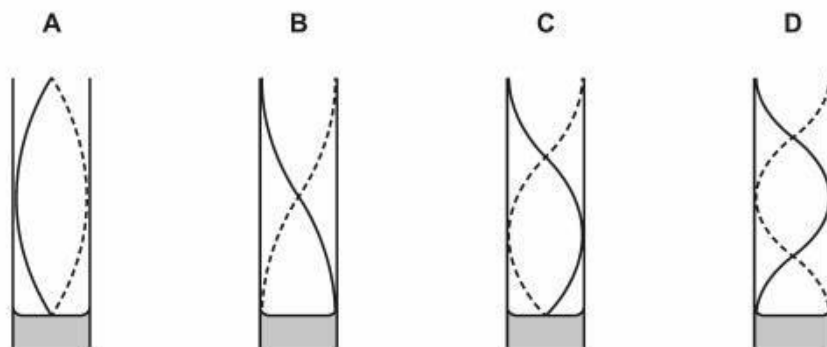
74 - (9702/13_Summer_2020_Q27) - Superposition

A vertical tube is partially filled with water. A sound wave moves down the tube and is reflected by the surface of the water. The frequency of the sound wave is gradually increased from zero until a much louder sound is heard.



Water is then removed from the tube until a second louder sound is heard.

Which diagram shows the new pattern of the stationary wave that is formed?



75 - (9702/11_Summer_2020_Q29) - Superposition

Light of a single wavelength is incident normally on two slits that are 0.20 mm apart. Interference fringes are observed on a screen that is 5.4 m away from the slits. The distance between successive bright fringes is 12 mm.

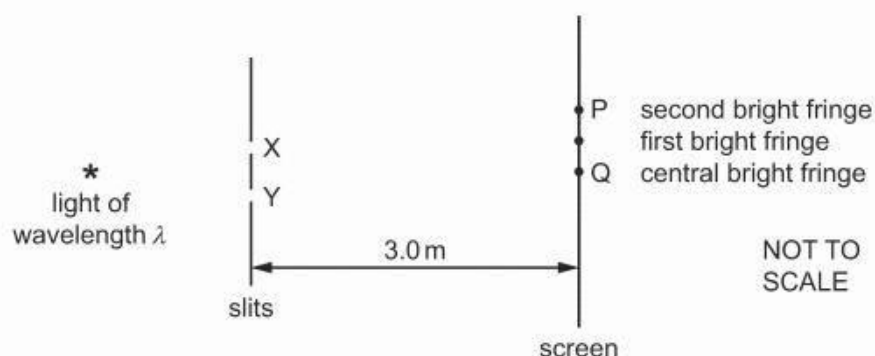
What is the wavelength of the light?

- A 440 nm B 540 nm C 650 nm D 900 nm



76 - (9702/12_Summer_2020_Q29) - *Superposition*

The diagram shows an arrangement for demonstrating two-source interference using coherent light of a single wavelength λ .



An interference pattern is observed on a screen 3.0 m away from the slits X and Y, which have a separation of 1.0 mm.

The central bright fringe is at Q, and the **second** bright fringe from the centre is at P.

What is the distance between Q and P?

- A $6.0 \times 10^3 \lambda$
- B $3.0 \times 10^3 \lambda$
- C $6.7 \times 10^{-4} \lambda$
- D $3.3 \times 10^{-4} \lambda$

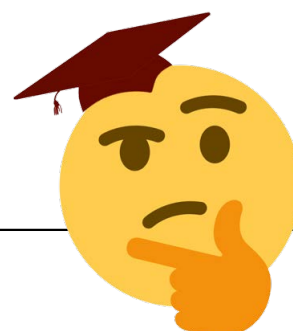
77 - (9702/13_Summer_2020_Q29) - *Superposition*

A double-slit interference experiment is set up using green light.

A pattern of interference fringes is formed on a screen.

Which single change will increase the separation of the fringes?

- A increase the width of each slit
- B move the screen nearer to the double slit
- C use slits that are further apart
- D use red light instead of green light



78 - (9702/11_Summer_2020_Q30) - Superposition

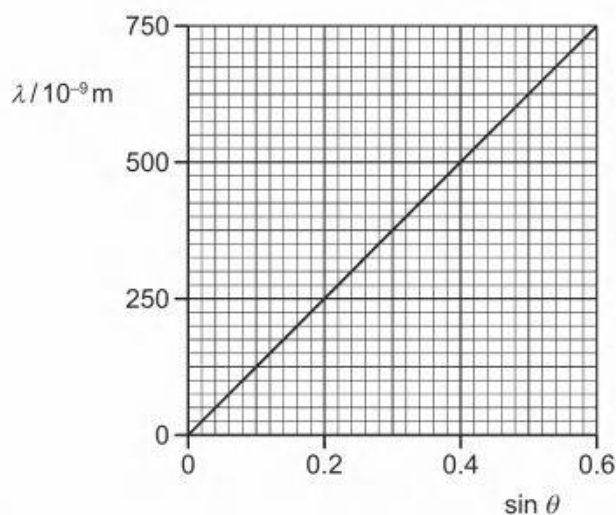
A diffraction grating and a screen are used to determine the single wavelength λ of the light from a source.

What is an essential feature of this experiment?

- A A curved screen must be used.
- B The diffraction angle θ must be measured for at least two interference maxima.
- C The light waves incident on the grating must be coherent.
- D The third order intensity maximum must be produced.

79 - (9702/12_Summer_2020_Q30) - Superposition

Light of wavelength λ is incident normally on a diffraction grating. The angle between the **second**-order maximum and the normal to the grating is θ . The variation with $\sin \theta$ of λ is shown on the graph.



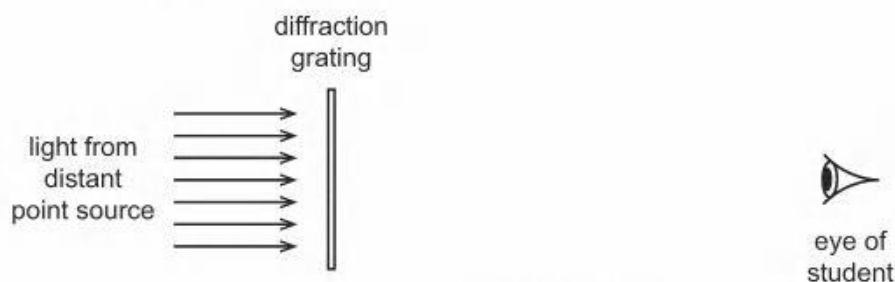
How many lines per millimetre are on the diffraction grating?

- A 400 mm^{-1}
- B 625 mm^{-1}
- C 800 mm^{-1}
- D 1250 mm^{-1}



80 - (9702/13_Summer_2020_Q30) - Superposition

Light of a single wavelength from a distant point source falls normally onto a diffraction grating positioned with its lines vertical.



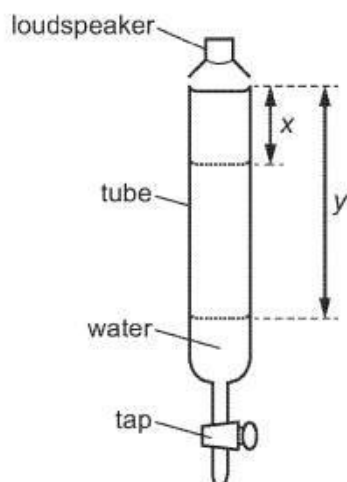
The plane of the diffraction grating is at right angles to the incident light. A student looks at the grating from a position near to the grating.

What could the student see?

- A a central point source with a series of point source images on either side
- B a central vertical line with a series of spectra on either side
- C a series of fine vertical lines
- D a single point source

81 - (9702/11_Winter_2020_Q23) - Superposition

A loudspeaker emits a sound wave into a tube initially full of water.



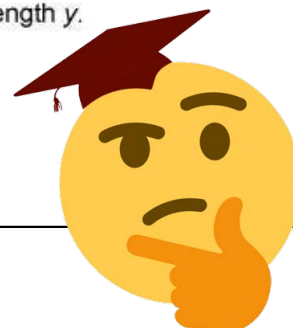
A tap at the bottom of the tube is opened so that water slowly leaves the tube. For some lengths of the air column in the tube, the sound heard is much louder.

The first loud sound is heard when the air column in the tube has length x .

The next time that a loud sound is heard is when the air column in the tube has length y .

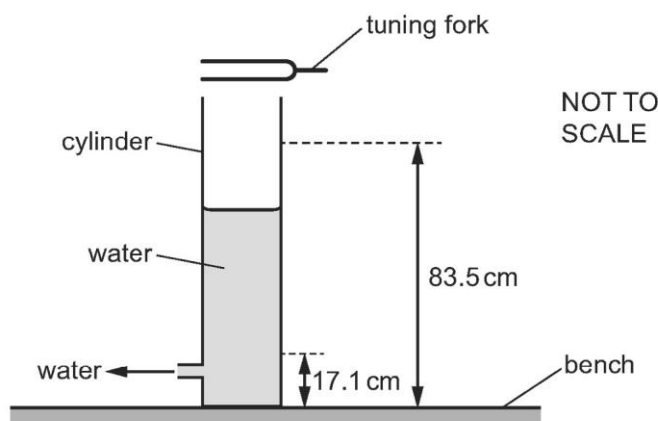
What is the wavelength of the sound wave from the loudspeaker?

- A $2x$
- B $4y$
- C $2(y - x)$
- D $4(y - x)$



82 - (9702/12_Winter_2020_Q24) - *Superposition*

A vibrating tuning fork is held above a glass cylinder filled to the top with water. The water level is steadily lowered. A loud sound is first heard when the water level is 83.5 cm above the bench. The next loud sound is heard when the water level is 17.1 cm above the bench.



The speed of sound in air is 340 m s^{-1} .

What is the frequency of the tuning fork?

- A 128 Hz B 256 Hz C 384 Hz D 512 Hz

83 - (9702/11_Winter_2020_Q26) - *Superposition*

Which statement concerning a stationary wave is correct?

- A All the particles between two adjacent nodes oscillate in phase.
B The amplitude of the stationary wave is equal to the amplitude of one of the waves creating it.
C The wavelength of the stationary wave is equal to the separation of two adjacent nodes.
D There is no displacement of a particle at an antinode at any time.

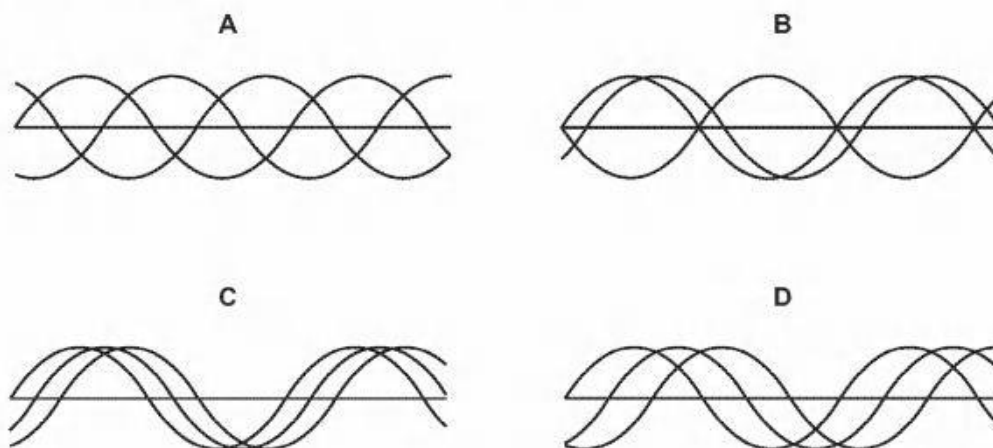


84 - (9702/12_Winter_2020_Q27) - Superposition

The three waves shown in each diagram have the same amplitude and frequency but different phase.

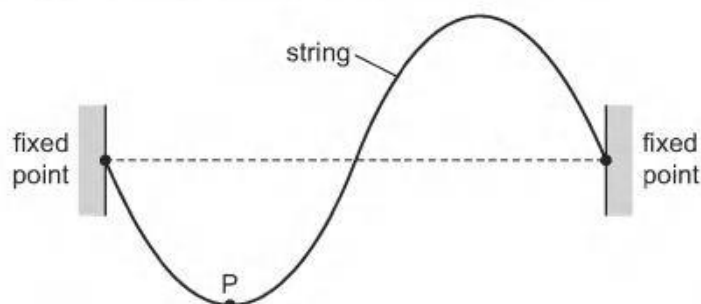
They are added together to give a resultant wave.

In which case is the resultant wave zero at this instant?



85 - (9702/13_Winter_2020_Q27) - Superposition

A stationary wave is formed on a stretched string. The diagram illustrates the string at an instant of time when the displacement of the string is at its maximum.



The frequency of the wave is 250 Hz. Point P on the string has a vertical displacement of -1.0 mm .

What will be the vertical displacement of the point P after a time of 5.0 ms?

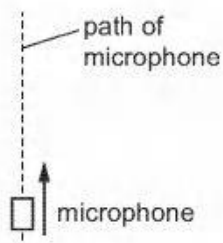
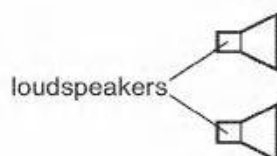
- A -1.0 mm B zero C $+0.5\text{ mm}$ D $+1.0\text{ mm}$



86 - (9702/11_Winter_2020_Q28) - Superposition

Two loudspeakers are placed near to each other and facing in the same direction.

A microphone connected to an oscilloscope is moved along a line some distance away from the loudspeakers, as shown.



Which statement about the waves emitted by the loudspeakers is **not** a necessary condition for the microphone to detect a fixed point along the line where there is no sound?

- A The waves must be emitted in phase.
- B The waves must be emitted with a similar amplitude.
- C The waves must have the same frequency.
- D The waves must have the same wavelength.

87 - (9702/11_Winter_2020_Q29) - Superposition

A parallel beam of white light passes through a diffraction grating. Orange light of wavelength 600 nm in the fourth-order diffraction maximum coincides with blue light in the fifth-order diffraction maximum.

What is the wavelength of the blue light?

- A 450 nm B 480 nm C 500 nm D 750 nm

88 - (9702/12_Winter_2020_Q29) - Superposition

An experiment is carried out to demonstrate double-slit interference using light of wavelength 500 nm. The distance between bright fringes in the interference pattern is 5 mm.

What are possible values for the distance between the slits and the screen, and the slit separation?

	slit-screen distance	slit separation
A	50 cm	0.5 mm
B	50 cm	5 mm
C	5 m	0.5 mm
D	5 m	5 mm



89 - (9702/13_Winter_2020_Q29) - Superposition

In a dark room, a small source of red light illuminates two slits that are 0.75 mm apart. A few metres beyond the slits, the light falls on a screen producing a series of equally spaced bright lines.

Which change would cause the distance between the bright lines on the screen to be reduced?

- A Change the source for one emitting blue light.
- B Reduce the distance between the light source and the slits.
- C Reduce the distance between the slits to 0.55 mm.
- D Reduce the intensity of the light source.

90 - (9702/12_Winter_2020_Q30) - Superposition

Light of a single frequency is incident on a diffraction grating. Seven bright spots are observed on a screen.

Which change will result in an increase in the number of bright spots observed?

- A Increase the distance between the grating and the screen.
- B Increase the frequency of the incident light.
- C Increase the intensity of the incident light.
- D Increase the number of lines per metre in the grating.

91 - (9702/13_Winter_2020_Q30) - Superposition

Light of wavelength $5.30 \times 10^{-7} \text{ m}$ is incident normally on a diffraction grating. The first-order maximum is observed at an angle of 15.4° to the direction of the incident light.

What is the angle between the first-order and second-order diffraction maxima?

- A 7.7° B 15.4° C 16.7° D 32.1°

92 - (9702/11_Summer_2021_Q25) - Superposition

Microwaves in a vacuum travel at speed X and have wavelength of order of magnitude Y .

What are the speed and a possible order of magnitude of wavelength of X-rays in a vacuum?

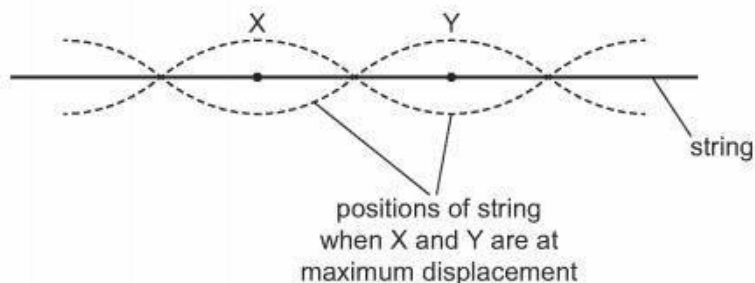
	speed	wavelength
A	X	$10^{-8} Y$
B	X	$10^{-4} Y$
C	$10^4 X$	Y
D	$10^8 X$	Y



93 - (9702/11_Summer_2021_Q26) - Superposition

The diagram shows part of a stationary wave on a string.

X and Y are points on the string. The vibrations at X and Y are 180° out of phase.

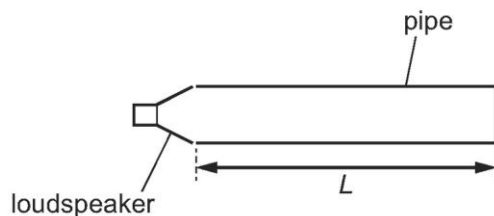


What is the distance between X and Y?

- A one-quarter of a wavelength
- B half a wavelength
- C one wavelength
- D two wavelengths

94 - (9702/12_Summer_2021_Q26) - Superposition

A pipe of length L is open at one end and closed at the other end. A loudspeaker is at the open end and emits a sound wave into the pipe.



When a stationary wave is formed, there is an antinode at the open end of the pipe.

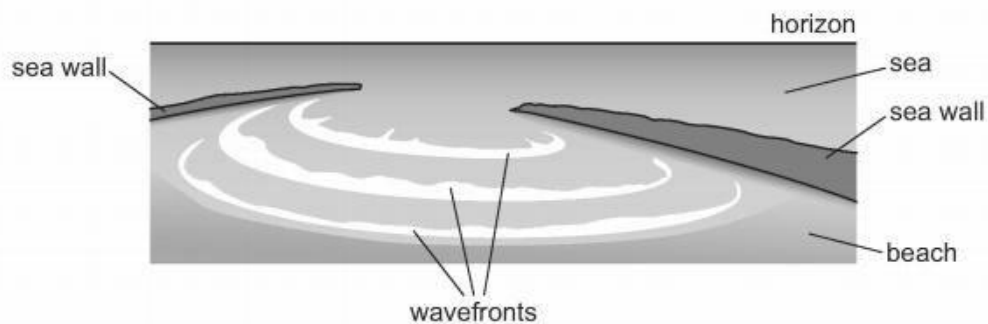
Which wavelength of sound could be used to produce a stationary wave?

- A $\frac{2L}{3}$
- B L
- C $\frac{4L}{3}$
- D $2L$



95 - (9702/11_Summer_2021_Q27) - *Superposition*

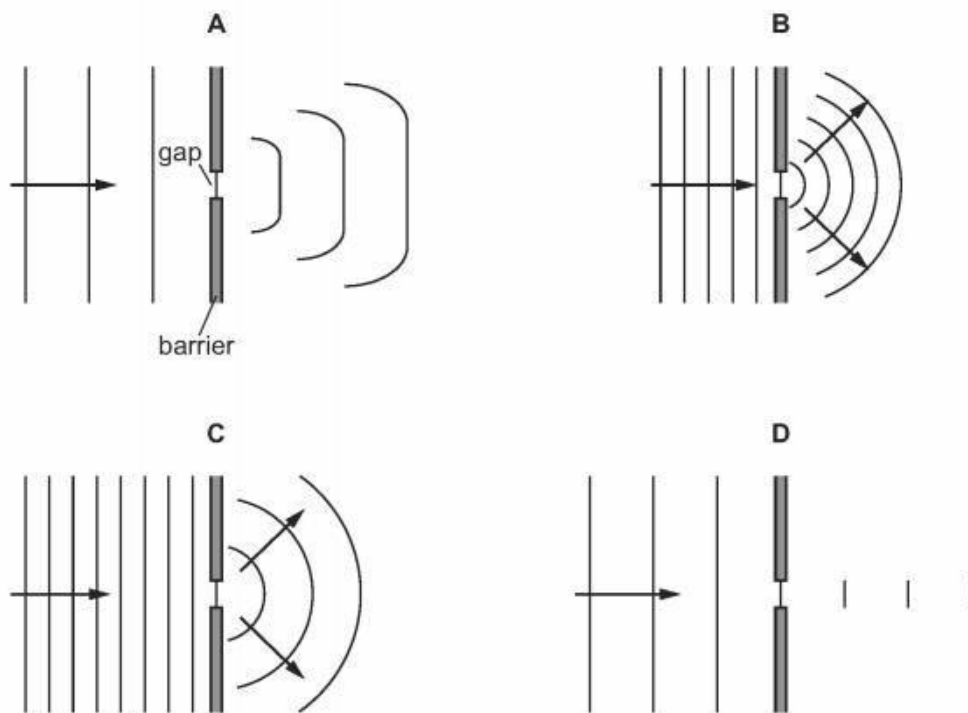
Which wave behaviour is shown in the diagram?



- A diffraction
- B Doppler shift
- C interference
- D superposition

96 - (9702/12_Summer_2021_Q27) - *Superposition*

Which diagram best shows how water waves diffract when they pass through a gap in a barrier?



97 - (9702/13_Summer_2021_Q27) - Superposition

To produce a stationary wave, two waves must travel in opposite directions through the same space.

Which statement about the properties of the two waves **must** also be correct?

- A The waves must have equal frequencies, but different speeds and wavelengths.
- B The waves must have equal speeds, but different wavelengths and frequencies.
- C The waves must have equal speeds, frequencies and wavelengths.
- D The waves must have equal wavelengths, but different speeds and frequencies.

98 - (9702/11_Summer_2021_Q28) - Superposition

A teacher sets up the apparatus shown to demonstrate a double-slit interference pattern on a screen.



Which change to the apparatus will increase the fringe spacing?

- A decrease the distance p
- B decrease the distance q
- C decrease the distance r
- D decrease the wavelength of the light

99 - (9702/12_Summer_2021_Q28) - Superposition

In a two-source interference experiment, light of a single frequency is incident on a double slit.

The light waves emerging from the slits are coherent.

What is meant by *coherent*?

- A The waves are in phase.
- B The waves have a constant phase difference.
- C The waves have the same amplitude.
- D The waves interfere constructively wherever they overlap.



100 - (9702/13_Summer_2021_Q28) - Superposition

The speed of sound in air is 330 m s^{-1} .

Which size of architectural features in a large concert hall would best diffract sound waves of frequency 0.44 kHz ?

- A 1.3 mm B 750 mm C 7.5 m D 17 m

101 - (9702/11_Summer_2021_Q29) - Superposition

Light of a single unknown wavelength and blue light of a single wavelength are both incident normally on a diffraction grating. Two diffraction patterns are produced, one for each wavelength of light.

The third-order maximum for the blue light occurs at the same angle as the second-order maximum for the light of unknown wavelength. The wavelength of the blue light is 480 nm .

What is the unknown wavelength?

- A 320 nm B 720 nm C 960 nm D 1440 nm

102 - (9702/12_Summer_2021_Q29) - Superposition

A parallel beam of light consists of light of wavelength 420 nm and light of wavelength 630 nm .

The light is incident normally on a diffraction grating.

The diffraction maxima for the two wavelengths overlap only at an angle of 31° from the direction of the incident light beam.

What could be the line spacing of the diffraction grating?

- A $1.2 \mu\text{m}$ B $1.6 \mu\text{m}$ C $2.4 \mu\text{m}$ D $3.7 \mu\text{m}$

103 - (9702/13_Summer_2021_Q29) - Superposition

A double-slit interference pattern using red light of wavelength $7.0 \times 10^{-7} \text{ m}$ has a fringe spacing of 3.5 mm .

Which fringe spacing would be observed for the same arrangement of apparatus but using blue light of wavelength $4.5 \times 10^{-7} \text{ m}$?

- A 2.3 mm B 3.5 mm C 5.4 mm D 9.0 mm



104 - (9702/13_Summer_2021_Q30) - Superposition

A beam of light of a single wavelength is incident normally on a diffraction grating.

The angle of diffraction θ is measured for each order of diffraction n . The distance between adjacent slits in the diffraction grating is d .

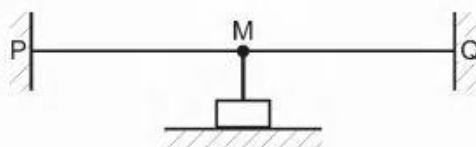
A graph is plotted to determine the wavelength of the light.

Which graph should be plotted and how is the wavelength determined from the graph?

	y-axis	x-axis	wavelength
A	n	$d \sin \theta$	gradient
B	n	$d \sin \theta$	$1/\text{gradient}$
C	$\sin \theta$	d/n	gradient
D	$\sin \theta$	$d \times n$	$1/\text{gradient}$

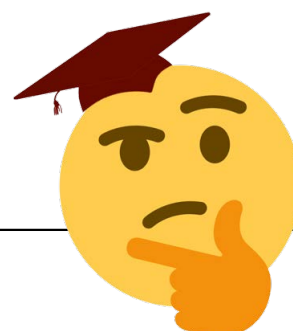
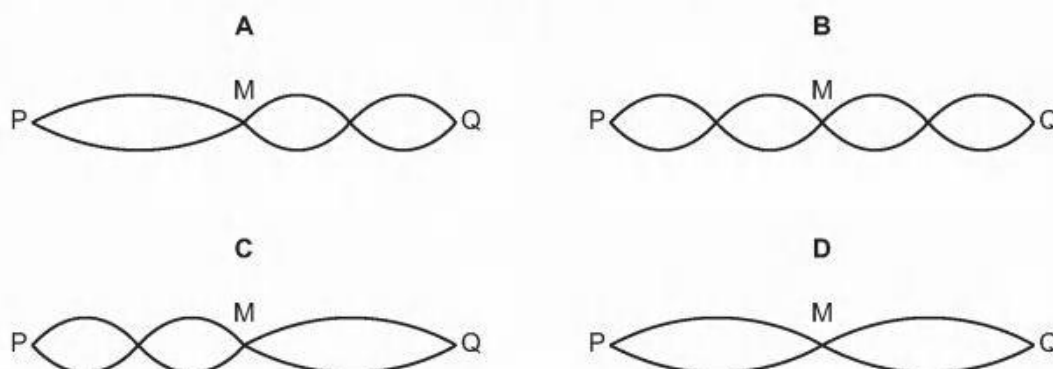
105 - (9702/11_Winter_2021_Q26) - Superposition

A string is fixed between point P and an oscillator M. Another string is fixed between M and point Q. M is midway between P and Q.



The frequency of the oscillator is adjusted until a stationary wave is formed on both strings. The speed of the wave between P and M is twice the speed of the wave between M and Q.

Which diagram could represent the stationary wave pattern?



106 - (9702/11_Winter_2021_Q27) - *Superposition*

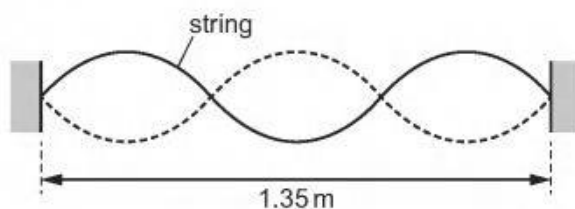
A water wave in a ripple tank is diffracted as it passes through a gap in a barrier.

Which two factors affect the angle of diffraction of the wave?

- A the amplitude and frequency of the incident wave
- B the amplitude of the incident wave and the width of the gap
- C the wavelength and amplitude of the incident wave
- D the wavelength of the incident wave and the width of the gap

107 - (9702/12_Winter_2021_Q27) - *Superposition*

A stationary wave is produced on a string that is stretched between two fixed points that are a distance of 1.35 m apart, as shown.



The speed of the waves on the string is 450 m s^{-1} .

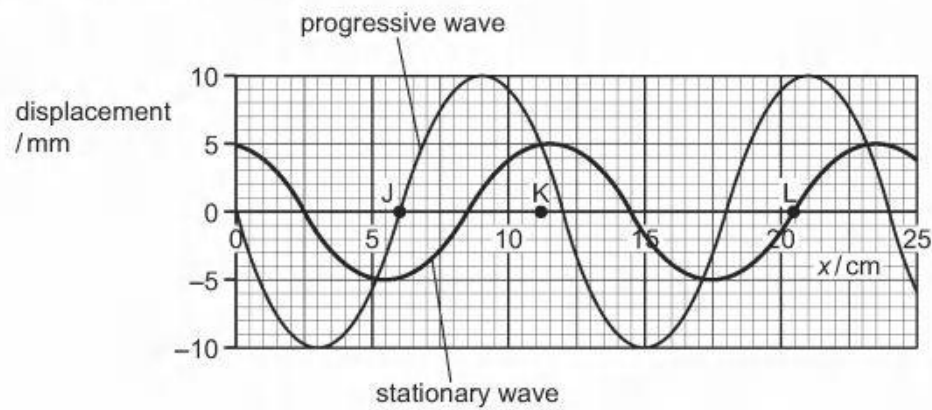
What is the frequency of oscillation of the stationary wave?

- A 333 Hz B 405 Hz C 500 Hz D 1000 Hz



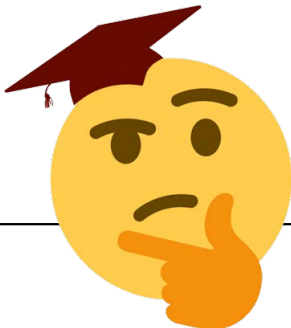
108 - (9702/13_Winter_2021_Q27) - Superposition

Two progressive waves travel in opposite directions and form a stationary wave. The graph shows the variation with distance x of the displacement of the stationary wave and of one of the two progressive waves at the same instant in time.



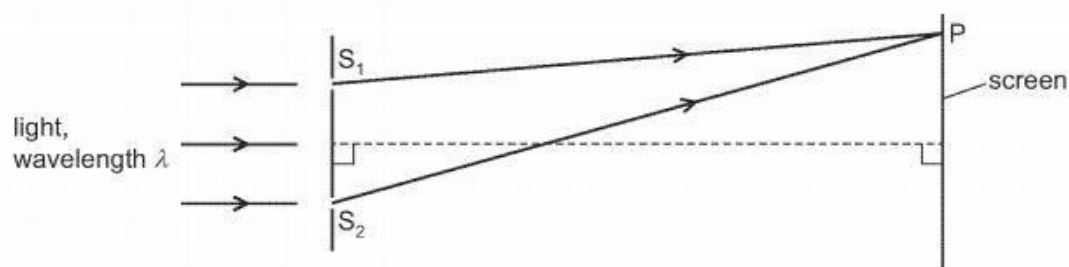
What are the approximate displacements of the **other** progressive wave at the positions J, K and L?

	displacement / mm		
	J	K	L
A	-5	0	-10
B	-5	+5	0
C	0	+5	+10
D	+5	-5	0



109 - (9702/11_Winter_2021_Q28) - Superposition

Light of wavelength λ is incident normally on two narrow slits S_1 and S_2 , a small distance apart. Bright and dark fringes are observed on a screen a long distance away from the slits.



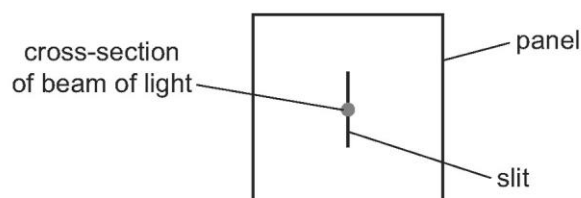
The n th **dark** fringe from the central bright fringe is observed at point P on the screen.

Which equation is correct for all positive values of n ?

- A $S_2P - S_1P = \frac{n\lambda}{2}$
- B $S_2P - S_1P = n\lambda$
- C $S_2P - S_1P = (n - \frac{1}{2})\lambda$
- D $S_2P - S_1P = (n + \frac{1}{2})\lambda$

110 - (9702/12_Winter_2021_Q28) - Superposition

A beam of laser light is directed towards a narrow slit.



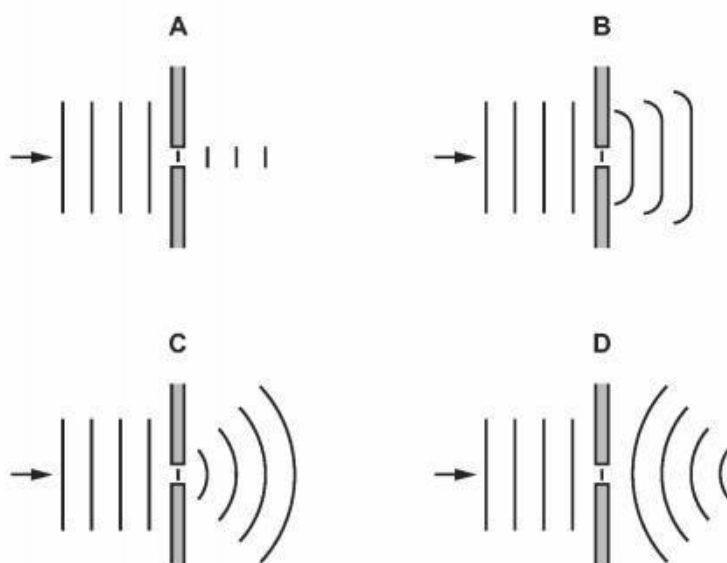
After emerging from the other side of the slit, the diffracted light then falls on a screen.

What is the pattern of light seen on the screen?



111 - (9702/13_Winter_2021_Q28) - *Superposition*

Which diagram shows the diffraction of water waves in a ripple tank?

112 - (9702/11_Winter_2021_Q29) - *Superposition*

Green light is incident normally on a diffraction grating and forms a diffraction pattern on a distant screen.



Which change, on its own, would **decrease** the separation of the diffraction maxima on the screen?

- A Increase the distance between the screen and the diffraction grating.
- B Replace the diffraction grating with a grating that has a smaller separation between the slits.
- C Replace the diffraction grating with a grating that has fewer slits per unit length.
- D Replace the green light with red light.



113 - (9702/12_Winter_2021_Q29) - Superposition

Two waves, each with a constant amplitude, interfere and produce an interference pattern. The pattern has minima at fixed points where the displacement is zero at all times.

Which statement describes the two waves?

- A They must be coherent and of the same amplitude.
- B They must be coherent but not necessarily of the same amplitude.
- C They must be of the same amplitude but not necessarily coherent.
- D They must not be coherent or of the same amplitude.

114 - (9702/13_Winter_2021_Q29) - Superposition

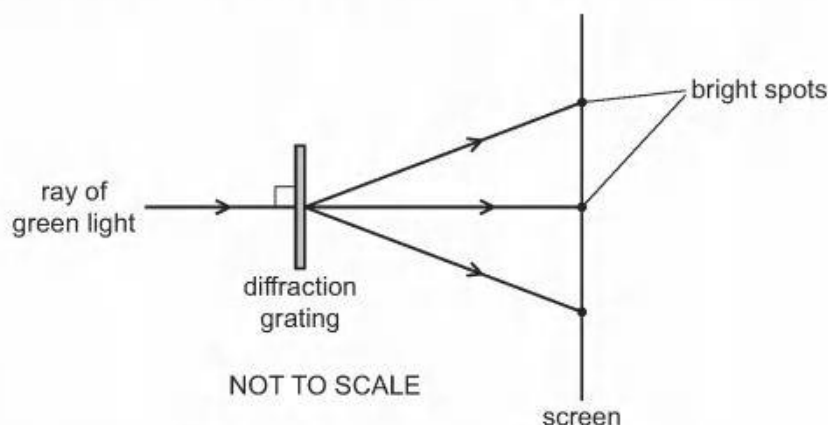
Interference fringes are produced on a screen by double-slit interference using light of wavelength 600 nm. The fringe separation is 4.0 mm and the separation of the slits is 0.60 mm.

What is the distance between the double slit and the screen?

- A 0.25 m B 0.40 m C 2.5 m D 4.0 m

115 - (9702/13_Winter_2021_Q30) - Superposition

A ray of green light is incident normally on a diffraction grating. Several bright spots are produced on a screen on the other side of the grating, as shown.



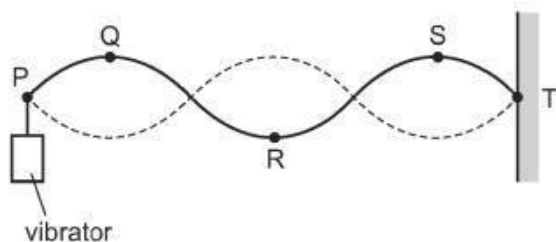
Which pair of changes could result in bright spots at exactly the same angles as previously?

- A Use blue light and increase the distance between the grating and the screen.
- B Use blue light and increase the number of lines per unit length in the grating.
- C Use red light and increase the distance between the grating and the screen.
- D Use red light and increase the number of lines per unit length in the grating.



116 - (9702/12_Summer_2022_Q27) - Superposition

A stationary wave on a stretched string is set up between two points P and T.

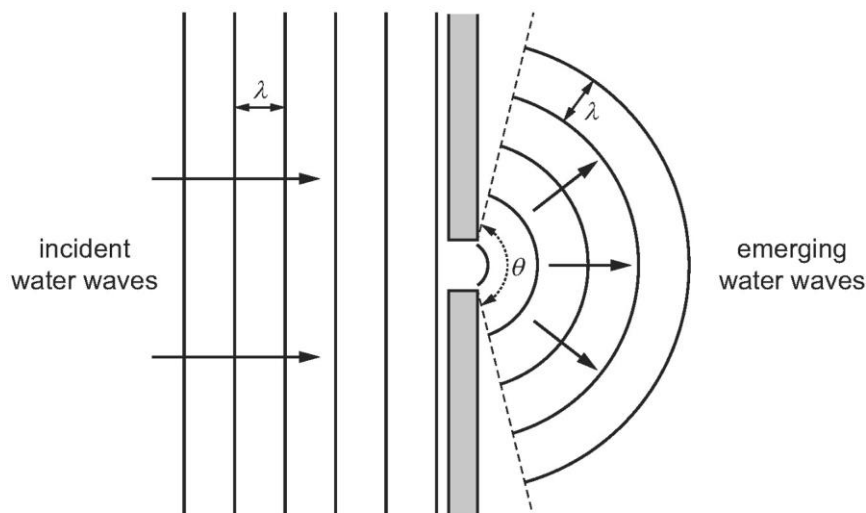


Which statement about the stationary wave is correct?

- A Point R is at a node.
- B Points Q and S vibrate in phase.
- C The distance between P and T is three wavelengths.
- D The wave transfers energy from P to T.

117 - (9702/11_Summer_2022_Q28) - Superposition

Water waves of wavelength λ are incident normally on an obstacle with a narrow gap. The width of the gap is equal to λ . The waves from the gap emerge over an angle θ , as shown.



The gap is slowly widened.

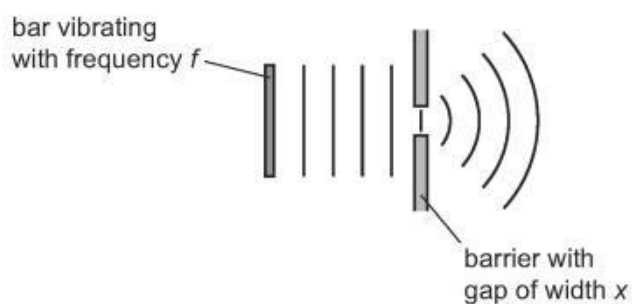
Which changes, if any, occur to θ and to the wavelength of the emerging waves?

	θ	wavelength
A	decreases	remains the same
B	increases	remains the same
C	remains the same	decreases
D	remains the same	increases



118 – (9702/12_Summer_2022_Q28) – *Superposition*

A bar vibrates with frequency f to produce water waves in a ripple tank.



The waves pass through a gap of width x in a barrier so that diffraction occurs.

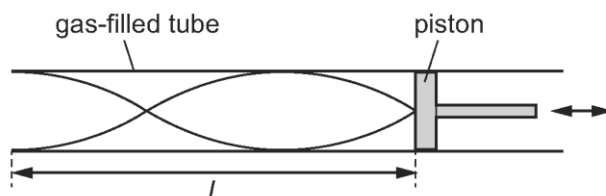
Which combination of vibration frequency and gap width will produce the smallest angle of diffraction?

	vibration frequency	gap width
A	$\frac{f}{2}$	$\frac{x}{2}$
B	$\frac{f}{2}$	$2x$
C	$2f$	$\frac{x}{2}$
D	$2f$	$2x$

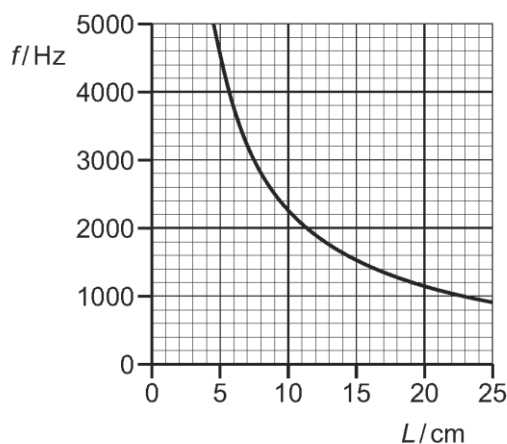
119 - (9702/13_Summer_2022_Q28) - Superposition

A stationary sound wave is formed in a gas-filled tube of length L , which is closed at one end by a piston. The length of the tube can be altered by moving the piston.

The length of the tube and the frequency of the sound are varied so that the stationary wave always has two antinodes and two nodes, as shown.



The graph shows the variation of the frequency f of the stationary sound wave with the length L of the tube.



What is the speed of sound in the gas in the tube?

- A 150 m s^{-1} B 230 m s^{-1} C 300 m s^{-1} D 340 m s^{-1}

120 - (9702/11_Summer_2022_Q29) - Superposition

Light of a single frequency passes through two narrow slits and produces an interference pattern on a screen some distance away. The interference fringes are very close together.

Which change would **increase** the distance between the fringes?

- A Increase the brightness of the light source.
B Increase the distance between the slits and the screen.
C Increase the distance between the two slits.
D Increase the frequency of the light used.

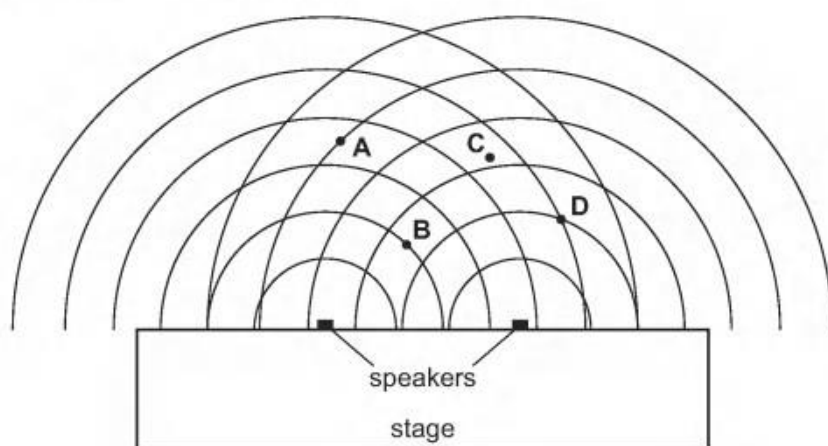
121 - (9702/12_Summer_2022_Q29) - *Superposition*

An outdoor concert has two large speakers beside the stage for broadcasting music.

In order to test the speakers, they are made to emit sound of the same wavelength and the same amplitude.

The curved lines in the diagram represent wavefronts.

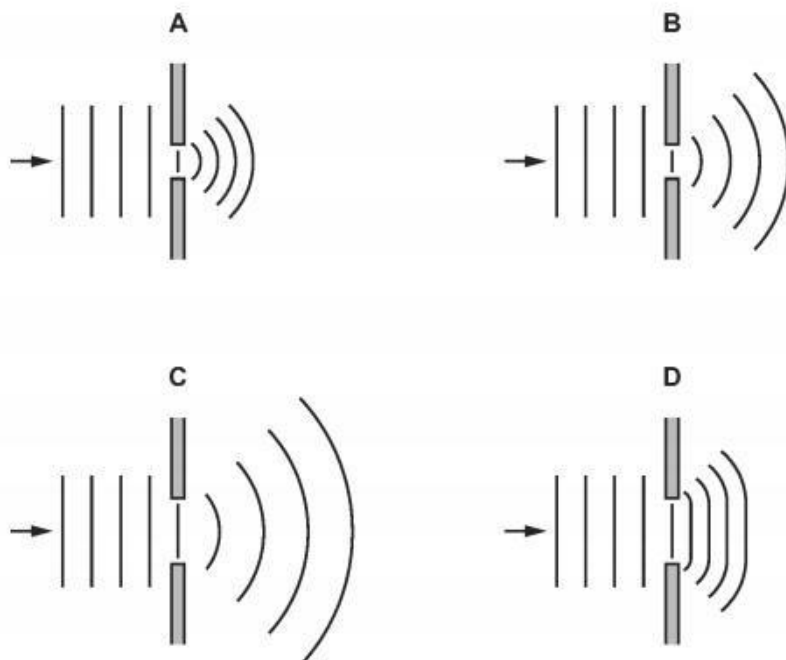
Where is the loudest sound heard?



122 - (9702/13_Summer_2022_Q29) - *Superposition*

The diagrams show the diffraction of water waves in a ripple tank as they pass through a gap between two barriers.

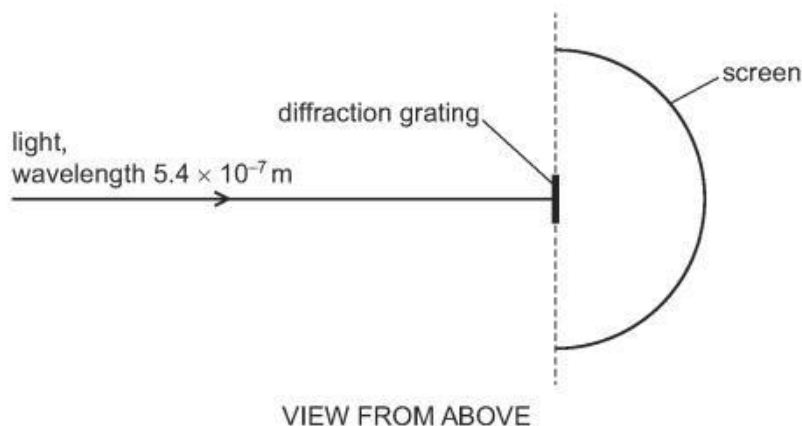
Which diagram is correct?



123 - (9702/11_Summer_2022_Q30) - Superposition

Light of wavelength $5.4 \times 10^{-7} \text{ m}$ is incident normally on a diffraction grating.

The separation between adjacent lines in the grating is $2.0 \times 10^{-6} \text{ m}$. The light that emerges from the grating falls on a semicircular screen, as shown in the view from above.



The grating is at the centre of the semicircle, and the lines of the grating are vertical.

How many bright dots are formed on the screen?

- A 3 B 4 C 6 D 7

124 - (9702/12_Summer_2022_Q30) - Superposition

The equation

$$\lambda = \frac{d \sin \theta}{n}$$

is used to calculate the wavelength λ of light in an experiment that uses a diffraction grating. The light from the diffraction grating is displayed on a screen.

What do the symbols n and d represent?

	n	d
A	number of slits in the grating	distance between adjacent slits in the grating
B	number of slits in the grating	distance from grating to screen
C	order of intensity maximum	distance between adjacent slits in the grating
D	order of intensity maximum	distance from grating to screen

125 - (9702/13_Summer_2022_Q30) - Superposition

A beam of light from a laser is incident normally on a double slit. Interference fringes are seen on a screen placed parallel to the double slit.

The separation of the two slits is a . The distance between the slits and the screen is D . The distance between the centres of two adjacent bright fringes is x .

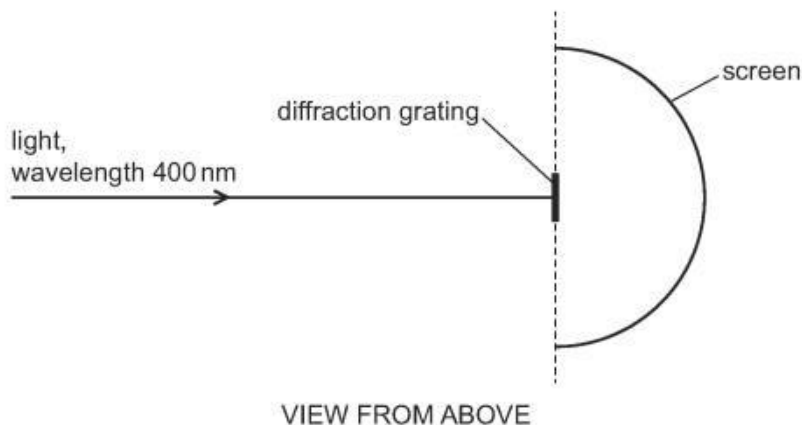
D and a are both halved.

What is the distance between the centres of two adjacent bright fringes after these changes?

- A $\frac{x}{2}$ B x C $2x$ D $4x$

126 - (9702/13_Summer_2022_Q31) - Superposition

A beam of light of wavelength 400 nm is incident normally on a diffraction grating that has 300 lines per millimetre. The light passes through the grating and produces a series of maxima which are observed on a semicircular screen, as shown.



What is the total number of maxima observed on the screen?

- A 8 B 9 C 16 D 17

127 - (9702/13_Winter_2022_Q25) - Superposition

Two progressive waves overlap.

What is an essential condition for the two waves to form a stationary wave?

- A The waves are longitudinal.
B The waves are polarised.
C The waves travel in opposite directions.
D The waves travel in the same direction.

128 - (9702/11_Winter_2022_Q26) - Superposition

Two waves of the same type overlap.

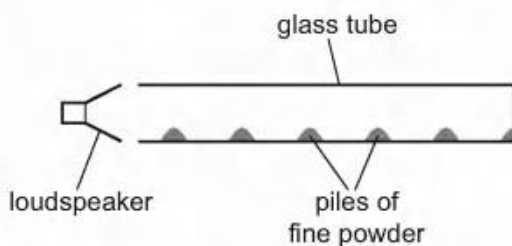
When does the principle of superposition apply?

- A always
- B only when the waves have the same amplitude
- C only when the waves have the same frequency
- D only when the waves travel in opposite directions

129 - (9702/13_Winter_2022_Q26) - Superposition

In an experiment to produce a stationary sound wave in air, a fine powder is initially evenly distributed along the length of a horizontal glass tube which is closed at one end.

At the open end of the tube, a loudspeaker emits a sound wave of a constant wavelength. A stationary wave is formed and the powder accumulates in regularly spaced piles, as shown.



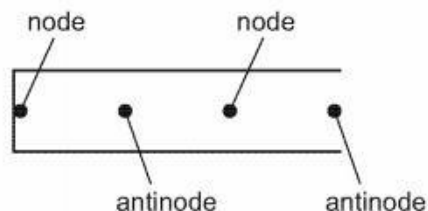
Which statement explains the positions of the piles of powder within the tube?

- A The piles are where the air molecules vibrate with maximum amplitude.
- B The piles are where the air molecules vibrate with minimum amplitude.
- C The piles are where the air molecules vibrate with the highest frequency.
- D The piles are where the air molecules vibrate vertically.

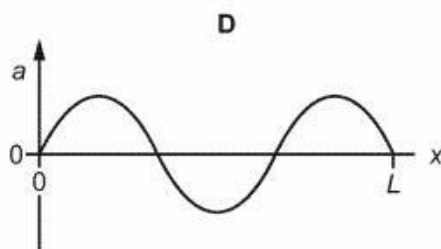
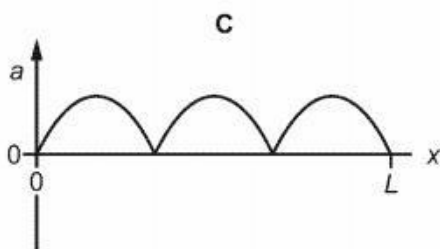
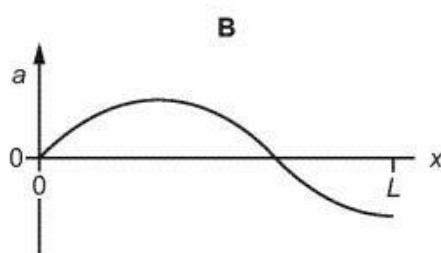
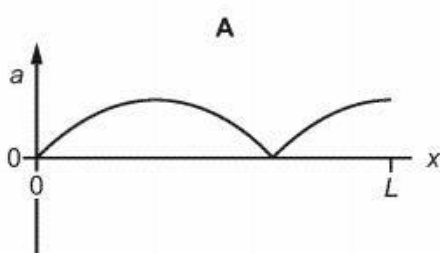
130 - (9702/11_Winter_2022_Q27) - Superposition

A stationary sound wave is formed in a tube of length L that is closed at one end.

The diagram shows the positions of the nodes and antinodes of the stationary wave.



Which graph shows the variation of the amplitude a of the wave with distance x measured from the closed end of the tube?



131 - (9702/13_Winter_2022_Q27) - Superposition

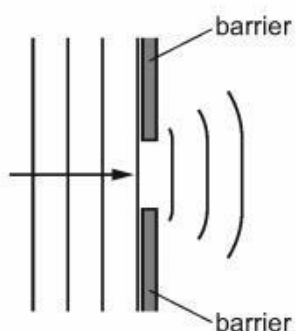
A sound wave of wavelength 0.50 m passes through a doorway of width 1.0 m between two rooms.

Which change increases the amount of diffraction that takes place?

- A** Double the amplitude of the sound wave.
- B** Double the width of the doorway.
- C** Halve the frequency of the sound wave.
- D** Halve the period of the sound wave.

132 - (9702/11_Winter_2022_Q28) - *Superposition*

A wave on the surface of water passes through a gap between two barriers and is diffracted, as shown.

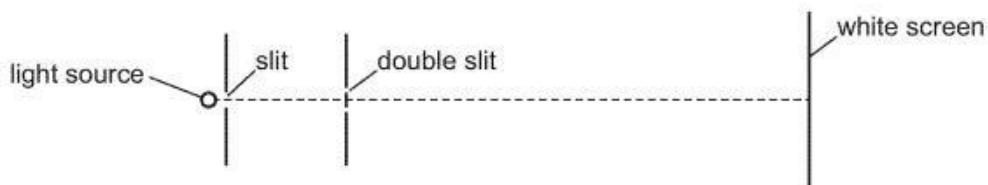


What happens when the frequency of the wave is halved?

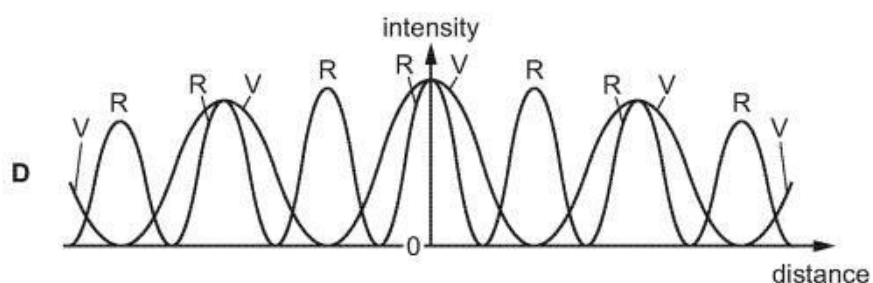
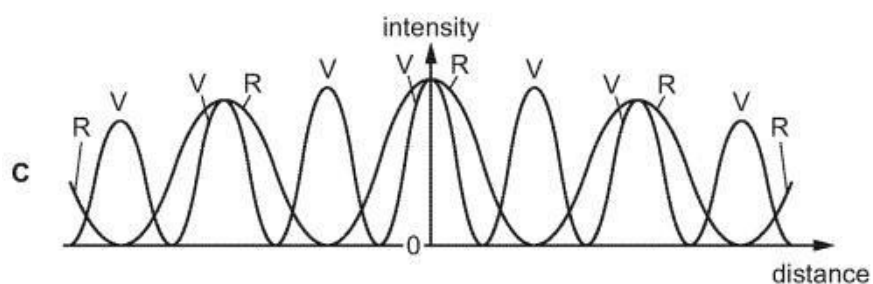
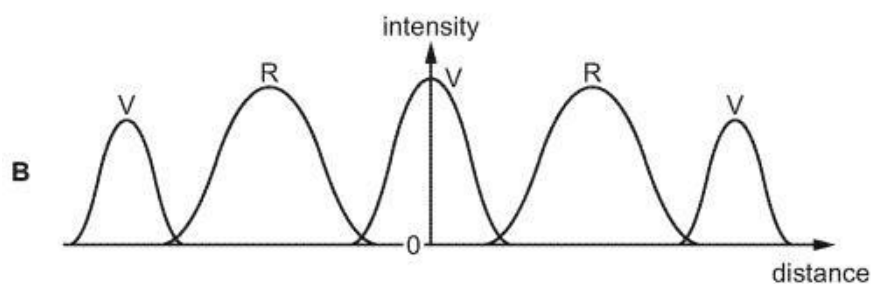
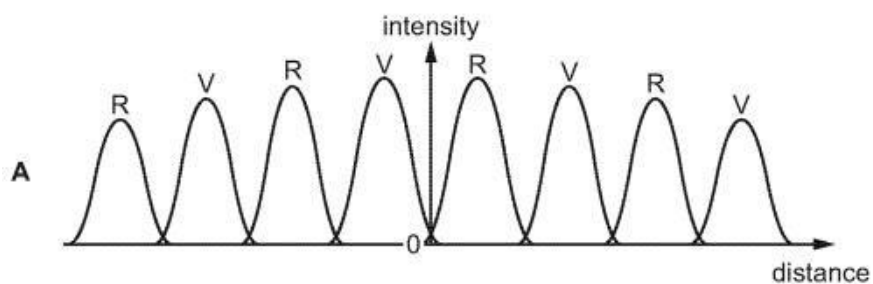
- A Less diffraction is observed.
- B More diffraction is observed.
- C There is no diffraction.
- D The same amount of diffraction is observed.

133 - (9702/13_Winter_2022_Q28) - Superposition

A light source consists of a vertical slit illuminated by red light (R) and violet light (V). The wavelength of R is approximately twice the wavelength of V. A parallel vertical double slit is placed nearby. A white screen is placed so that fringes are formed on it.



Which graph best represents the interference fringes formed on the screen?



134 - (9702/11_Winter_2022_Q29) - Superposition

Observable interference fringes are produced using light from a double slit. The intensity of the light emerging from each slit is initially the same.

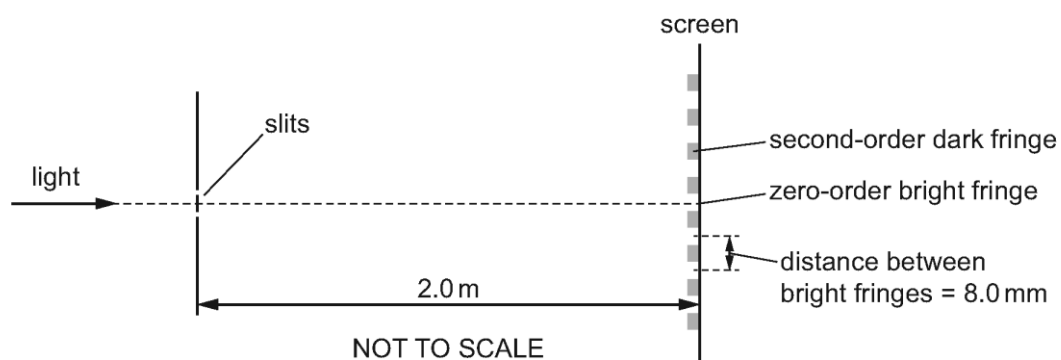
The intensity of the light emerging from one of the slits is now reduced.

How does this affect the interference pattern?

- A The bright fringes and the dark fringes all become brighter.
- B The bright fringes and the dark fringes all become darker.
- C The bright fringes become brighter and the dark fringes become darker.
- D The bright fringes become darker and the dark fringes become brighter.

135 - (9702/12_Winter_2022_Q29) - Superposition

Light of a single frequency is incident on a pair of narrow slits that are a distance of 0.10 mm apart. A series of bright and dark fringes is observed on a screen a distance of 2.0 m away. The distance between adjacent bright fringes is 8.0 mm.



What is the path difference of the light waves from the two slits that meet at the second-order dark fringe?

- A $2.0 \times 10^{-7} \text{ m}$
- B $4.0 \times 10^{-7} \text{ m}$
- C $6.0 \times 10^{-7} \text{ m}$
- D $8.0 \times 10^{-7} \text{ m}$

136 - (9702/13_Winter_2022_Q29) - Superposition

Which property of a light wave can be determined using a diffraction grating?

- A amplitude
- B intensity
- C speed
- D wavelength

137 - (9702/11_Winter_2022_Q30) - Superposition

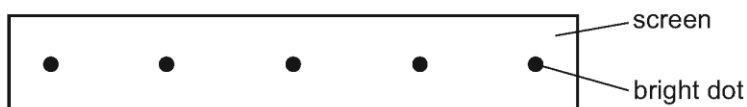
A diffraction grating has 4.00×10^5 lines per metre. A beam of light of wavelength 589×10^{-9} m is incident normally on the diffraction grating.

What is the angle between the second-order maximum and the direction of the incident beam of light?

- A 13.6° B 27.3° C 28.1° D 56.2°

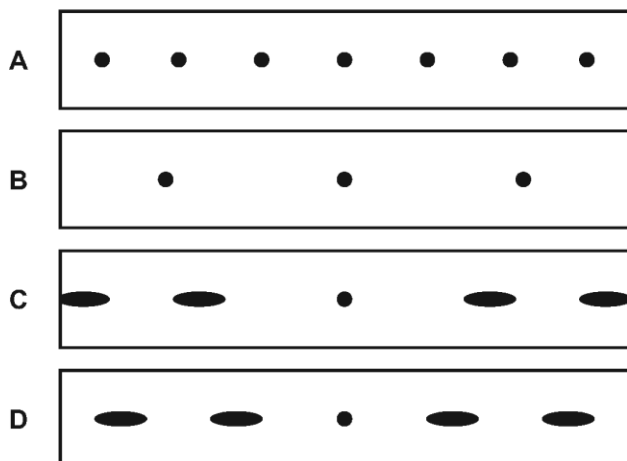
138 - (9702/12_Winter_2022_Q30) - Superposition

Red light of a single wavelength passes through a diffraction grating. Bright dots are formed on a screen, as shown.



The red light is replaced with white light.

Which diagram, drawn to the same scale, shows a possible pattern of bright light on the screen?



139 - (9702/11_Summer_2023_Q25) - Superposition

Two progressive waves meet at a point.

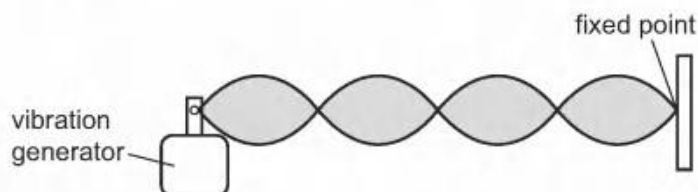
Which condition must be met for superposition of the waves to occur?

- A The waves must be coherent.
B The waves must be of the same type.
C The waves must be travelling in opposite directions.
D The waves must meet in phase.

140 - (9702/11_Summer_2023_Q26) - Superposition

A string is stretched between a vibration generator and a fixed point.

When the vibration generator is vibrating at a frequency f , a stationary wave with five nodes is created on the stretched string, as shown. There is a node at the end of the string that is attached to the vibration generator.



The frequency of vibration of the vibration generator is slowly increased.

What is the next frequency that produces a stationary wave on the string?

- A $1.25f$ B $1.50f$ C $1.75f$ D $2.00f$

141 - (9702/11_Summer_2023_Q28) - Superposition

A laser produces a beam of light of wavelength 650 nm . The beam is incident normally on two slits that are a distance of 0.12 mm apart.

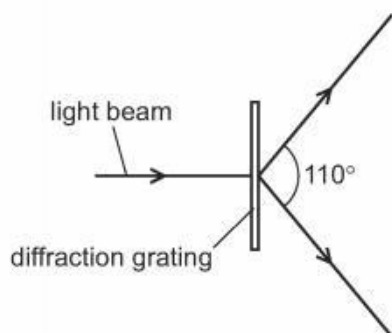
A screen is placed parallel to the slits. The bright interference fringes on the screen have a separation of 7.5 cm .

What is the distance between the screen and the two slits?

- A 1.4 m B 2.8 m C 7.0 m D 14 m

142 - (9702/11_Summer_2023_Q29) - Superposition

A beam of light from a laser is incident normally on a diffraction grating.



The diagram shows only the **second-order** maxima that are produced.

The grating has a line spacing of 1.0×10^{-6} m. The angle between the two second-order maxima is 110° .

What is the wavelength of the light?

- A 4.1×10^{-7} m
- B 4.7×10^{-7} m
- C 8.2×10^{-7} m
- D 9.4×10^{-7} m

143 - (9702/12_Summer_2023_Q25) - Superposition

A stationary wave is formed by two progressive waves travelling in opposite directions along the same line of travel.

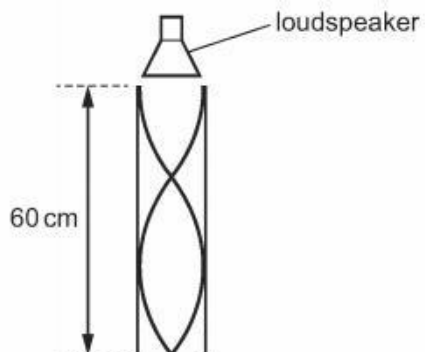
Which statement about the two progressive waves is **not** correct?

- A They must have a constant phase difference.
- B They must have the same frequency.
- C They must have the same wavelength.
- D They must travel at the same speed.

144 - (9702/12_Summer_2023_Q26) - Superposition

The sound from a loudspeaker placed above a tube causes resonance of the air in the tube.

A stationary wave is formed with two nodes and two antinodes, as shown.



The tube has height 60 cm.

The speed of sound in the air is 340 m s^{-1} .

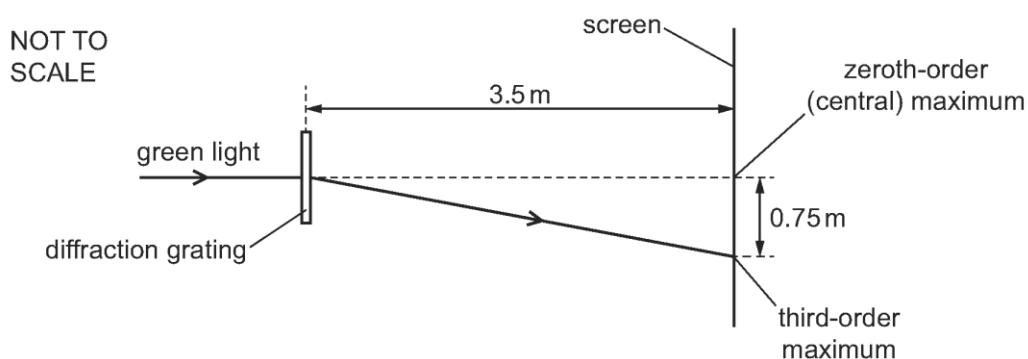
What is the frequency of the sound?

- A 430 Hz B 570 Hz C 850 Hz D 1700 Hz

145 - (9702/12_Summer_2023_Q29) - Superposition

Green light of wavelength 550 nm is incident normally on a diffraction grating and produces a diffraction pattern on a screen placed 3.5 m from the diffraction grating.

The **third-order** maximum on the screen is a distance of 0.75 m from the zeroth-order (central) maximum.

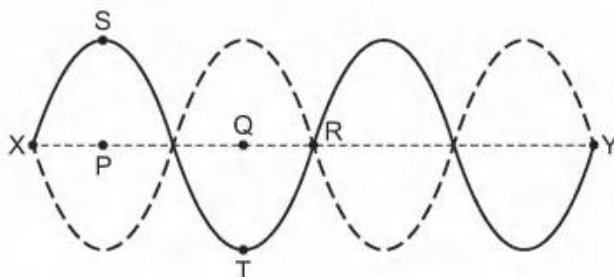


What is the distance between two adjacent slits in the diffraction grating?

- A $2.6 \times 10^{-6} \text{ m}$
B $7.7 \times 10^{-6} \text{ m}$
C $7.9 \times 10^{-6} \text{ m}$
D $1.0 \times 10^{-5} \text{ m}$

146 - (9702/13_Summer_2023_Q25) - Superposition

The diagram shows a string stretched between fixed points X and Y. There is a stationary wave on the string.



The solid curve shows the string at a position of maximum displacement at time t_0 . The dashed curve shows the other position of maximum displacement. The straight central dashed line shows the mean position of the string.

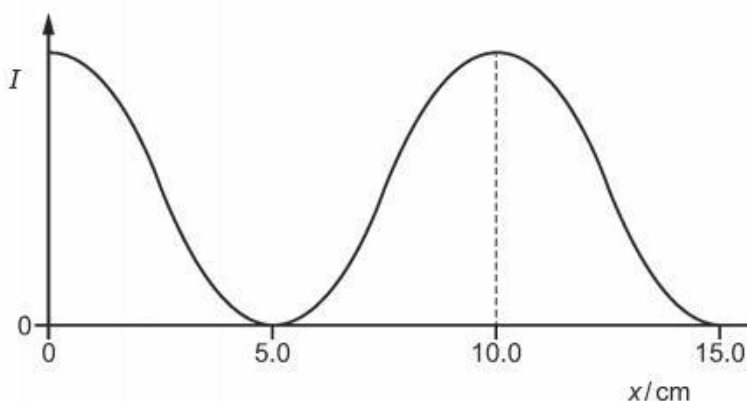
Point S on the string is directly above point P. Point T on the string is directly below point Q.

Which statement is correct?

- A A short time after t_0 , point R on the string will be displaced.
- B A short time after t_0 , points S and T on the string move in opposite directions.
- C The distance between P and Q is one wavelength.
- D Two moving points on the string that are equal distances from point R vibrate in phase.

147 - (9702/13_Summer_2023_Q26) - Superposition

The variation with distance x of the intensity I along a stationary sound wave in air is shown.



The speed of sound in air is 340 m s^{-1} .

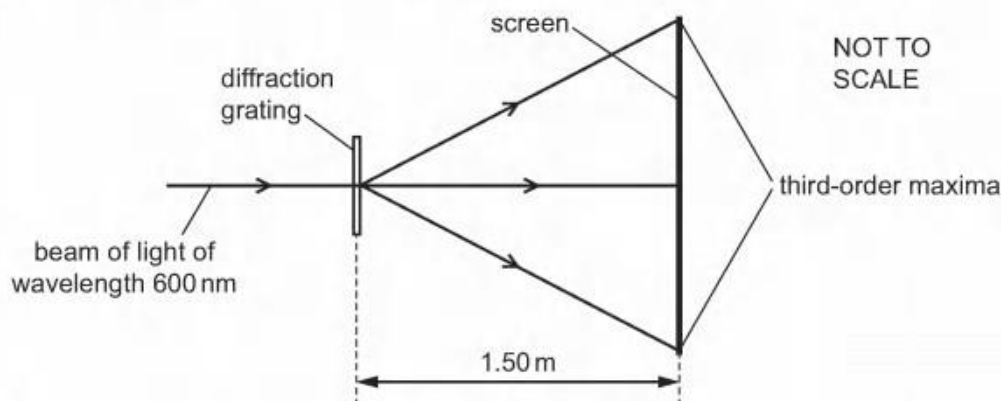
What is the frequency of the sound wave?

- A 1700 Hz
- B 2300 Hz
- C 3400 Hz
- D 6800 Hz

148 - (9702/13_Summer_2023_Q29) - Superposition

A parallel beam of light of wavelength 600 nm is incident normally on a diffraction grating.

The distance between adjacent slits in the grating is 2.0×10^{-6} m. A screen is placed parallel to the grating, at a distance of 1.50 m from the grating. **Third-order** diffraction maxima are observed at the two ends of the screen, as shown.



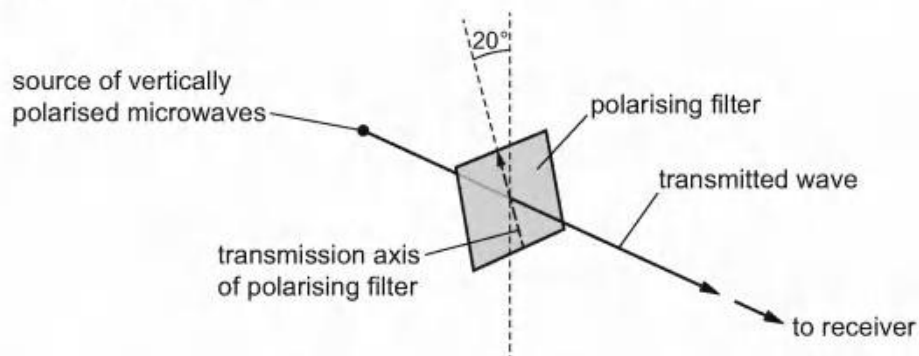
What is the distance between the two ends of the screen?

- A 1.4 m B 2.7 m C 3.1 m D 6.2 m

149 - (9702/11_Winter_2023_Q24) - Superposition

Vertically polarised microwaves are emitted from a source. The microwaves are detected by a receiver that is connected to a cathode-ray oscilloscope (CRO). The waveform displayed on the screen of the CRO has an amplitude of 2.6 cm.

A metal wire grid that acts as a polarising filter is now placed between the source and the receiver. The filter is orientated so that the plane of polarisation of the transmitted wave is at an angle of 20° to the vertical.



The distance between the source and receiver is unchanged. The settings on the CRO are also unchanged.

What is now the amplitude of the waveform displayed on the screen of the CRO?

- A 0.30 cm B 0.89 cm C 2.3 cm D 2.4 cm

150 - (9702/11_Winter_2023_Q25) - *Superposition*

In an experiment, a stationary wave is formed on a string stretched horizontally between two fixed points.

Which statement about the experiment is correct?

- A At certain times, the string between two nodes is horizontal with all points having zero displacement.
- B Each point on the string between two antinodes has an oscillation of the same amplitude.
- C The number of nodes is equal to the number of antinodes.
- D Two adjacent antinodes oscillate in phase.

151 - (9702/11_Winter_2023_Q26) - *Superposition*

A musical organ produces notes by blowing air into a set of pipes that are open at one end and closed at the other.

The speed of sound in the air in the pipes is 320 m s^{-1} .

What is the lowest frequency of sound produced by a pipe of length 10 m?

- A 4 Hz B 8 Hz C 16 Hz D 32 Hz

152 - (9702/11_Winter_2023_Q28) - *Superposition*

Light of wavelength λ is emitted from two point sources R and S and falls onto a distant screen.



At point P on the screen, the light intensity is zero.

What could explain the zero intensity at P?

- A Light from the two sources is emitted 180° out of phase and the path difference to P is $\frac{1}{2}\lambda$.
- B Light from the two sources is emitted in phase and the path difference to P is λ .
- C Light from the two sources is emitted 90° out of phase and the path difference to P is λ .
- D Light from the two sources is emitted in phase and the path difference to P is $\frac{1}{2}\lambda$.

153 - (9702/11_Winter_2023_Q29) - Superposition

A beam of red light of wavelength 720 nm is incident normally on a diffraction grating and produces a diffraction pattern on a screen placed parallel to the grating.

The beam of red light is replaced with a beam of electromagnetic radiation of wavelength X , which is incident normally on the same diffraction grating.

The third-order maximum for the electromagnetic radiation of wavelength X is at the same position on the screen as the second-order maximum for the red light.

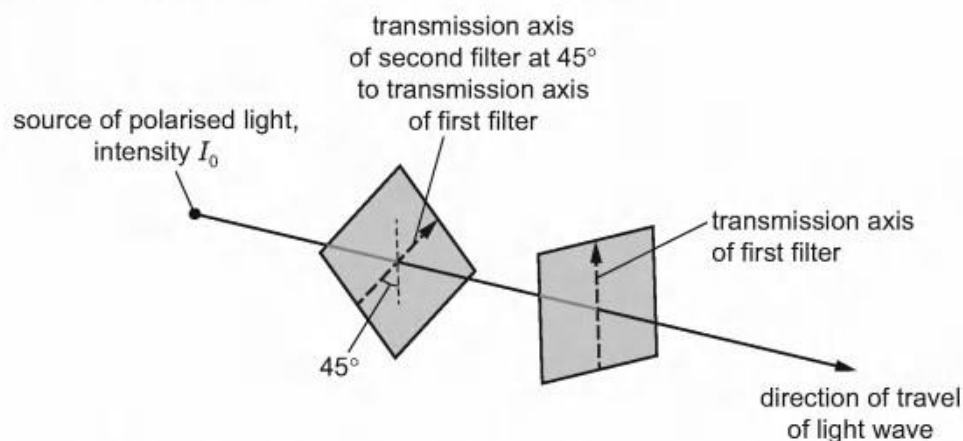
What is wavelength X ?

- A 480 nm B 540 nm C 960 nm D 1100 nm

154 - (9702/12_Winter_2023_Q24) - Superposition

A plane polarised light wave of intensity I_0 is incident normally on a polarising filter. The initial intensity of the transmitted wave is 0.

A second polarising filter is then inserted between the source and the first filter. Its transmission axis is at 45° to the transmission axis of the first filter, as shown.



What is the intensity of the transmitted wave from the filter combination?

- A 0 B $\frac{I_0}{8}$ C $\frac{I_0}{4}$ D $\frac{I_0}{2}$

155 - (9702/12_Winter_2023_Q25) - Superposition

What can explain how stationary waves are formed from progressive waves?

- A diffraction
B polarisation
C superposition
D the Doppler effect

156 - (9702/12_Winter_2023_Q27) - *Superposition*

A teacher is explaining diffraction to a group of students.

Which piece of apparatus is most appropriate for the teacher to use to demonstrate diffraction?

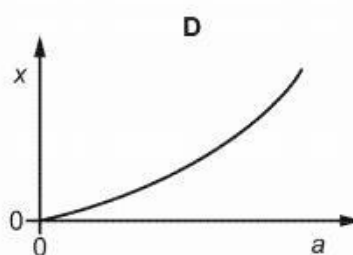
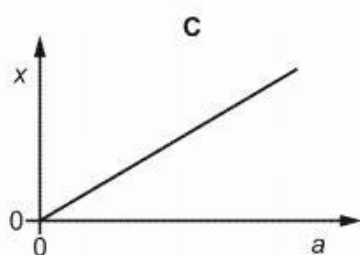
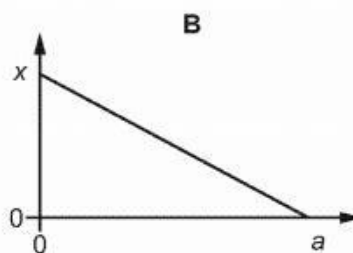
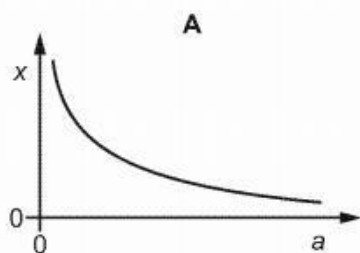
- A a long spring
- B a ripple tank
- C a rope
- D a stretched string

157 - (9702/12_Winter_2023_Q28) - *Superposition*

Coherent light of constant wavelength is incident normally on a double slit. Interference fringes are formed on a screen that is a fixed distance from the double slit. The screen is parallel to the double slit.

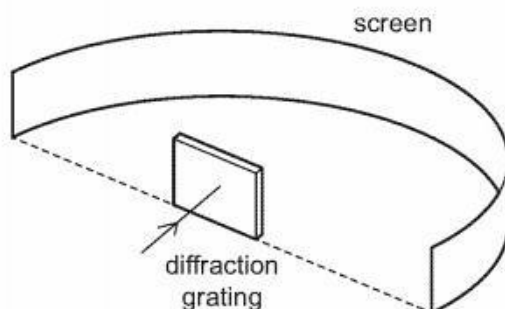
The separation of the slits is varied.

Which graph best shows the variation with slit separation a of the spacing x of the interference fringes?



158 - (9702/12_Winter_2023_Q29) - Superposition

Light of wavelength 690 nm passes through a diffraction grating with 300 lines per mm, producing a series of bright spots (maxima) on a screen.



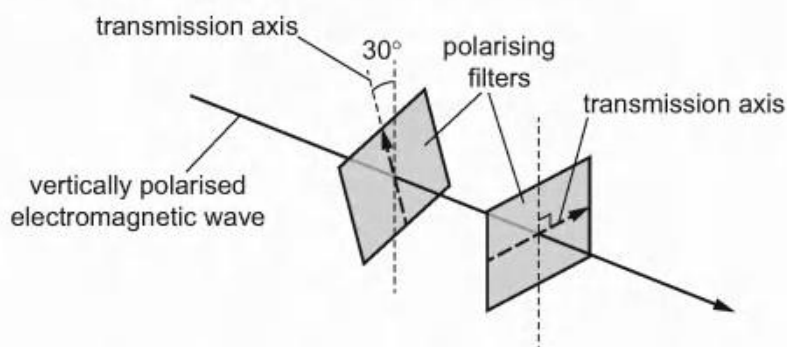
What is the total number of bright spots that are produced?

- A 4 B 5 C 8 D 9

159 - (9702/13_Winter_2023_Q24) - Superposition

A vertically polarised electromagnetic wave of intensity I_0 is incident normally on a polarising filter. The transmission axis of the filter is at an angle of 30° to the vertical.

The transmitted wave from the first filter is then incident normally on a second polarising filter. The transmission axis of this filter is at an angle of 90° to the vertical.



What is the intensity of the wave after passing through the second filter?

- A 0 B $0.063 I_0$ C $0.19 I_0$ D $0.56 I_0$

160 - (9702/13_Winter_2023_Q25) - Superposition

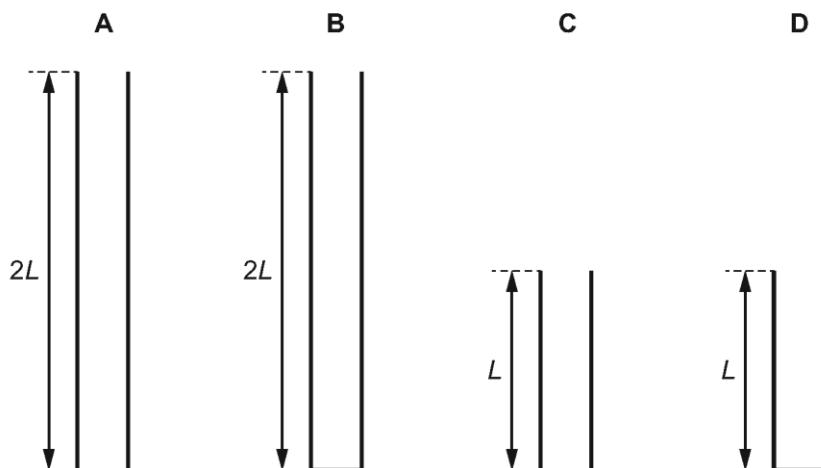
Which statement concerning a stationary wave is correct?

- A All the particles between two adjacent nodes oscillate in phase.
B The amplitude of the stationary wave is equal to the amplitude of one of the waves creating it.
C The wavelength of the stationary wave is equal to the separation of two adjacent nodes.
D There is no displacement of a particle at an antinode at any time.

161 - (9702/13_Winter_2023_Q26) - *Superposition*

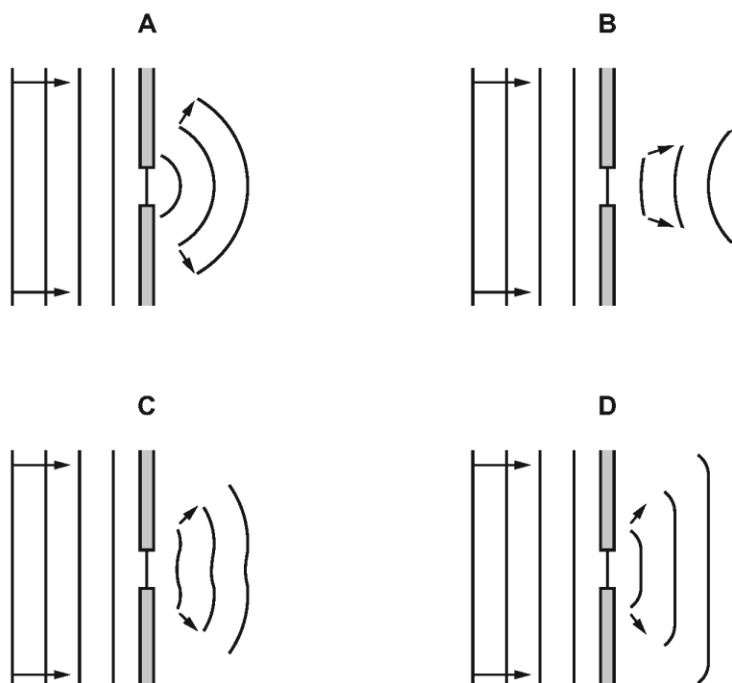
Stationary sound waves can be formed in the air columns of pipes. One type of pipe is closed at one end and open at the other end. Another type of pipe is open at both ends.

Which pipe can form a stationary sound wave with the lowest frequency?

**162** - (9702/13_Winter_2023_Q27) - *Superposition*

Water waves in a ripple tank are made to pass through a small gap, as shown.

Which diagram shows the waves after they have passed through the gap?



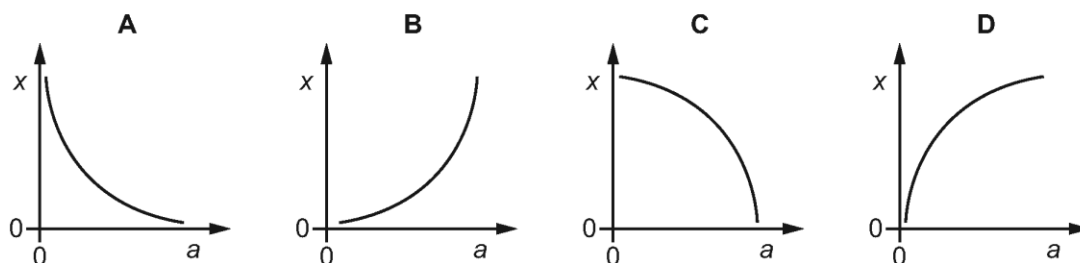
163 - (9702/13_Winter_2023_Q28) - *Superposition*

Light of a single wavelength is incident normally on a double slit. The slit separation can be varied.

A screen is placed a fixed distance away from the double slit. The screen and double slit are parallel. A pattern of bright interference fringes is observed on a screen.

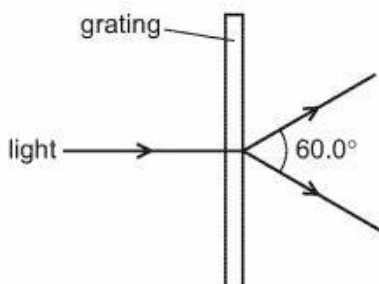


Which graph best shows the variation of the separation x of the bright interference fringes with the slit separation a ?

**164** - (9702/13_Winter_2023_Q29) - *Superposition*

A diffraction grating is used to measure the wavelength of light.

The spacing of the slits in the grating is $1.15 \times 10^{-6} \text{ m}$. The angle between the first-order diffraction maxima is 60.0° , as shown.



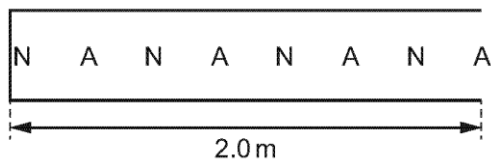
What is the wavelength of the light?

- A 288 nm B 498 nm C 575 nm D 996 nm

1 - (9702/12_Winter_2023_Q26) - Communication

A pipe has a length of 2.0 m. It is open at one end and closed at the other end.

A stationary sound wave is set up within the pipe. There are four nodes (N) and four antinodes (A) within the length of the pipe.



What is the wavelength of the sound wave?

- A 0.57 m B 1.1 m C 1.3 m D 1.6 m

1 - (9702/11_Summer_2017_Q11) - *Electric Fields*

A particle with mass and charge is moving from left to right in a uniform gravitational field and a uniform electric field. The gravitational field is downwards. The gravitational force and the electric force on this particle act in opposite directions.

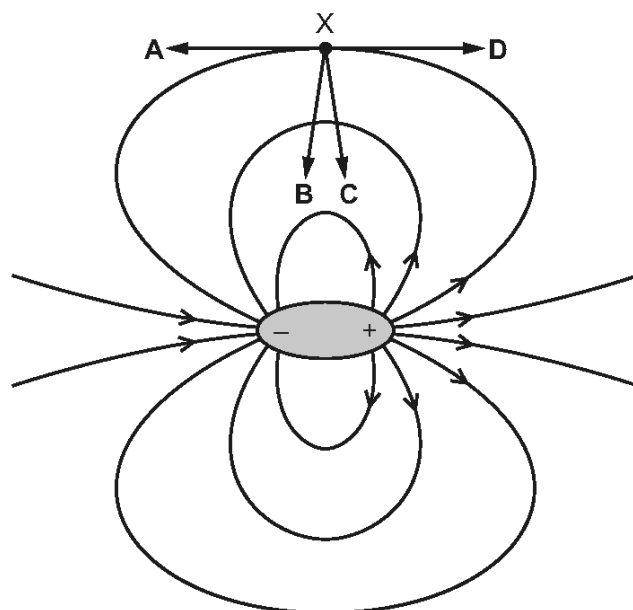
What could be the sign of the charge on the particle and the direction of the electric field?

	sign of charge	direction of electric field
A	negative	down
B	negative	up
C	positive	left
D	positive	right

2 - (9702/13_Summer_2017_Q29) - *Electric Fields*

A dipole is a pair of charges of equal magnitude, one negative and one positive. The electric field of a dipole is shown below.

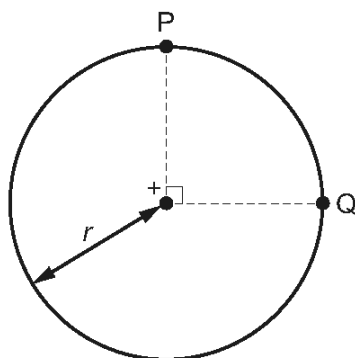
In which direction does the force act on an electron when at point X?



3 - (9702/11_Summer_2017_Q30) - *Electric Fields*

The diagram shows two points P and Q which lie 90° apart on a circle of radius r .

A positive point charge at the centre of the circle creates an electric field of magnitude E at both P and Q.

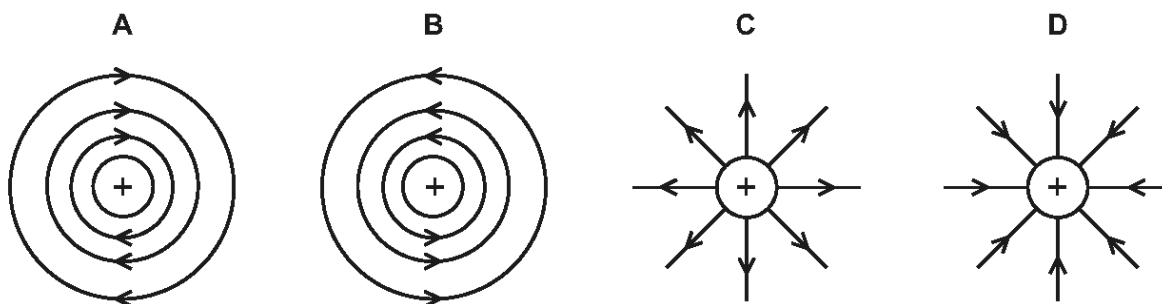


Which expression gives the work done in moving a unit positive charge from P to Q?

- A 0 B $E \times r$ C $E \times \left(\frac{\pi r}{2}\right)$ D $E \times (\pi r)$

4 - (9702/12_Summer_2017_Q30) - *Electric Fields*

Which diagram best illustrates the electric field around a positive point charge?

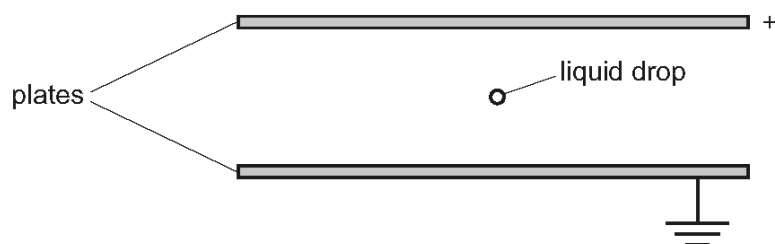
5 - (9702/13_Summer_2017_Q30) - *Electric Fields*

In a uniform electric field, which statement is correct?

- A All charged particles experience the same force.
 B All charged particles move with the same velocity.
 C All electric field lines are directed towards positive charges.
 D All electric field lines are parallel.

6 - (9702/11_Summer_2017_Q31) - *Electric Fields*

The diagram shows two parallel horizontal metal plates. The top plate is positively charged and the bottom plate is earthed.



A small charged liquid drop, midway between the plates, is held in equilibrium by the combination of its weight and the electric force acting on it.

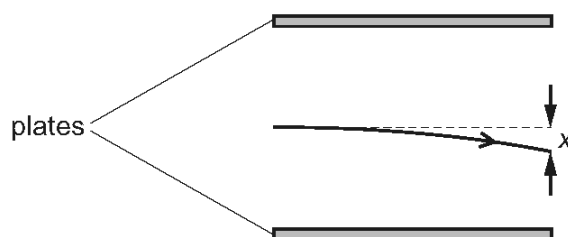
The acceleration of free fall is g and the electric field strength is E .

What is the polarity of the charge on the drop, and the ratio of charge to mass of the drop?

	polarity	$\frac{\text{charge}}{\text{mass}}$
A	negative	$\frac{E}{g}$
B	negative	$\frac{g}{E}$
C	positive	$\frac{E}{g}$
D	positive	$\frac{g}{E}$

7 - (9702/12_Summer_2017_Q31) - *Electric Fields*

The path of an electron with initial speed v in the uniform electric field between two parallel plates is shown.



The vertical deflection x is measured at the right-hand edge of the plates.

The distance between the plates is halved. The potential difference between the plates remains the same.

What will be the new deflection of the electron with the same initial speed v ?

- A** x **B** $\sqrt{2}x$ **C** $2x$ **D** $4x$

8 - (9702/13_Summer_2017_Q31) - *Electric Fields*

Two metal plates are a distance of 30 cm apart in a vacuum.

A current exists between the two plates consisting of electrons moving at a constant speed of $1.5 \times 10^6 \text{ ms}^{-1}$.

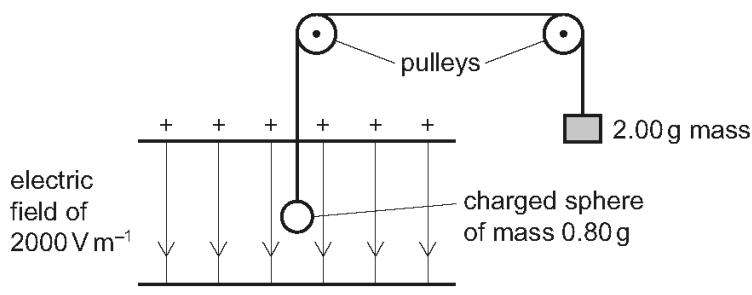
At any instant, there is always just one electron travelling between the plates.

What is the current between the plates?

- A $3.2 \times 10^{-26} \text{ A}$
- B $8.0 \times 10^{-13} \text{ A}$
- C $1.6 \times 10^{-12} \text{ A}$
- D $2.0 \times 10^{-7} \text{ A}$

9 - (9702/11_Winter_2017_Q31) - *Electric Fields*

A small charged sphere of mass 0.80 g hangs from a light thread inside a vertical uniform electric field of strength 2000 V m^{-1} . The thread passes over two frictionless pulleys and a mass of 2.00 g hangs on the other end.



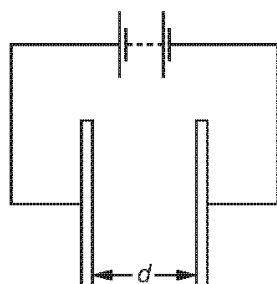
The sphere is in equilibrium.

What is the charge on the sphere?

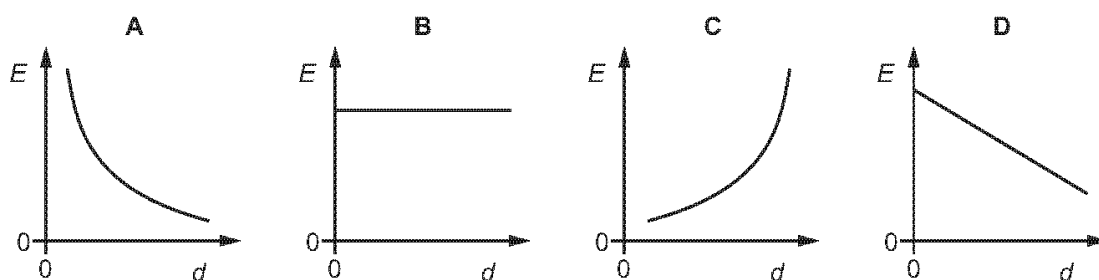
- A $-5.9 \mu\text{C}$
- B $+0.60 \mu\text{C}$
- C $+5.9 \mu\text{C}$
- D $+9.8 \mu\text{C}$

10 - (9702/12_Winter_2017_Q31) - *Electric Fields*

The diagram shows two metal plates connected to a constant high voltage.



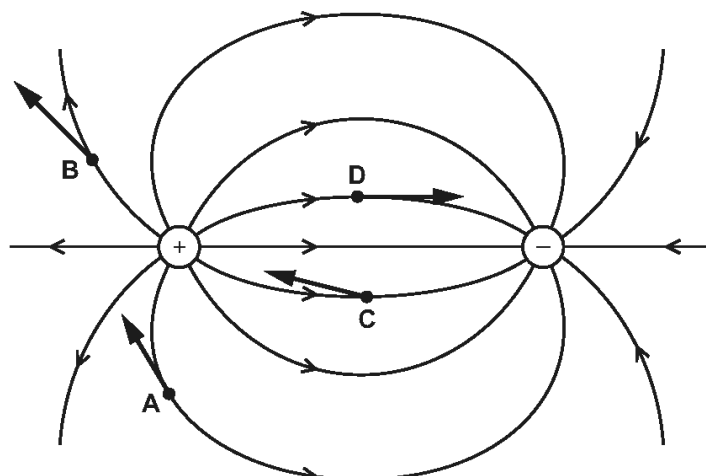
Which graph shows the variation of the electric field strength E midway between the two plates as the distance d between the two plates is increased?

11 - (9702/13_Winter_2017_Q31) - *Electric Fields*

The diagram shows the electric field near a positively charged sphere and a negatively charged sphere.

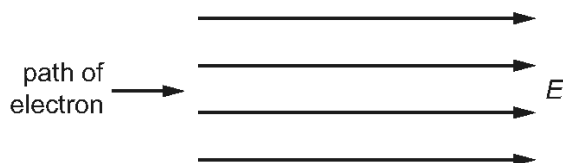
Four electrons **A**, **B**, **C** and **D** are shown at different positions in the field.

On which electron is the direction of the force on the electron shown correctly?



12 - (9702/11_Winter_2017_Q32) - *Electric Fields*

An electron enters a region of space where there is a uniform electric field E as shown.



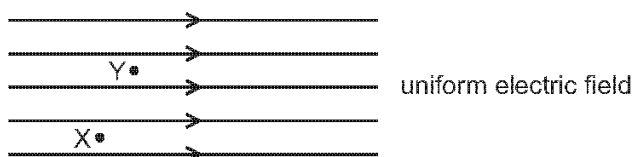
Initially, the electron is moving parallel to, and in the direction of, the electric field.

What is the subsequent path and change of speed of the electron caused by the electric field?

	path of electron	speed of electron
A	curved	decreases
B	curved	increases
C	linear	decreases
D	linear	increases

13 - (9702/12_Winter_2017_Q32) - *Electric Fields*

An electron moves between two points X and Y in a uniform electric field, as shown.



The distance between X and Y is 4.0 cm and the line XY is at an angle of 60° to the direction of the field.

The field exerts the only force on the electron.

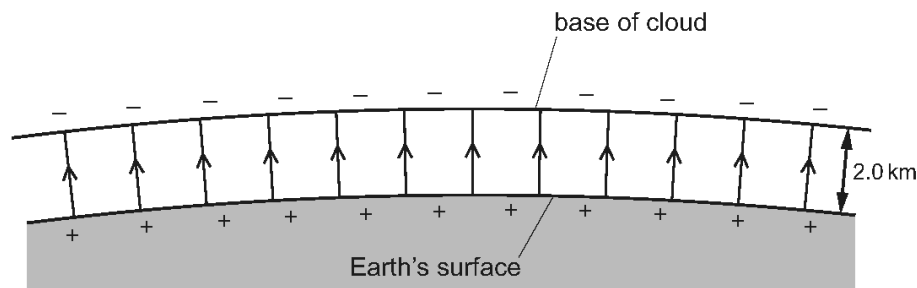
The field strength is 100 N C^{-1} .

What is the change in the kinetic energy of the electron as it moves from X to Y?

- A** -4 eV **B** -2 eV **C** $+2 \text{ eV}$ **D** $+4 \text{ eV}$

14 - (9702/13_Winter_2017_Q32) - *Electric Fields*

Lightning can occur between a charged cloud and the Earth's surface when the electric field strength in the intervening atmosphere reaches 25 kNC^{-1} . The diagram shows the electric field between the base of a cloud and the Earth's surface.

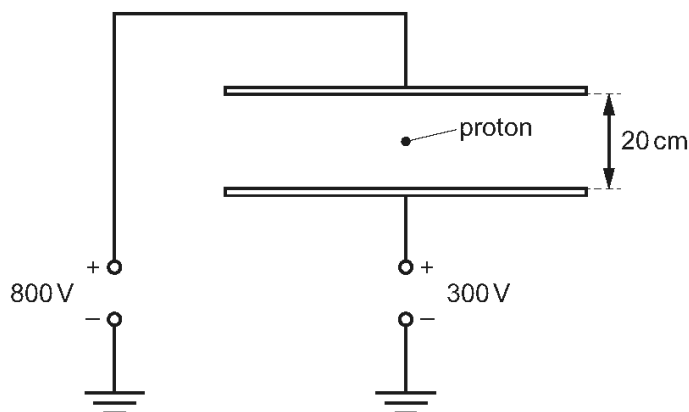


What is the minimum potential difference between the Earth and the base of a cloud, 2.0 km high, for lightning to occur?

- A 12.5 MV B 25 MV C 50 MV D 100 MV

15 - (9702/13_Summer_2018_Q27) - *Electric Fields*

Two parallel metal plates are situated 20 cm apart in a vacuum. They are connected to two sources of potential difference as shown.



A proton is released in the space between the plates.

What is the magnitude and direction of the acceleration of the proton?

- A $2.4 \times 10^{11} \text{ m s}^{-2}$ downwards
B $2.4 \times 10^{11} \text{ m s}^{-2}$ upwards
C $5.3 \times 10^{11} \text{ m s}^{-2}$ downwards
D $5.3 \times 10^{11} \text{ m s}^{-2}$ upwards

16 - (9702/11_Summer_2018_Q28) - *Electric Fields*

A particle has a charge of $+2.0\text{mC}$ and is in a vertical uniform electric field. An electric force of $1.0 \times 10^{-2}\text{N}$ acts upwards on the particle.

What is the electric field strength?

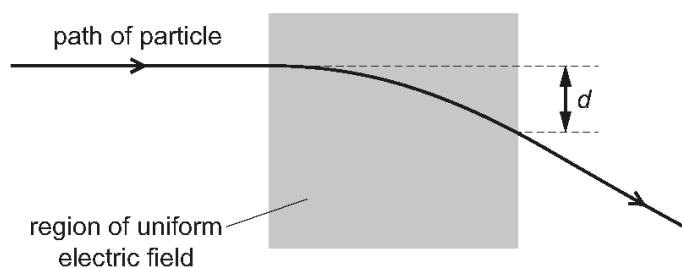
- A 0.20V m^{-1} downwards
- B 0.20V m^{-1} upwards
- C 5.0V m^{-1} downwards
- D 5.0V m^{-1} upwards

17 - (9702/13_Summer_2018_Q28) - *Electric Fields*

A particle having mass m and charge $+q$ enters a uniform electric field with speed v .

Initially, the particle is travelling at right-angles to the electric field.

During its movement through the field, the particle is deflected through distance d , as shown.



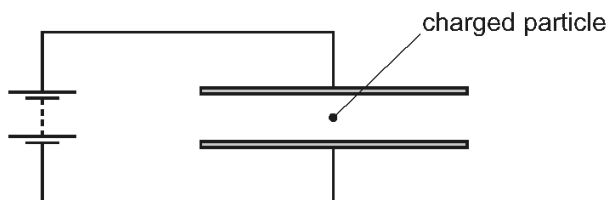
A second particle of mass $2m$, charge $+q$ and speed v enters the electric field along the same path.

What is the distance through which this particle is deflected in the electric field?

- A $\frac{d}{4}$
- B $\frac{d}{2}$
- C $2d$
- D $4d$

18 - (9702/11_Summer_2018_Q29) - *Electric Fields*

A charged particle is in the electric field between two horizontal metal plates connected to a battery, as shown. There is a force F on the particle due to the electric field.



The separation of the plates is doubled.

What is the new force on the particle?

- A $\frac{F}{4}$
- B $\frac{F}{2}$
- C F
- D $2F$

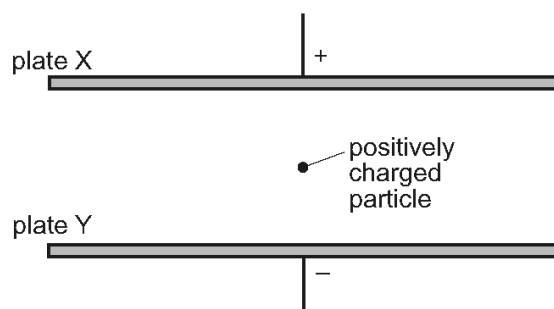
19 - (9702/13_Summer_2018_Q29) - *Electric Fields*

What is a possible charge on a particle?

- A $6.40 \times 10^{-20} \text{ C}$
- B $4.00 \times 10^{-19} \text{ C}$
- C $1.12 \times 10^{-18} \text{ C}$
- D $9.11 \times 10^{-18} \text{ C}$

20 - (9702/12_Summer_2018_Q30) - *Electric Fields*

Two large parallel metal plates X and Y are situated in a vacuum as shown.



Plates X and Y carry equal and opposite charges.

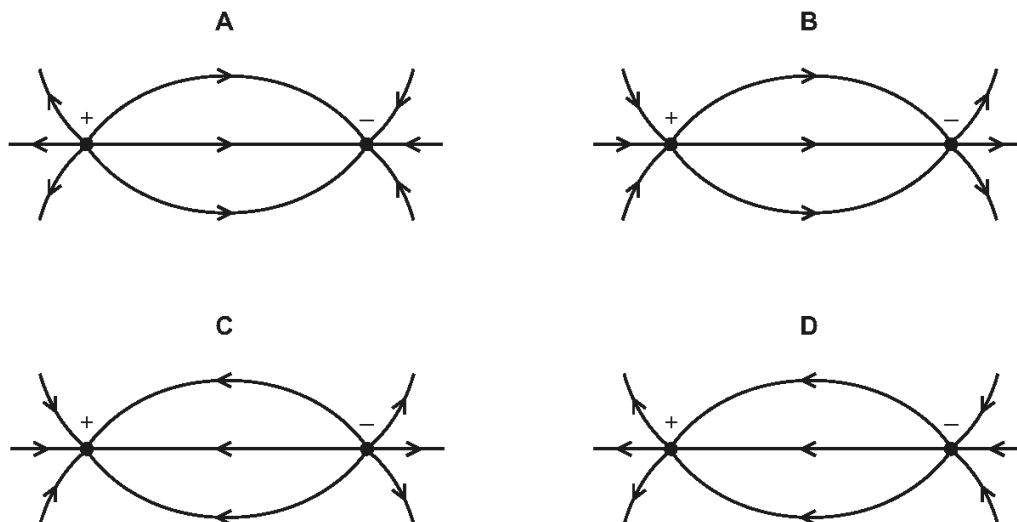
What happens to the force on a positively charged particle as it moves from plate X to plate Y?

- A It decreases because the positively charged particle is moving away from the positively charged plate.
- B It decreases because the positively charged particle is moving in the direction of the electric field between the plates.
- C It increases because the positively charged particle is moving closer to a negatively charged plate.
- D It remains constant because the positively charged particle is in the uniform electric field between the plates.

21 - (9702/12_Summer_2018_Q31) - *Electric Fields*

Four diagrams representing the electric field between two oppositely-charged point charges are shown.

Which diagram correctly shows the electric field lines?



22 - (9702/11_Winter_2018_Q10) - *Electric Fields*

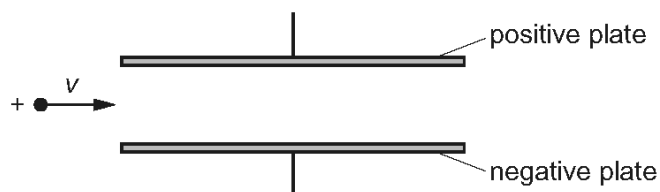
A charged particle is placed in a uniform field of force. The direction of the force on the particle is opposite to the direction of the field.

What is the field and what is the charge on the particle?

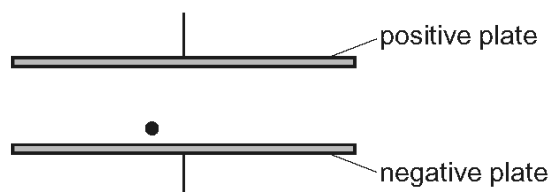
	field	charge on particle
A	electric	negative
B	electric	positive
C	gravitational	negative
D	gravitational	positive

23 - (9702/12_Winter_2018_Q11) - *Dynamics, Electric Fields*

A positively-charged particle of negligible mass, moving at constant velocity v in a vacuum, enters a uniform electric field between two parallel plates, as shown.



A short time later, the particle is at the position shown.

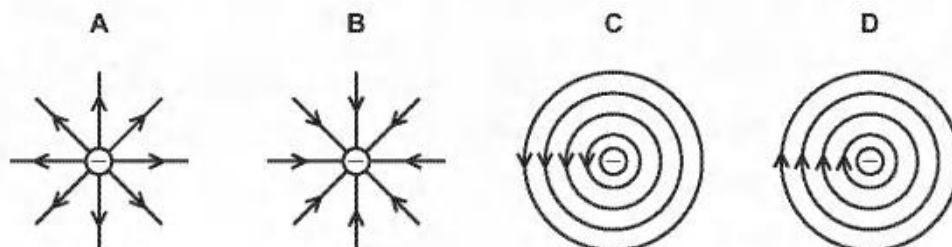


Which diagram represents the force or forces acting on the particle?



24 - (9702/11_Winter_2018_Q30) - *Electric Fields*

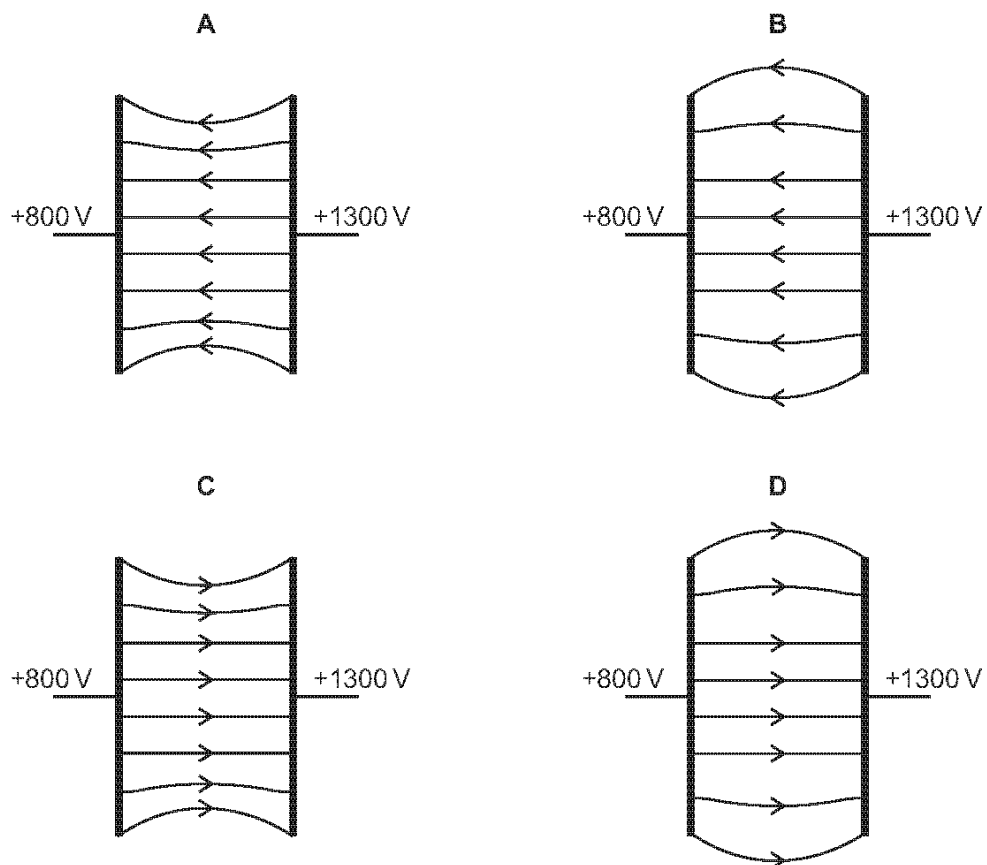
Which diagram shows the electric field lines surrounding an isolated negative point charge?



25 - (9702/13_Winter_2018_Q30) - *Electric Fields*

Two parallel metal plates are at electric potentials of $+800\text{ V}$ and $+1300\text{ V}$.

Which diagram best represents the electric field between the metal plates?



26 - (9702/11_Winter_2018_Q31) - *Electric Fields*

A beam of electrons is directed into an electric field and is deflected by it.

Diagram 1 represents an electric field in the plane of the paper.

Diagram 2 represents an electric field directed perpendicular to the plane of the paper.

The lines A, B, C and D represent possible paths of the electron beam. All paths are in the plane of the paper.

Which line best represents the path of the electrons inside the field?

diagram 1

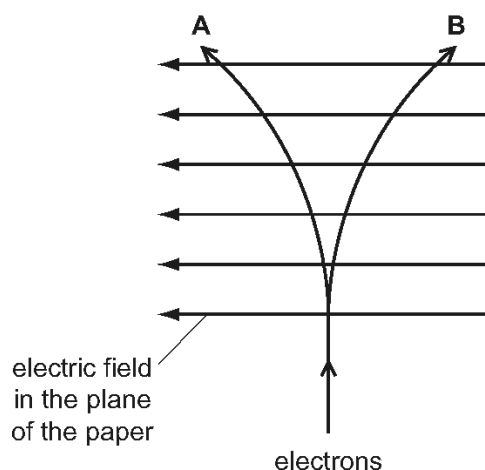
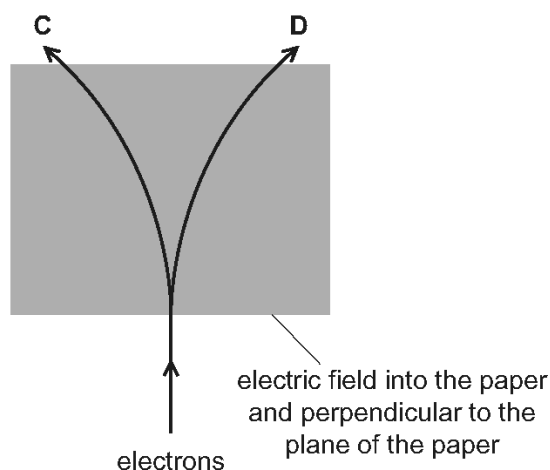


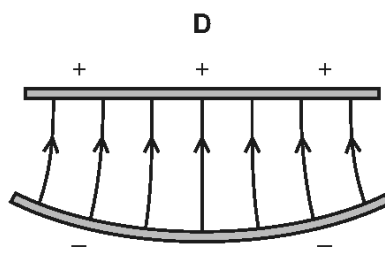
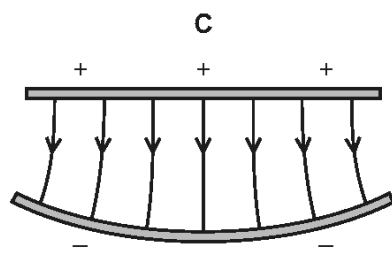
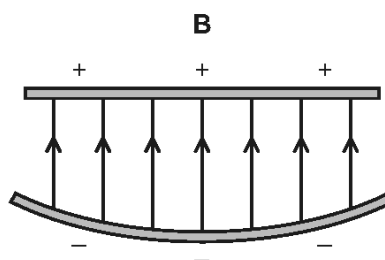
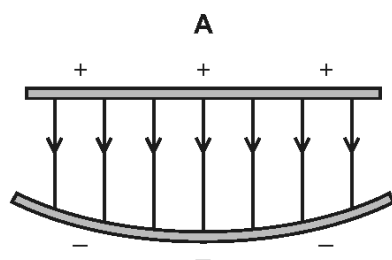
diagram 2



27 - (9702/12_Winter_2018_Q31) - *Electric Fields*

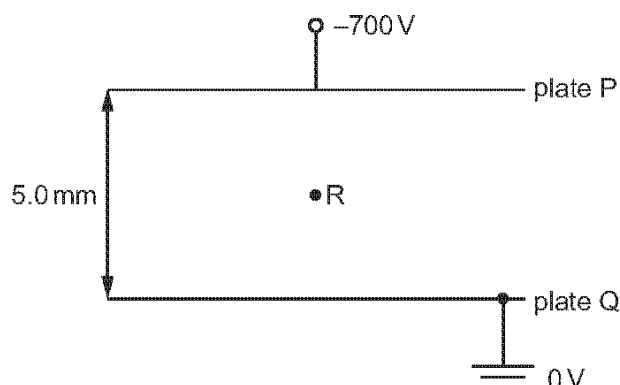
A flat plate is positively charged and a curved plate is negatively charged.

Which diagram shows the electric field lines between the two plates?



28 - (9702/13_Winter_2018_Q31) - *Electric Fields*

The diagram shows two metal plates P and Q. There is a potential difference of 700 V between the plates. Plate Q is earthed.



What is the magnitude and direction of the electric field at point R?

- A $1.4 \times 10^2 \text{ NC}^{-1}$ from P towards Q
- B $1.4 \times 10^2 \text{ NC}^{-1}$ from Q towards P
- C $1.4 \times 10^5 \text{ NC}^{-1}$ from P towards Q
- D $1.4 \times 10^5 \text{ NC}^{-1}$ from Q towards P

29 - (9702/11_Winter_2018_Q32) - *Electric Fields*

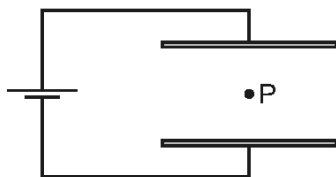
A charged particle of charge q and mass m is initially at rest in a uniform electric field. The field is produced by parallel metal plates separated by a distance d and having a potential difference V between them.

What is an expression for the acceleration of the charged particle?

- A $\frac{md}{qV}$
- B $\frac{mV}{qd}$
- C $\frac{qd}{mV}$
- D $\frac{qV}{md}$

30 - (9702/12_Winter_2018_Q32) - *Electric Fields*

Two parallel metal plates are connected to a d.c. supply, as shown.

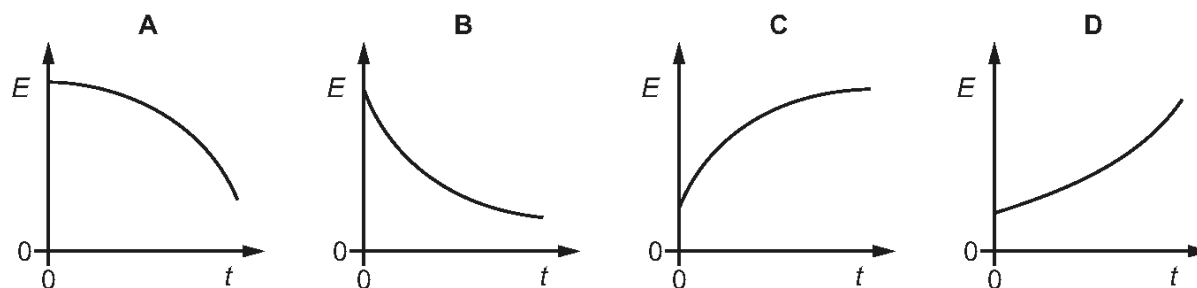


The two plates are moved towards each other at constant speed.

It may be assumed that the electric field between the plates is uniform.

Point P is mid-way between the two plates.

Which graph shows the variation with time t of the electric field strength E at point P?



31 - (9702/11_Summer_2019_Q8) - *Electric Fields*

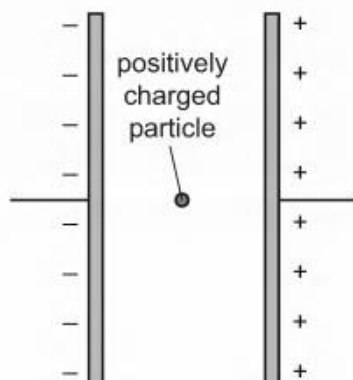
A positive charge of $2.6 \times 10^{-8} \text{ C}$ is in a uniform electric field of field strength $300\,000 \text{ V m}^{-1}$.

How much work must be done on the charge in order to move it a distance of 4.0 mm in the opposite direction to the direction of the field?

- A $3.1 \times 10^{-5} \text{ J}$
- B $2.0 \times 10^{-3} \text{ J}$
- C $3.1 \times 10^{-2} \text{ J}$
- D 2.0 J

32 - (9702/13_Summer_2019_Q10) - *Electric Fields*

A uniform electric field is created by two parallel vertical plates. A positively charged particle is in the vacuum between the plates, as shown.

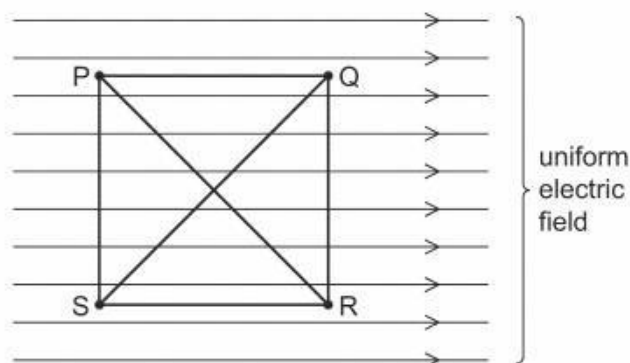


Which statement is correct?

- A** The electric field makes the particle move towards the negative plate with a constant speed.
- B** The electric field makes the particle move towards the negative plate with a constant acceleration.
- C** The electric field produces a uniform rate of decrease in the particle's acceleration.
- D** The electric field produces a uniform rate of increase in the particle's acceleration.

33 - (9702/12_Summer_2019_Q13) - *Electric Fields, Work, Energy & Power*

A small positive charge can move inside a uniform electric field.



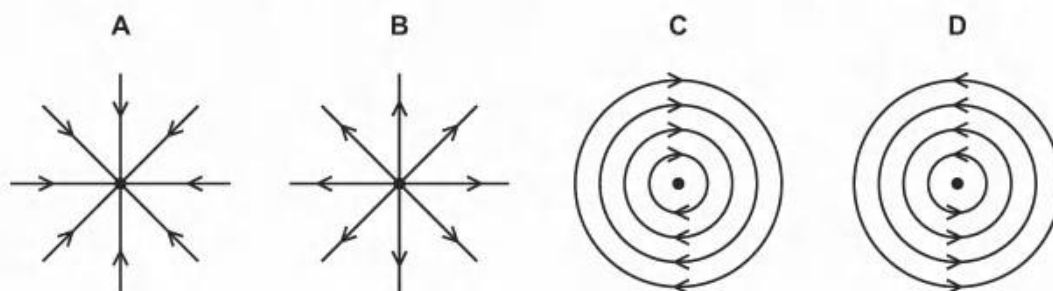
The charge moves along different straight paths between points P, Q, R and S.

Which row gives two paths that result in the same total work done on the charge?

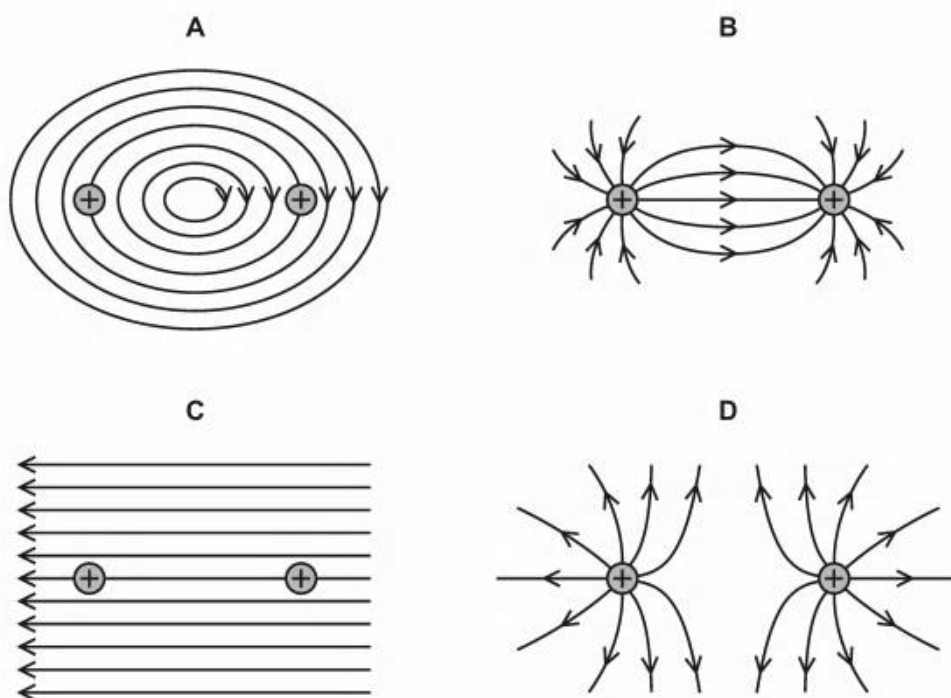
	path 1	path 2
A	P to R	Q to S
B	P to R	P to S
C	S to Q	S to R
D	S to Q	R to P

34 - (9702/11_Summer_2019_Q31) - *Electric Fields*

Which diagram shows the pattern of the electric field lines due to a negative point charge?

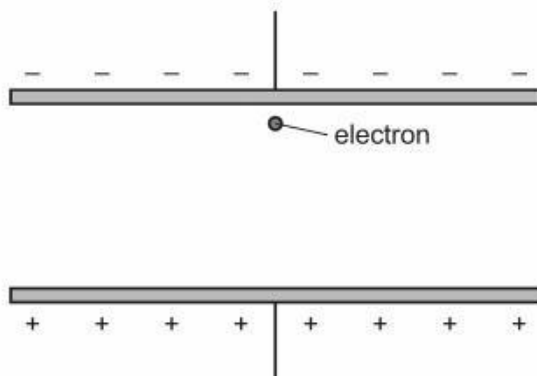
35 - (9702/13_Summer_2019_Q31) - *Electric Fields*

Which diagram represents the electric field line pattern due to a combination of two positive charges?



36 - (9702/12_Summer_2019_Q32) - *Electric Fields*

An electron is situated in a vacuum between two charged plates, as shown.



Which statement describes the motion of the electron due to the uniform electric field?

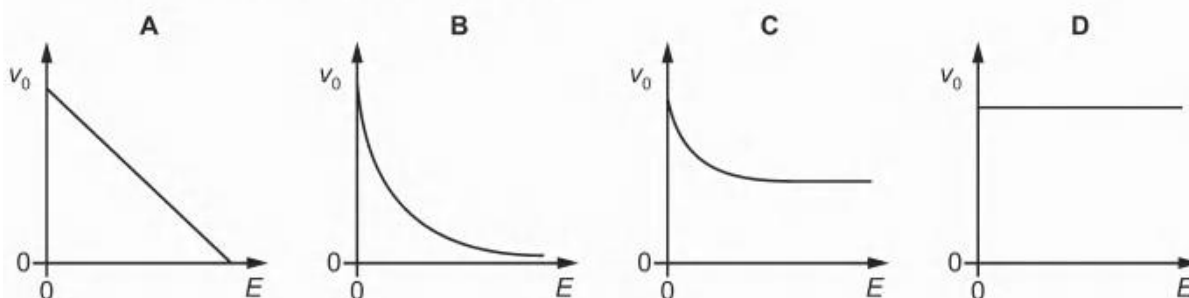
- A It moves downwards with a constant acceleration.
- B It moves downwards with zero acceleration.
- C It moves upwards with a constant acceleration.
- D It moves upwards with a decreasing acceleration.

37 - (9702/12_Winter_2019_Q10) - *Dynamics, Electric Fields*

A positively charged oil droplet falls in air in a uniform electric field that is vertically upwards. The droplet has a constant terminal speed v_0 and the electric field strength is E .

The magnitude of the force due to air resistance acting on the droplet is proportional to the speed of the droplet.

Which graph shows the variation with E of v_0 ?



38 - (9702/12_Winter_2019_Q29) - *Electric Fields*

P is a point near to charge X as shown.



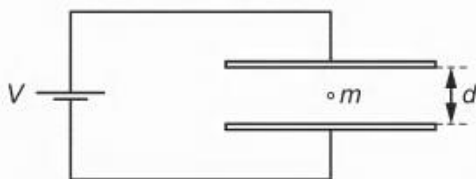
When a negatively charged test charge is placed at point P, it is found to experience a force of repulsion from X that is radially away from X.

Which arrow correctly shows the direction of the electric field at point P due to the charge X?



39 - (9702/12_Winter_2019_Q30) - *Electric Fields*

A charged oil drop of mass m , with n excess electrons, is held stationary in the uniform electric field between two horizontal plates separated by a distance d .



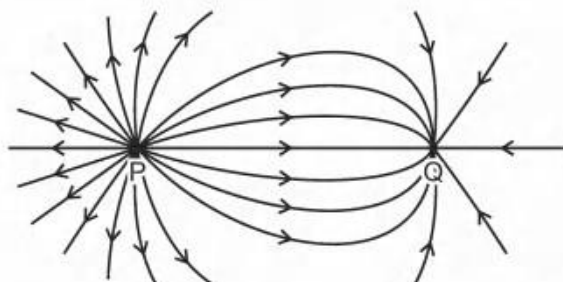
The voltage between the plates is V , the elementary charge is e and the acceleration of free fall is g .

What is the value of n ?

- A $\frac{eV}{mgd}$ B $\frac{mgd}{eV}$ C $\frac{meV}{gd}$ D $\frac{gd}{meV}$

40 - (9702/13_Winter_2019_Q31) - *Electric Fields*

The diagram shows the electric field pattern between two opposite and unequal point charges P and Q.

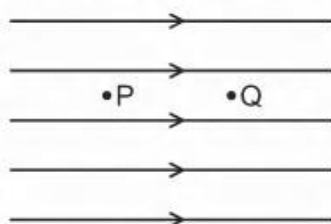


Which statement about the charges is correct?

- A P is negatively charged and has a smaller charge than Q.
- B P is negatively charged and has a greater charge than Q.
- C P is positively charged and has a smaller charge than Q.
- D P is positively charged and has a greater charge than Q.

41 - (9702/13_Winter_2019_Q32) - *Electric Fields*

A uniform electric field is represented by five horizontal field lines.



P and Q are two points in the field. The field causes a positively charged particle in a vacuum to move from P to Q.

Which statement must be correct?

- A The acceleration of the particle between P and Q is increasing.
- B The kinetic energy of the particle at P is the same as the kinetic energy of the particle at Q.
- C The force on the particle at Q is greater than the force on the particle at P.
- D Work is done on the particle as it moves from P to Q.

42 - (9702/11_Summer_2020_Q31) - *Electric Fields*

A small charge q is placed in the electric field of a large charge Q .

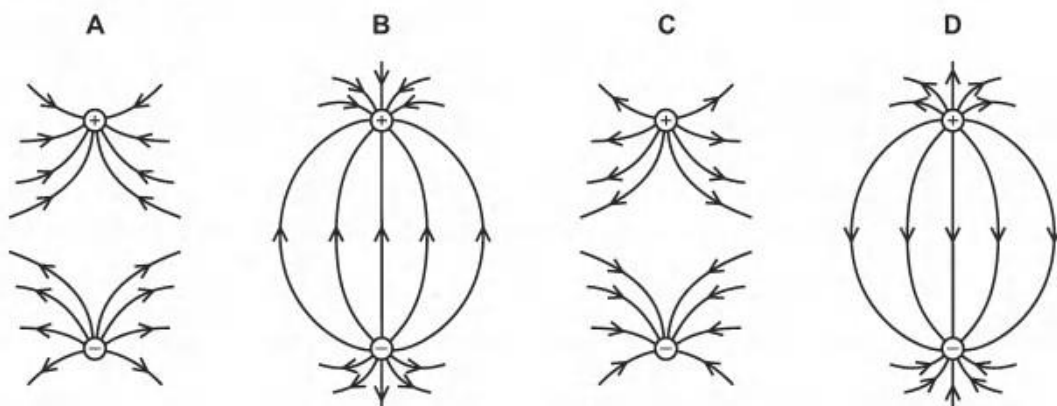
Both charges experience a force F .

What is the electric field strength of the charge Q at the position of the charge q ?

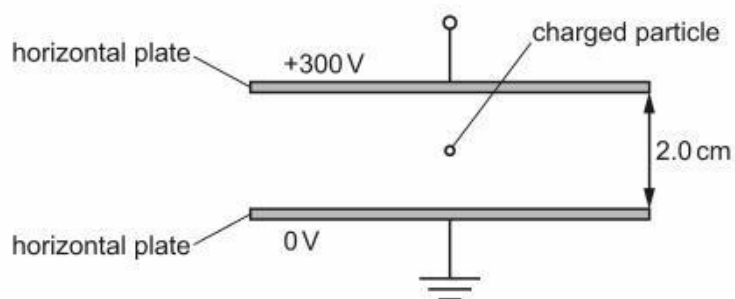
- A $\frac{F}{Qq}$
- B $\frac{F}{Q}$
- C FqQ
- D $\frac{F}{q}$

43 - (9702/13_Summer_2020_Q31) - *Electric Fields*

Which diagram best represents the electric field between two point charges of equal magnitude and opposite sign?

44 - (9702/11_Summer_2020_Q32) - *Electric Fields*

A charged particle is in a vacuum between two horizontal metal plates as shown.



The acceleration of the particle is $7.15 \times 10^{11} \text{ ms}^{-2}$ downwards. The particle has a mass of $3.34 \times 10^{-27} \text{ kg}$.

What is the charge on the particle?

- A $+1.6 \times 10^{-19} \text{ C}$
- B $-1.6 \times 10^{-19} \text{ C}$
- C $+1.6 \times 10^{-17} \text{ C}$
- D $-1.6 \times 10^{-17} \text{ C}$

45 - (9702/12_Summer_2020_Q32) - *Electric Fields*

A charged oil droplet of mass m is falling, initially freely, in a vacuum between two horizontal metal plates that are separated by a distance x .

A potential difference (p.d.) V is then applied across the plates. This results in the oil droplet continuing to accelerate downwards but with a reduced acceleration a .

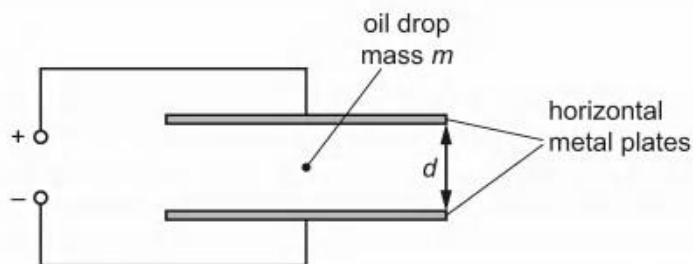
The polarity of the applied p.d. is then reversed so that the direction of the electric force on the droplet is reversed. This results in the downwards acceleration of the oil droplet increasing to $3a$.

What is the magnitude of the charge on the oil droplet?

- A $\frac{max}{V}$ B $2\frac{max}{V}$ C $3\frac{max}{V}$ D $4\frac{max}{V}$

46 - (9702/13_Summer_2020_Q32) - *Electric Fields*

A negatively charged oil drop of mass m is between two horizontal parallel metal plates a distance d apart.



When the potential difference (p.d.) between the plates is V_1 the oil drop rises at a constant speed. When the p.d. is decreased to a value V_2 the oil drop falls at the same constant speed.

Air resistance acts on the drop when it is moving. The upthrust on the drop is negligible.

The acceleration of free fall is g .

What is the charge on the oil drop?

- A $\frac{mdg}{V_1 - V_2}$ B $\frac{mdg}{V_1 + V_2}$ C $\frac{2mdg}{V_1 - V_2}$ D $\frac{2mdg}{V_1 + V_2}$

47 - (9702/13_Summer_2020_Q33) - *Electric Fields*

The unit of electric charge is the coulomb.

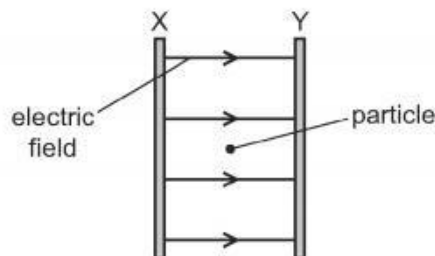
What is meant by 1 coulomb?

- A the charge passing a point in 1 second when a current produces 1 joule of work
 B the charge passing a point in 1 second when a current produces 1 watt of power
 C the charge passing a point in 1 second when there is a current of 1 ampere
 D the charge passing a point in 1 second when there is 1 ohm of resistance

48 - (9702/11_Winter_2020_Q11) - *Electric Fields*

A particle is situated at rest between two metal plates X and Y.

A potential difference (p.d.) is then applied across the plates and produces the electric field shown.



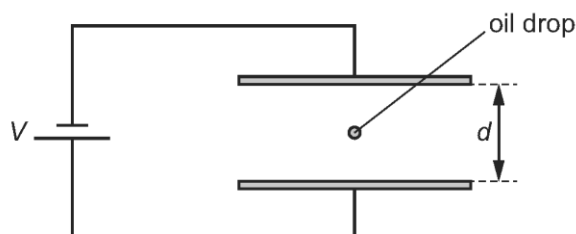
The particle moves towards plate X when the p.d. is applied.

What could be the particle?

- A alpha-particle
- B electron
- C neutron
- D proton

49 - (9702/11_Winter_2020_Q31) - *Electric Fields*

An oil drop has mass m and charge q . The drop is held stationary in an electric field between two parallel horizontal plates, a distance d apart, as shown.



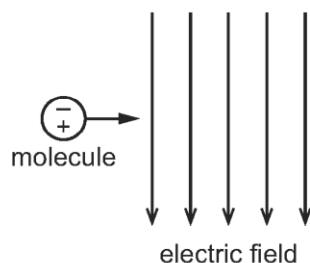
The potential difference between the plates is V and the acceleration of free fall is g .

What is the charge-to-mass ratio $\frac{q}{m}$ of the oil drop?

- A $\frac{gd}{V}$ B $\frac{V}{dg}$ C $\frac{gV}{d}$ D $\frac{d}{Vg}$

50 - (9702/12_Winter_2020_Q31) - *Electric Fields*

A molecule behaves as an electric 'dipole' consisting of two equal point charges of opposite sign, separated by a fixed distance. The molecule moves with constant horizontal velocity as it enters a vertical uniform electric field, as shown.



The positive and negative charges of the molecule enter the field at the same time.

What describes the effect of the electric field on the velocity of the molecule?

	horizontal component of velocity	vertical component of velocity
A	constant	increases
B	constant	zero
C	increases	increases
D	increases	zero

51 - (9702/13_Winter_2020_Q31) - *Electric Fields*

A stationary particle is in an electric field.

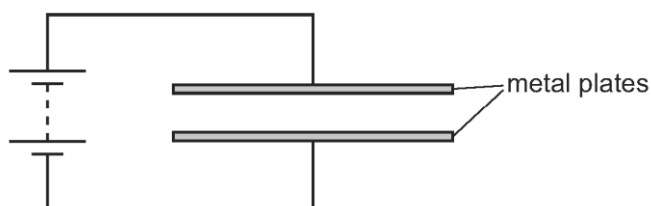
The only force on the particle is that from the electric field.

In which case is the electric field strength $5.0 \times 10^5 \text{ V m}^{-1}$?

- A a force of $1.6 \times 10^{-14} \text{ N}$ acting on an electron
- B a force of $3.2 \times 10^{-14} \text{ N}$ acting on an alpha-particle
- C a force of $8.0 \times 10^{-14} \text{ N}$ acting on an alpha-particle
- D a force of $8.0 \times 10^{-14} \text{ N}$ acting on a proton

52 - (9702/12_Winter_2020_Q32) - *Electric Fields*

Two parallel metal plates are connected to a battery of negligible internal resistance.



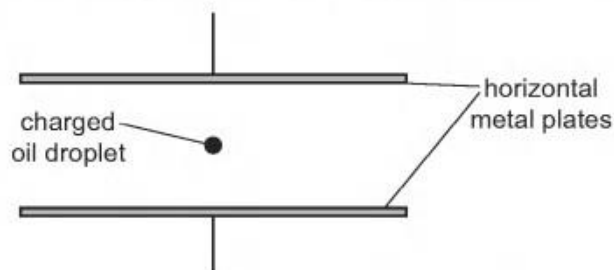
One of the plates is slowly moved towards the other.

Which row is correct?

	electric field strength between the plates	potential difference between the plates
A	decreases	constant
B	increases	constant
C	decreases	increases
D	increases	increases

53 - (9702/13_Winter_2020_Q32) - *Electric Fields*

A constant potential difference is applied between two horizontal metal plates. A charged oil droplet is held stationary by the electric field between the plates.



As some of the oil evaporates, the droplet loses mass and starts to accelerate. Its charge remains constant.

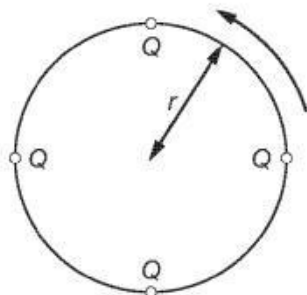
In which direction does the droplet accelerate, and which change needs to be made to the separation of the plates in order to stop this acceleration?

	direction of acceleration	separation of the plates
A	downwards	decrease
B	downwards	increase
C	upwards	decrease
D	upwards	increase

54 - (9702/12_Winter_2020_Q33) - *Electric Fields*

Four point charges, each of charge Q , are placed on the edge of an insulating disc of radius r .

The disc rotates at a rate of n revolutions per unit time.

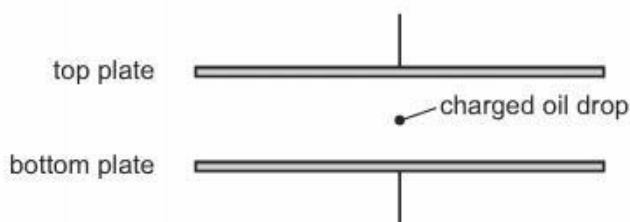


What is the equivalent electric current at the edge of the disc?

- A $4Qn$ B $\frac{4Q}{n}$ C $8\pi rQn$ D $\frac{2Qn}{\pi r}$

55 - (9702/11_Summer_2021_Q11) - *Electric Fields*

A charged oil drop is held stationary between two charged parallel plates.



Which forces act on the oil drop?

- A both electric and gravitational
B electric only
C gravitational only
D neither electric nor gravitational

56 - (9702/12_Summer_2021_Q11) - *Electric Fields*

A charged particle is placed in a uniform field of force. The direction of the force on the particle is opposite to the direction of the field.

What is the field and what is the charge on the particle?

	field	charge on particle
A	electric	negative
B	electric	positive
C	gravitational	negative
D	gravitational	positive

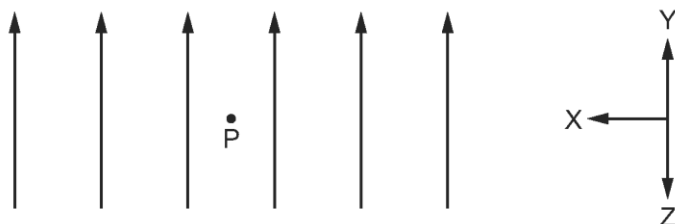
57 - (9702/11_Summer_2021_Q30) - *Electric Fields*

What is the electric field strength in a region where a proton accelerates at 2.00 m s^{-2} due to the field?

- A 11.4 pV m^{-1} B 5.22 nV m^{-1} C 10.4 nV m^{-1} D 20.9 nV m^{-1}

58 - (9702/12_Summer_2021_Q30) - *Electric Fields*

A positively charged particle P is in an electric field, as shown.



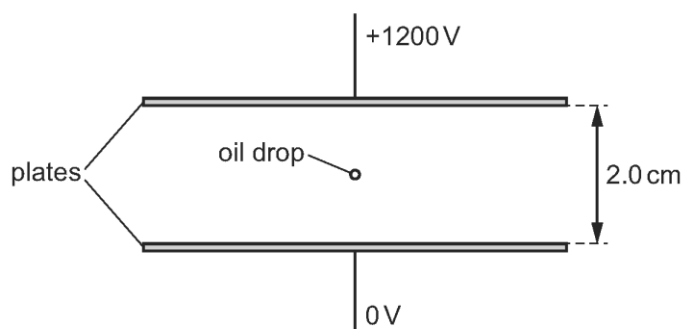
The field lines (lines of force) are evenly spaced and parallel.

Which statement is correct?

- A Moving P a small distance in any direction will not change the electric force on P.
B Moving P a small distance in direction Y will increase the electric force on P.
C Moving P a small distance in direction Z will increase the electric force on P.
D Moving P a small distance in direction X will increase the electric force on P.

59 - (9702/11_Summer_2021_Q31) - *Electric Fields*

An oil drop of mass $2.6 \times 10^{-15} \text{ kg}$ and with a charge of $-4.8 \times 10^{-19} \text{ C}$ is in a vacuum between two horizontal plates. The plates have a separation of 2.0 cm and a potential difference (p.d.) between them of 1200 V , as shown.

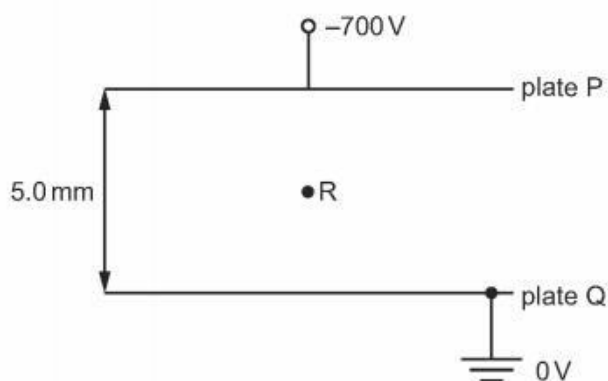


Which statement describes the motion of the oil drop?

- A It is stationary.
B It has a downward acceleration of 9.7 m s^{-2} .
C It has an upward acceleration of 1.3 m s^{-2} .
D It has an upward acceleration of 11 m s^{-2} .

60 - (9702/12_Summer_2021_Q31) - *Electric Fields*

The diagram shows two parallel metal plates P and Q, separated by a distance of 5.0 mm. There is a potential difference of 700 V between the plates. Plate Q is earthed.



What is the magnitude and direction of the electric field at point R?

- A $1.4 \times 10^2 \text{ NC}^{-1}$ from P towards Q
- B $1.4 \times 10^2 \text{ NC}^{-1}$ from Q towards P
- C $1.4 \times 10^5 \text{ NC}^{-1}$ from P towards Q
- D $1.4 \times 10^5 \text{ NC}^{-1}$ from Q towards P

61 - (9702/13_Summer_2021_Q31) - *Electric Fields*

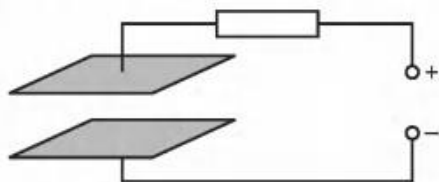
A particle has a charge of +2.0 mC and is in a vertical uniform electric field. An electric force of $1.0 \times 10^{-2} \text{ N}$ acts upwards on the particle.

What is the electric field strength?

- A 0.20 V m^{-1} downwards
- B 0.20 V m^{-1} upwards
- C 5.0 V m^{-1} downwards
- D 5.0 V m^{-1} upwards

62 - (9702/13_Summer_2021_Q32) - *Electric Fields*

The diagram shows two parallel metal plates connected to a d.c. power supply through a resistor.



There is a uniform electric field in the region between the plates.

Which change would cause a **decrease** in the strength of the electric field?

- A a small increase in the distance between the plates
- B a small increase in the potential difference between the plates
- C a small increase in the resistance of the resistor
- D a small increase to the area of both plates

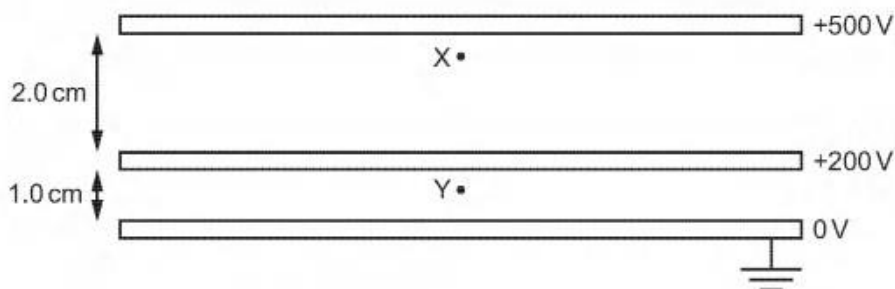
63 - (9702/11_Winter_2021_Q30) - *Electric Fields*

What is meant by electric field strength?

- A force per unit charge acting on a small mass
- B force per unit charge acting on a small positive charge
- C force per unit mass acting on a small mass
- D force per unit mass acting on a small positive charge

64 - (9702/11_Winter_2021_Q31) - *Electric Fields*

Three parallel metal plates of the same area are fixed with a separation of 2.0 cm between the top plate and the middle plate, and 1.0 cm between the middle plate and the bottom plate. The top plate is held at a potential of +500 V, the middle plate at +200 V and the bottom plate is earthed, as shown.



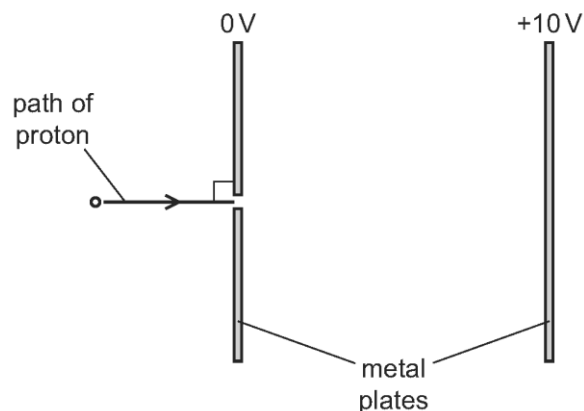
What is the value of the ratio $\frac{\text{magnitude of force on an electron at X}}{\text{magnitude of force on an electron at Y}}$?

- A 0.75
- B 1.00
- C 1.25
- D 1.50

65 - (9702/12_Winter_2021_Q32) - *Electric Fields*

A proton enters the uniform electric field between two parallel vertical metal plates in a vacuum.

One plate is at a potential of 0 V and the other plate is at a potential of +10 V, as shown.



What is the initial change in the motion of the proton caused by the electric field, immediately after the proton enters the field?

- A It begins to move downwards.
- B It begins to move upwards.
- C Its speed decreases.
- D Its speed increases.

66 - (9702/13_Winter_2021_Q32) - *Electric Fields*

An electron is in a uniform electric field of field strength 1500 V m^{-1} .

What is the acceleration of the electron due to the electric field?

- A $8.5 \times 10^{-9} \text{ m s}^{-2}$
- B $1.6 \times 10^{-5} \text{ m s}^{-2}$
- C $1.4 \times 10^{11} \text{ m s}^{-2}$
- D $2.6 \times 10^{14} \text{ m s}^{-2}$

67 - (9702/12_Winter_2021_Q33) - *Electric Fields*

What is a description of the coulomb?

- A the electric charge of one electron
- B the electric charge transferred by a current of one ampere in one second
- C the kinetic energy gained by an electron accelerated through a potential difference of one volt
- D the kinetic energy of an electron moving at a speed of one metre per second

68 - (9702/12_Winter_2023_Q30) - *Electric Fields*

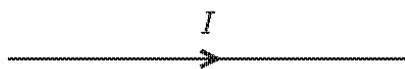
A fine mist of oil droplets is sprayed into air. As the oil droplets leave the nozzle of the spraying device they can become electrically charged.

What is **not** a possible value for the charge on an oil droplet?

- A zero
- B $1.0 \times 10^{-19} \text{ C}$
- C $4.8 \times 10^{-19} \text{ C}$
- D $8.0 \times 10^{-19} \text{ C}$

1 - (9702/11_Summer_2017_Q32) - *Current Of Electricity*

The diagram shows the symbol for a wire carrying a current I .



What does this current represent?

- A** the charge flowing past a point in the wire per unit time
- B** the number of electrons flowing past a point in the wire per unit time
- C** the number of positive ions flowing past a point in the wire per unit time
- D** the number of protons flowing past a point in the wire per unit time

2 - (9702/12_Summer_2017_Q32) - *Current Of Electricity*

The current in a circuit component is $2.00\ \mu\text{A}$.

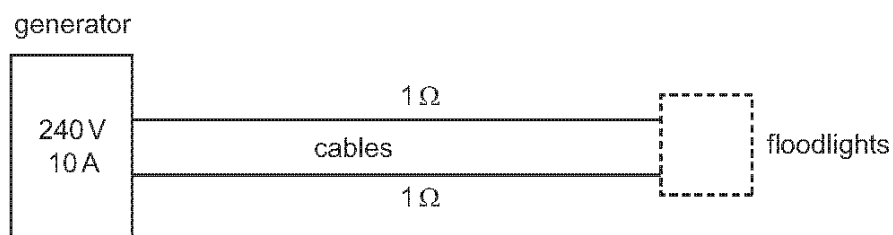
How many electrons pass through the component each second?

- A** 1.25×10^{13} **B** 1.25×10^{16} **C** 1.25×10^{19} **D** 1.25×10^{25}

3 - (9702/13_Summer_2017_Q32) - *Current Of Electricity*

The diagram shows a portable generator connected by cables to floodlights. The generator produces a current of $10\ \text{A}$ at a constant potential difference (p.d.) of $240\ \text{V}$.

The total resistance of the cables is $2\ \Omega$.



What is the p.d. V across, and the power P delivered to, the floodlights?

	V/V	P/W
A	220	2000
B	220	2200
C	230	2000
D	230	2300

4 - (9702/11_Summer_2017_Q33) - *Current Of Electricity*

Which values of current and resistance will produce a rate of energy transfer of 16 Js^{-1} ?

	current / A	resistance / Ω
A	1	4
B	2	8
C	4	1
D	16	1

5 - (9702/12_Summer_2017_Q33) - *Current Of Electricity*

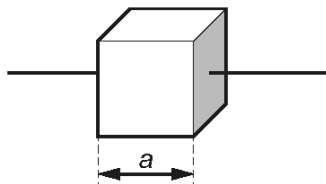
The filament of a 240 V, 100 W electric lamp heats up from room temperature to its operating temperature. As it heats up, its resistance increases by a factor of 16.

What is the resistance of the filament at room temperature?

- A** 36Ω **B** 580Ω **C** $1.5 \text{ k}\Omega$ **D** $9.2 \text{ k}\Omega$

6 - (9702/13_Summer_2017_Q33) - *Current Of Electricity*

A metal cube with sides of length a has electrical resistance R between opposite faces.

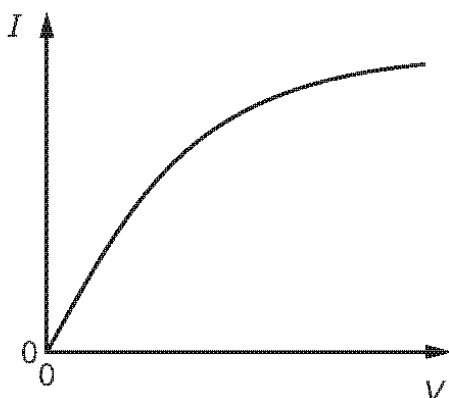


What is the resistance between the opposite faces of a cube of the same metal with sides of length $3a$?

- A** $9R$ **B** $3R$ **C** $\frac{R}{3}$ **D** $\frac{R}{9}$

7 - (9702/11_Summer_2017_Q34) - *Current Of Electricity*

Which component has the I - V graph shown?



- A** filament lamp
- B** metallic conductor at constant temperature
- C** resistor of fixed resistance
- D** semiconductor diode

8 - (9702/12_Summer_2017_Q34) - *Current Of Electricity*

Two wires have the same length and the same resistance. Wire X is made of a metal of resistivity $1.7 \times 10^{-8} \Omega \text{ m}$ and wire Y is made of a metal of resistivity $5.6 \times 10^{-8} \Omega \text{ m}$.

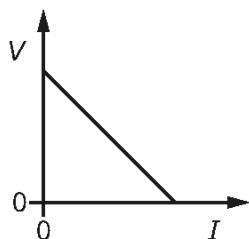
The diameter of wire X is 0.315 mm.

What is the diameter of wire Y?

- A** 0.17 mm **B** 0.33 mm **C** 0.57 mm **D** 1.0 mm

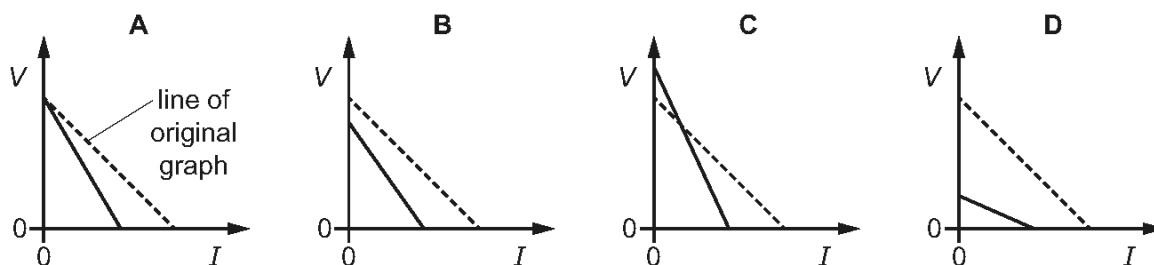
9 - (9702/13_Summer_2017_Q34) - *Current Of Electricity*

A graph of potential difference (p.d.) V across a cell against current I in the cell is shown.



As the cell reaches the end of its useful life, its internal resistance increases and its electromotive force (e.m.f.) decreases.

Which diagram shows a graph of V against I for the cell nearing the end of its useful life?

**10** - (9702/12_Winter_2017_Q19) - *Work, Energy & Power, Current Of Electricity*

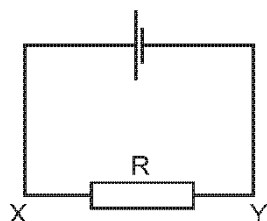
During refuelling, a petrol car receives 50 litres of fuel in 90 seconds. The petrol has 34 MJ of energy per litre.

For an electric car to receive the same amount of energy in the same time from a 230 V supply, what is the minimum current required?

- A** 2700 A **B** 8.2×10^4 A **C** 7.4×10^6 A **D** 6.6×10^8 A

11 - (9702/11_Winter_2017_Q33) - Current Of Electricity, D.c. Circuits

The current in the circuit shown is 3.2 mA.

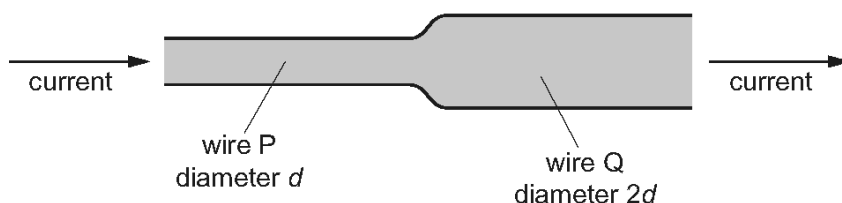


What are the direction of flow and the rate of flow of electrons through the resistor R?

	direction of flow	rate of flow / s ⁻¹
A	X to Y	2.0×10^{16}
B	X to Y	5.1×10^{-22}
C	Y to X	2.0×10^{16}
D	Y to X	5.1×10^{-22}

12 - (9702/12_Winter_2017_Q33) - Current Of Electricity

Two copper wires are joined together and carry a current, as shown.



Wire P has diameter d and wire Q has diameter $2d$.

What is the ratio $\frac{\text{average drift speed of the free electrons in wire P}}{\text{average drift speed of the free electrons in wire Q}}$?

- A** $\frac{1}{4}$ **B** $\frac{1}{2}$ **C** 2 **D** 4

13 - (9702/13_Winter_2017_Q33) - Current Of Electricity

The number density of conduction electrons in copper is $8.0 \times 10^{28} \text{ m}^{-3}$.

What is the average drift speed of electrons in a copper wire of diameter 0.42 mm when the current in the wire is 0.57 A?

- A** $8.0 \times 10^{-11} \text{ ms}^{-1}$
B $3.2 \times 10^{-10} \text{ ms}^{-1}$
C $8.0 \times 10^{-5} \text{ ms}^{-1}$
D $3.2 \times 10^{-4} \text{ ms}^{-1}$

14 - (9702/11_Winter_2017_Q34) - *Current Of Electricity*

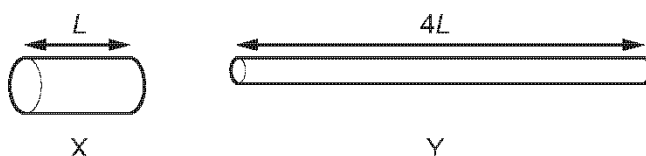
A filament lamp has a resistance of $180\ \Omega$ when the current in it is $500\ \text{mA}$.

What is the power dissipated in the lamp?

- A 45 W B 90 W C 290 W D 360 W

15 - (9702/11_Winter_2017_Q35) - *Current Of Electricity*

Two copper wires X and Y have the same volume. Wire Y is four times as long as wire X.

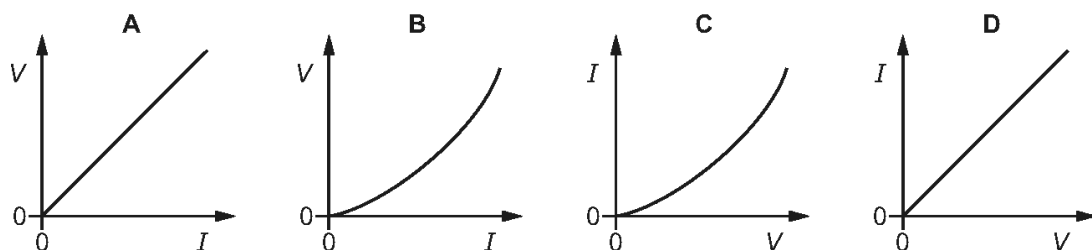


What is the ratio $\frac{\text{resistance of wire Y}}{\text{resistance of wire X}}$?

- A 1 B 4 C 8 D 16

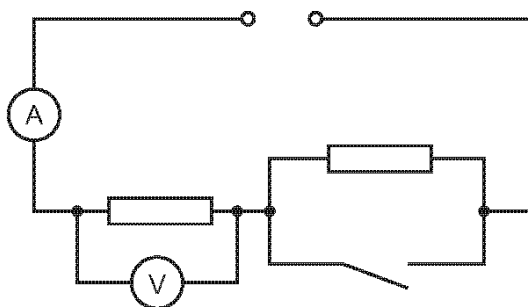
16 - (9702/12_Winter_2017_Q35) - *Current Of Electricity, D.c. Circuits*

Which graph represents a metallic conductor, where the resistance of the conductor is given by the gradient of the graph?



17 - (9702/11_Winter_2017_Q36) - *Current Of Electricity, Alternating Currents*

In the circuit shown, the ammeter reading is I and the voltmeter reading is V .



When the switch is closed, which row describes what happens to I and to V ?

	I	V
A	decreases	decreases
B	increases	increases
C	increases	stays the same
D	stays the same	increases

18 - (9702/12_Winter_2017_Q36) - *Current Of Electricity, D.c. Circuits*

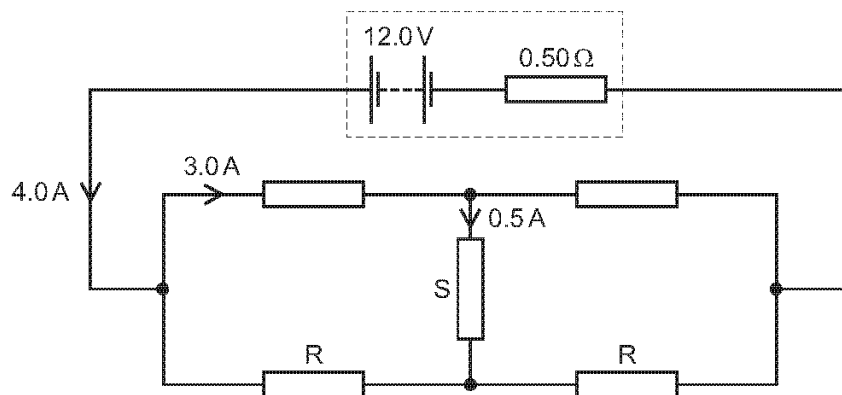
A typical mobile phone battery has an e.m.f. of 5.0 V and an internal resistance of 200 m Ω .

What is the terminal p.d. of the battery when it supplies a current of 500 mA?

- A 4.8 V B 4.9 V C 5.0 V D 5.1 V

19 - (9702/12_Winter_2017_Q37) - Current Of Electricity, D.c. Circuits

The circuit shown contains a resistor S that is neither in series nor in parallel with the other resistors.



Kirchhoff's laws can be used with the data in the diagram to deduce the resistance of each of the two identical resistors labelled R.

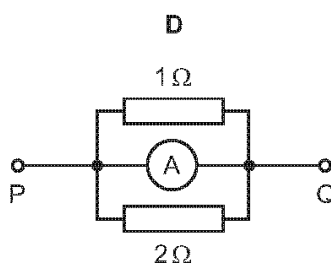
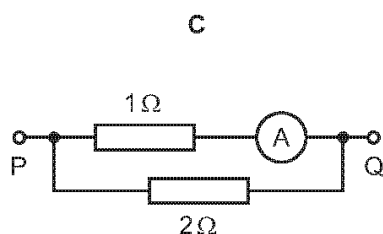
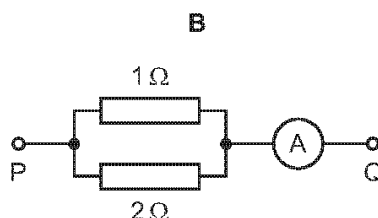
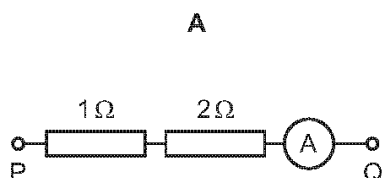
What is the resistance of each resistor R?

- A $3.0\ \Omega$ B $4.0\ \Omega$ C $4.8\ \Omega$ D $5.0\ \Omega$

20 - (9702/13_Winter_2017_Q38) - Current Of Electricity, D.c. Circuits

In each arrangement of resistors, the ammeter has a resistance of $2\ \Omega$.

Which arrangement gives the largest reading on the ammeter when the same potential difference is applied between points P and Q?



21 - (9702/12_Summer_2018_Q16) - *Work, Energy & Power, Current Of Electricity*

In 'normal driving conditions', an electric car has a range of 150 km. This uses all of the 200 MJ of energy stored in its batteries.

With the batteries initially fully charged, the car is driven 100 km in 'normal driving conditions'. The batteries are then recharged from a household electrical supply delivering a constant current of 13.0 A at a potential difference of 230 V.

What is the minimum time required to recharge the batteries?

- A 0.95 hours
- B 12.4 hours
- C 18.6 hours
- D 27.9 hours

22 - (9702/11_Summer_2018_Q30) - *Current Of Electricity*

The current I in a metal wire is given by the expression shown.

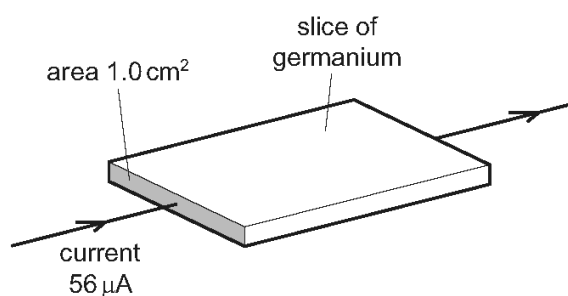
$$I = Anvq$$

What does the symbol n represent?

- A the number of atoms per unit volume of the metal
- B the number of free electrons per atom in the metal
- C the number of free electrons per unit volume of the metal
- D the total number of electrons per unit volume of the metal

23 - (9702/13_Summer_2018_Q30) - *Current Of Electricity*

A slice of germanium of cross-sectional area 1.0 cm^2 carries a current of $56 \mu\text{A}$. The number density of charge carriers in the germanium is $2.0 \times 10^{13} \text{ cm}^{-3}$. Each charge carrier has a charge equal to the charge on an electron.

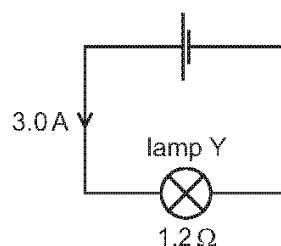
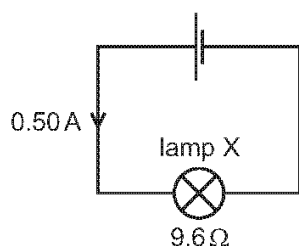


What is the average drift velocity of the charge carriers in the germanium?

- A 0.18 ms^{-1}
- B 18 ms^{-1}
- C 180 ms^{-1}
- D 1800 ms^{-1}

24 - (9702/11_Summer_2018_Q31) - *Current Of Electricity*

The circuit diagrams show two lamps X and Y each connected to a cell. The current in lamp X is 0.50 A and its resistance is $9.6\ \Omega$. The current in lamp Y is 3.0 A and its resistance is $1.2\ \Omega$.

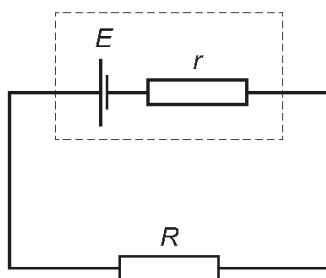


What is the ratio $\frac{\text{power in lamp X}}{\text{power in lamp Y}}$?

- A 0.22 B 0.75 C 1.3 D 4.5

25 - (9702/13_Summer_2018_Q31) - *Current Of Electricity, D.c. Circuits*

A cell of electromotive force (e.m.f.) E and internal resistance r is connected to an external resistor of resistance R , as shown.



What is the power dissipated in the external resistor?

- A $\frac{E^2(R+r)}{R^2}$ B $\frac{E^2R}{(R+r)^2}$ C $\frac{E^2(R+r)}{r^2}$ D $\frac{E^2r}{(R+r)^2}$

26 - (9702/11_Summer_2018_Q32) - *Current Of Electricity*

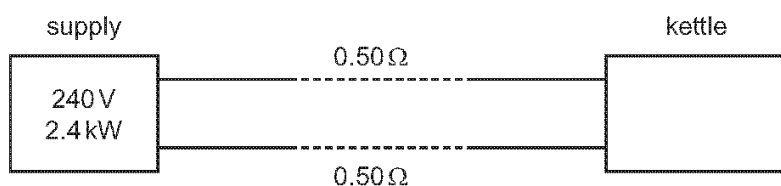
A cylindrical piece of a soft, electrically-conducting material has resistance R . It is rolled out so that its length is doubled but its volume stays constant.

What is its new resistance?

- A $\frac{R}{2}$ B R C $2R$ D $4R$

27 - (9702/12_Summer_2018_Q32) - *Current Of Electricity*

The power output of an electrical supply is 2.4 kW at a potential difference (p.d.) of 240 V. The two wires between the supply and a kettle each have a resistance of $0.50\ \Omega$, as shown.

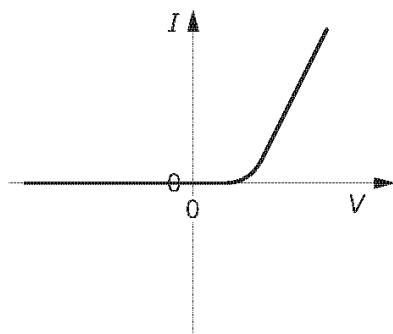


What is the power supplied to the kettle and what is the p.d. across the kettle?

	power / kW	p.d. / V
A	2.3	230
B	2.3	235
C	2.4	230
D	2.4	235

28 - (9702/13_Summer_2018_Q32) - *Current Of Electricity*

The graph shows the I - V characteristic of an electrical component.

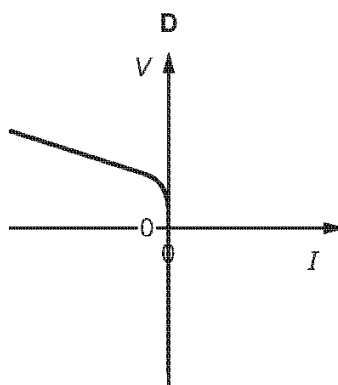
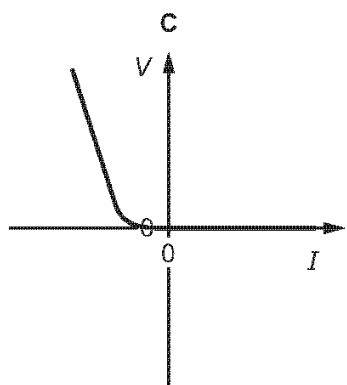
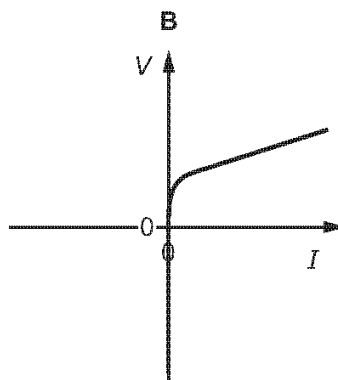
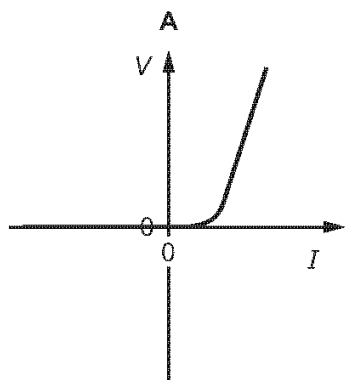


What is the component?

- A a filament lamp
- B a metallic conductor at constant temperature
- C a resistor
- D a semiconductor diode

29 - (9702/12_Summer_2018_Q33) - *Current Of Electricity*

Which graph shows the variation of voltage V with current I for a semiconductor diode?



30 - (9702/13_Summer_2018_Q33) - *Current Of Electricity*

A metal wire of length 1.4 m has a uniform cross-sectional area of $7.8 \times 10^{-7} \text{ m}^2$.

The resistivity of the metal is $1.7 \times 10^{-8} \Omega \text{ m}$.

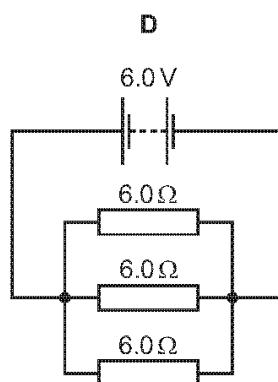
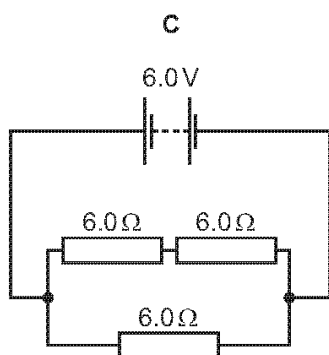
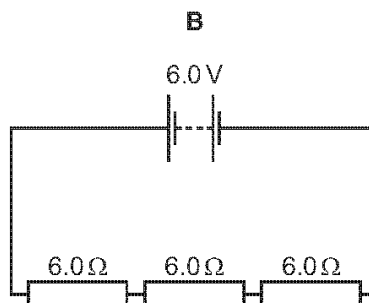
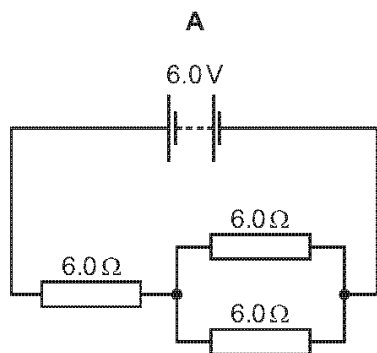
What is the resistance of the wire?

- A** 0.016Ω **B** 0.031Ω **C** 33Ω **D** 64Ω

31 - (9702/13_Summer_2018_Q34) - *Current Of Electricity, D.c. Circuits*

A battery of electromotive force (e.m.f.) 6.0 V and negligible internal resistance is connected to three resistors each of resistance $6.0\ \Omega$.

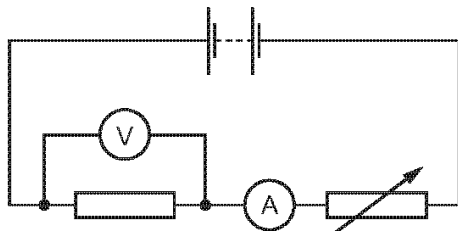
Which circuit will produce a current through the battery of 0.67 A ?



32 - (9702/13_Summer_2018_Q36) - *Current Of Electricity, D.c. Circuits*

The diagram shows a battery, a fixed resistor, an ammeter and a variable resistor connected in series.

A voltmeter is connected across the fixed resistor.



The resistance of the variable resistor is reduced.

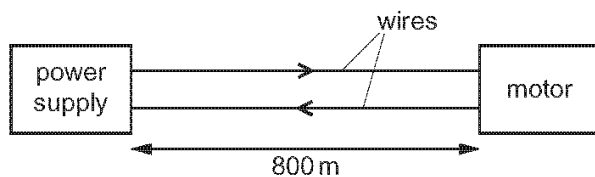
Which row describes the changes in the readings of the ammeter and of the voltmeter?

	ammeter	voltmeter
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

33 - (9702/11_Summer_2018_Q37) - *Current Of Electricity, D.c. Circuits*

A motor is required to operate at a distance of 800 m from its power supply. The motor requires a potential difference (p.d.) of 16.0 V and a current of 0.60 A to operate.

Two wires are used to supply power to the motor as shown.



The resistance of each of these wires is 0.0050Ω per metre.

What is the minimum output p.d. of the power supply?

- A 11.2 V B 16.0 V C 18.4 V D 20.8 V

34 - (9702/13_Winter_2018_Q32) - *Current Of Electricity*

The current I in a copper wire can be calculated using the equation shown.

$$I = Anvq$$

What does the symbol v represent?

- A the average drift velocity of the charge carriers
- B the instantaneous velocity of the charge carriers
- C the voltage applied across the wire
- D the volume of the wire

35 - (9702/11_Winter_2018_Q33) - *Current Of Electricity*

When there is a current of 5.0 A in a copper wire, the average drift velocity of the free electrons is $8.0 \times 10^{-4} \text{ m s}^{-1}$.

What is the average drift velocity in a different copper wire that has twice the diameter and a current of 10.0 A ?

- A $4.0 \times 10^{-4} \text{ m s}^{-1}$
- B $8.0 \times 10^{-4} \text{ m s}^{-1}$
- C $1.6 \times 10^{-3} \text{ m s}^{-1}$
- D $3.2 \times 10^{-3} \text{ m s}^{-1}$

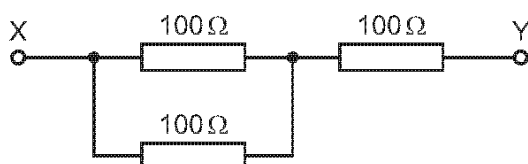
36 - (9702/12_Winter_2018_Q33) - *Current Of Electricity*

Which two units are used to define the coulomb?

- A ampere and second
- B ampere and volt
- C volt and ohm
- D volt and second

37 - (9702/13_Winter_2018_Q33) - *Current Of Electricity, D.c. Circuits*

Three resistors are to be connected into a circuit with the arrangement shown.



The power in any resistor must not be greater than 4.0 W .

What is the maximum voltage across XY?

- A 24 V
- B 30 V
- C 40 V
- D 60 V

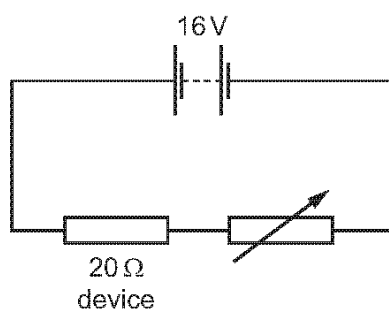
38 - (9702/11_Winter_2018_Q34) - *Current Of Electricity*

What is equivalent to one volt?

- A one coulomb per second
- B one joule per coulomb
- C one joule per second
- D one joule second per coulomb squared

39 - (9702/12_Winter_2018_Q34) - *Current Of Electricity, D.c. Circuits*

An electrical device of fixed resistance 20Ω is connected in series with a variable resistor and a battery of electromotive force (e.m.f.) 16V and negligible internal resistance.



What is the resistance of the variable resistor when the power dissipated in the electrical device is 4.0W ?

- A 16Ω
- B 36Ω
- C 44Ω
- D 60Ω

40 - (9702/13_Winter_2018_Q34) - *Current Of Electricity*

Gold is sometimes used to make very small connecting wires in electronic circuits.

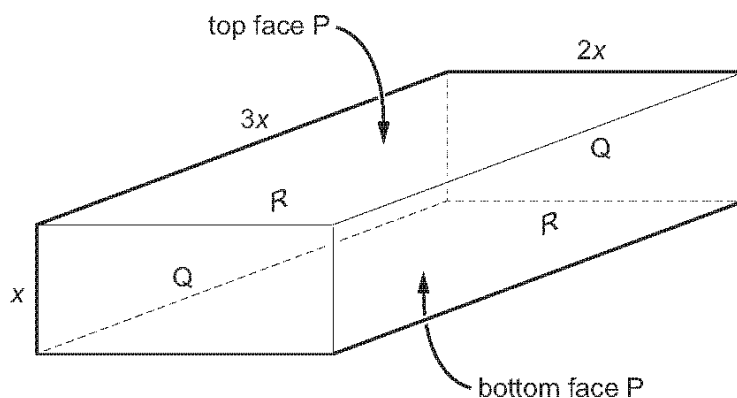
A particular gold wire has length $2.50 \times 10^{-3}\text{m}$ and cross-sectional area $6.25 \times 10^{-8}\text{m}^2$. Gold has resistivity $2.30 \times 10^{-8}\Omega\text{m}$.

What is the resistance of the wire?

- A $3.6 \times 10^{-18}\Omega$
- B $5.8 \times 10^{-13}\Omega$
- C $9.2 \times 10^{-4}\Omega$
- D $6.8 \times 10^{-3}\Omega$

41 - (9702/11_Winter_2018_Q35) - *Current Of Electricity*

The diagram shows a rectangular block with dimensions x , $2x$ and $3x$.



Electrical contact can be made to the block between opposite pairs of faces (for example, between the faces labelled R).

Which statement describing the electrical resistance of the block is correct?

- A It is maximum between the faces labelled P.
- B It is maximum between the faces labelled Q.
- C It is maximum between the faces labelled R.
- D It is the same, whichever pair of faces is used.

42 - (9702/12_Winter_2018_Q35) - *Current Of Electricity*

A wire of length L has resistance R . The cross-section of the wire is circular with radius r .

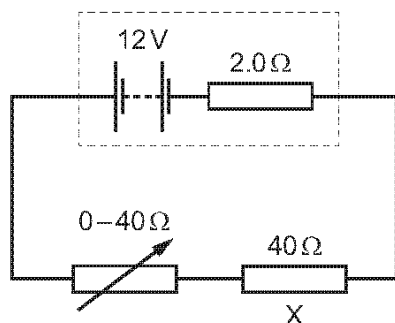
A second wire, also of circular cross-section, and of the same material, has resistance $\frac{1}{2}R$.

What could be the radius and the length of the second wire?

	radius	length
A	$\frac{r}{2}$	$\frac{L}{2}$
B	$\frac{r}{\sqrt{2}}$	$\frac{L}{2}$
C	$r\sqrt{2}$	$2L$
D	$2r$	$2L$

43 - (9702/13_Winter_2018_Q35) - Current Of Electricity, D.c. Circuits

A resistor X of resistance $40\ \Omega$ and a variable resistor are connected to a battery of electromotive force (e.m.f.) 12 V and internal resistance $2.0\ \Omega$, as shown.



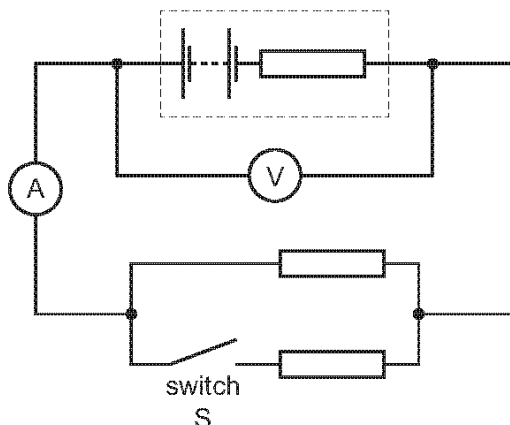
The resistance of the variable resistor is changed from 0 to $40\ \Omega$.

What is the change in power dissipated in resistor X?

- A 2.4W B 2.7W C 3.6W D 5.6W

44 - (9702/11_Winter_2018_Q36) - Current Of Electricity, D.c. Circuits

A battery, with internal resistance, is connected to a parallel arrangement of two resistors and a switch S, as shown.



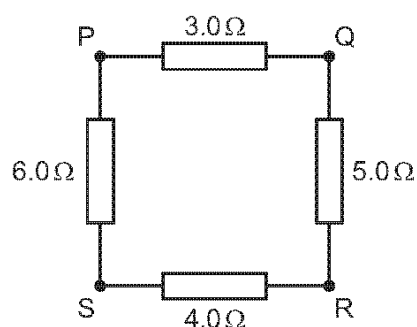
Initially switch S is open.

What happens to the voltmeter and ammeter readings when switch S is closed?

	voltmeter reading	ammeter reading
A	decreases	increases
B	decreases	decreases
C	increases	increases
D	increases	decreases

45 - (9702/12_Winter_2018_Q36) - *Current Of Electricity, D.c. Circuits*

A battery of negligible internal resistance may be connected between any two points P, Q, R and S of the network of resistors shown.

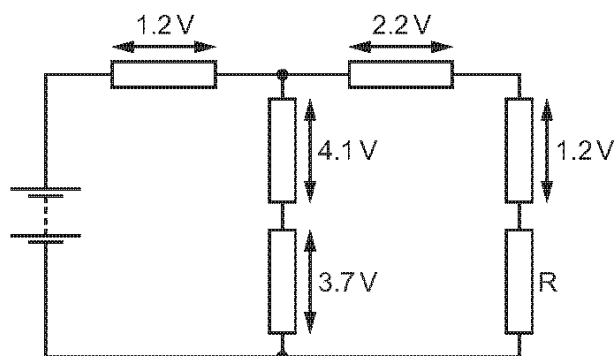


Which connections will give the largest current and the smallest current in the battery?

	largest current	smallest current
A	PQ	PR
B	PQ	QS
C	RS	PR
D	RS	QS

46 - (9702/11_Winter_2018_Q37) - *Current Of Electricity, D.c. Circuits*

A battery is connected to a network of six resistors, as shown.



The potential differences across five of the resistors are labelled on the diagram.

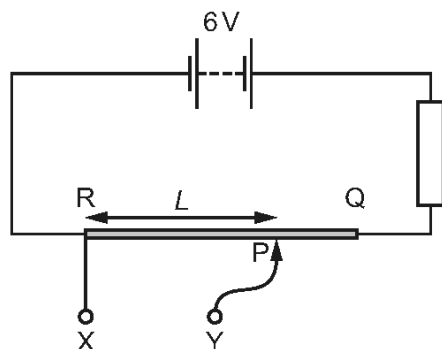
What is the potential difference across resistor R?

- A 4.4V B 4.6V C 6.6V D 11.2V

47 - (9702/11_Winter_2018_Q38) - *Current Of Electricity*

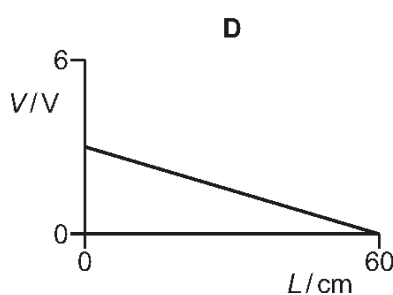
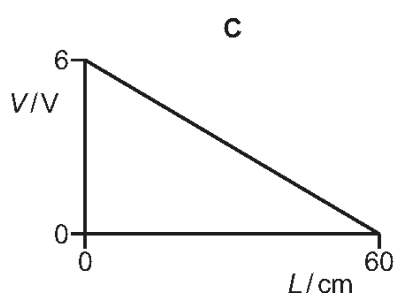
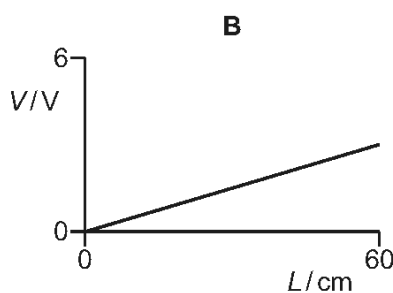
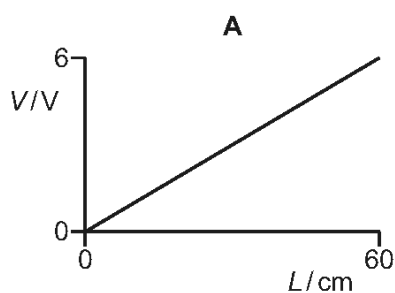
The diagram shows a battery of electromotive force (e.m.f.) 6 V , connected in series with a resistor and a uniform resistance wire RQ of length 60 cm .

The resistance of RQ is equal to the resistance of the resistor.



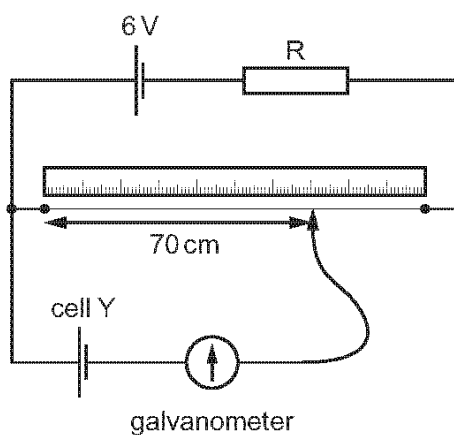
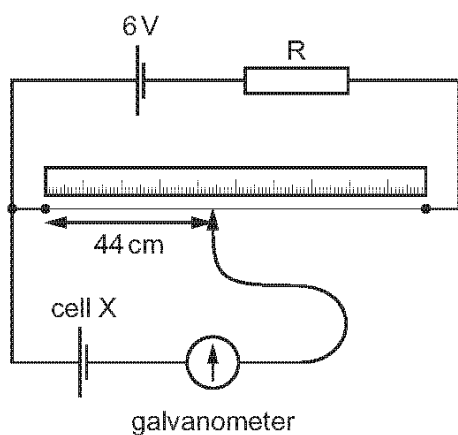
Terminal X is connected to fixed point R. Terminal Y is connected to point P, a connection that may be made at any position along the wire. L is the distance between R and P.

Which graph shows the variation with L of the potential difference (p.d.) V across XY?



48 - (9702/12_Winter_2018_Q38) - *Current Of Electricity, D.c. Circuits*

Two cells are investigated using a potentiometer. At the balance point, cell X gives a reading of 44 cm and cell Y gives a reading of 70 cm.



Which statement is **not** correct?

- A A potentiometer balance point results in zero current through the galvanometer.
- B At the balance point, the current through resistor R in both circuits is the same.
- C The electromotive force (e.m.f.) of cell X is larger than that of cell Y.
- D The value of the e.m.f. of each of the cells X and Y is less than 6 V.

49 - (9702/11_Summer_2019_Q32) - *Current Of Electricity*

In an electrolyte, the electric current is carried by charged particles (ions) in solution.

What is **not** a possible value for the charge on an ion in solution?

- A $-4.8 \times 10^{-19} \text{ C}$
- B $+1.6 \times 10^{-19} \text{ C}$
- C $+3.2 \times 10^{-19} \text{ C}$
- D $+4.0 \times 10^{-19} \text{ C}$

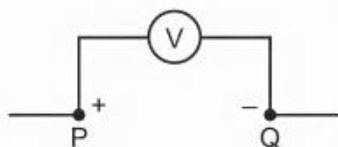
50 - (9702/13_Summer_2019_Q32) - *Current Of Electricity*

Which two units are used to define the volt?

- A ampere and ohm
- B coulomb and joule
- C coulomb and ohm
- D coulomb and second

51 - (9702/11_Summer_2019_Q33) - *Current Of Electricity*

A voltmeter connected between two points P and Q in an electrical circuit shows a reading of 1 V.

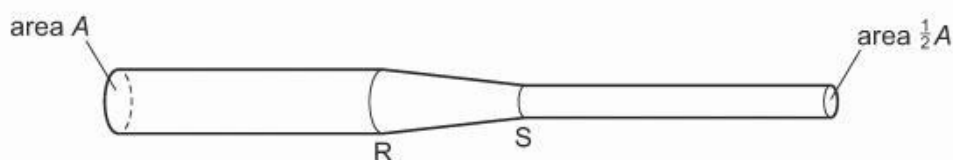


Which statement is correct?

- A The energy needed to move +1 C of charge from P to Q is 1 J.
- B The energy needed to move +1 C of charge from Q to P is 1 J.
- C The energy needed to move one electron from P to Q is 1 J.
- D The energy needed to move one electron from Q to P is 1 J.

52 - (9702/12_Summer_2019_Q33) - *Current Of Electricity*

A length of wire is connected into a circuit.



The area of the cross-section of the wire changes from A at R to $\frac{1}{2}A$ at S.

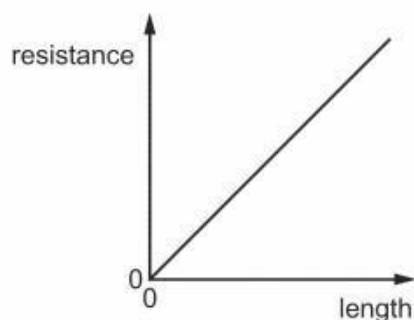
There is a constant current in the wire. Charge Q passes R in time t .

What is the charge passing point S in the same time t ?

- A $\frac{1}{2}Q$
- B Q
- C $Q\sqrt{2}$
- D $2Q$

53 - (9702/13_Summer_2019_Q33) - *Current Of Electricity*

The graph shows the variation with length of the resistance of a uniform metal wire.



The gradient of the graph is G .
The wire has cross-sectional area A .

Which expression could be used to calculate the resistivity of the metal of the wire?

A $G \times A$

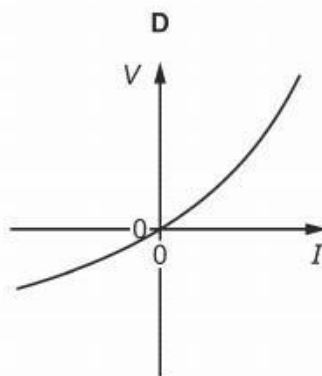
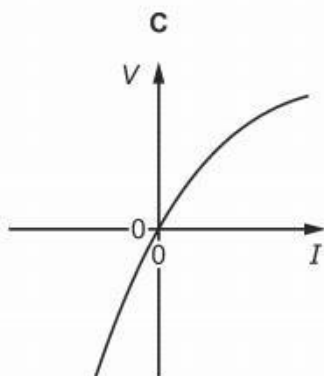
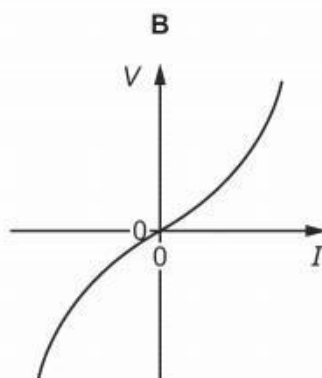
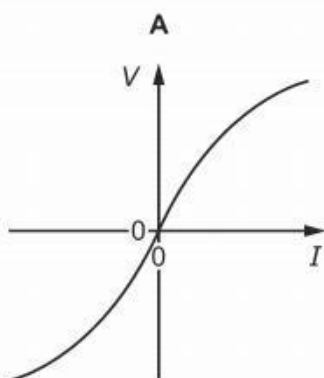
B $\frac{G}{A}$

C $\frac{A}{G}$

D $G \times A^2$

54 - (9702/11_Summer_2019_Q34) - *Current Of Electricity*

Which graph best represents the variation with current I of potential difference V for a filament lamp?



55 - (9702/12_Summer_2019_Q34) - *Current Of Electricity*

Four wires are made of the same metal. The cross-sectional areas, lengths and thermodynamic temperatures of the wires are shown.

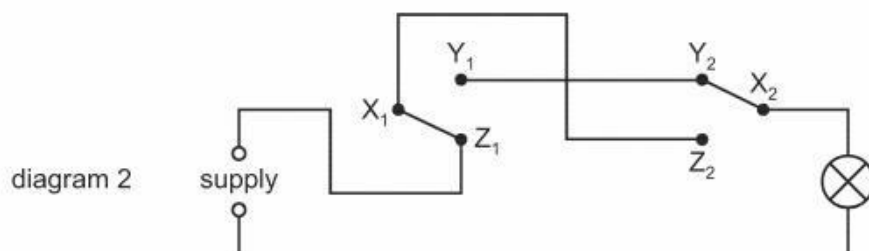
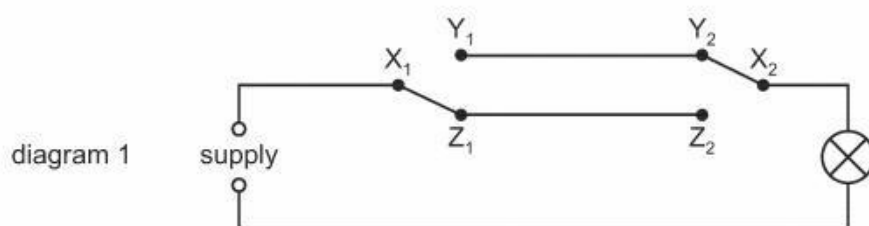
Which wire has the largest resistance?

	cross-sectional area	length	temperature
A	A	$2L$	$2T$
B	A	L	T
C	$2A$	$2L$	$2T$
D	$2A$	L	T

56 - (9702/13_Summer_2019_Q34) - *Current Of Electricity*

Diagram 1 shows a lamp connected to a supply through two switches.

During repairs, an electrician mistakenly reverses the connections X_1 and Z_1 , so that Z_1 is connected to the supply and X_1 to the other switch at Z_2 , as shown in diagram 2.



Which switch positions will now light the lamp?

A	X_1 to Y_1	X_2 to Y_2
B	X_1 to Y_1	X_2 to Z_2
C	X_1 to Z_1	X_2 to Y_2
D	X_1 to Z_1	X_2 to Z_2

57 - (9702/11_Summer_2019_Q35) - *Current Of Electricity, D.c. Circuits*

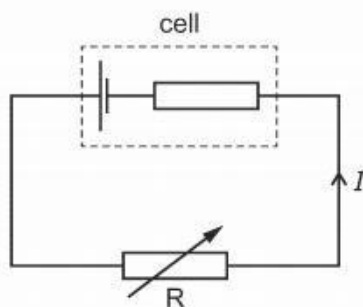
When a battery is connected to a resistor, the battery gradually becomes warm. This causes the internal resistance of the battery to increase whilst its electromotive force (e.m.f.) stays unchanged.

As the internal resistance of the battery increases, how do the terminal potential difference and the output power change, if at all?

	terminal potential difference	output power
A	decreases	decreases
B	decreases	unchanged
C	unchanged	decreases
D	unchanged	unchanged

58 - (9702/12_Summer_2019_Q35) - *Current Of Electricity, D.c. Circuits*

A cell with internal resistance is connected to a variable resistor R as shown.



The resistance of R is gradually decreased.

How do the current I and the terminal potential difference across the cell change?

	current I	terminal potential difference across cell
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

59 - (9702/13_Summer_2019_Q35) - *Current Of Electricity*

A wire supplying a shower heater with a current of 35 A has a resistance of $25\text{ m}\Omega$.

What is the power dissipated in the wire?

- A** 31 W **B** 49 W **C** 31 kW **D** 49 kW

60 - (9702/11_Summer_2019_Q36) - *Current Of Electricity, D.c. Circuits*

A cell is connected to a resistor of resistance $3.00\ \Omega$. The current in the resistor is 1.00 A .

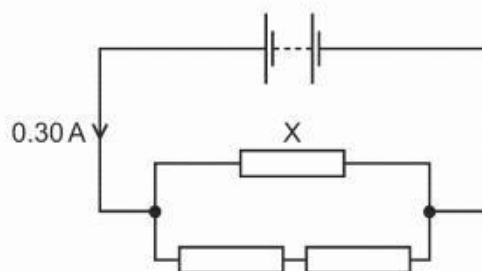
A second identical resistor is added in parallel. The current becomes 1.93 A .

What are the e.m.f. E and internal resistance r of the cell?

	E/V	r/Ω
A	0.113	3.11
B	3.04	0.0358
C	3.11	0.113
D	9.34	6.34

61 - (9702/11_Summer_2019_Q37) - *Current Of Electricity, D.c. Circuits*

A battery with negligible internal resistance is connected to three resistors, as shown.



All three resistors have the same resistance.

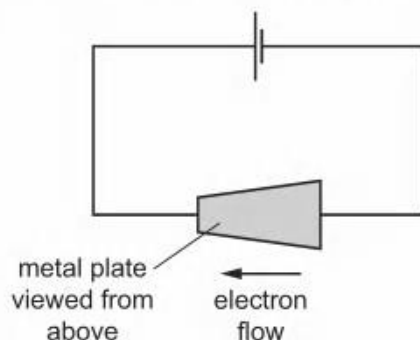
The current in the battery is 0.30 A .

What is the current in resistor X?

- A 0.10 A B 0.15 A C 0.20 A D 0.30 A

62 - (9702/11_Winter_2019_Q30) - *Current Of Electricity*

A metal plate of uniform thickness is connected to a cell as shown.



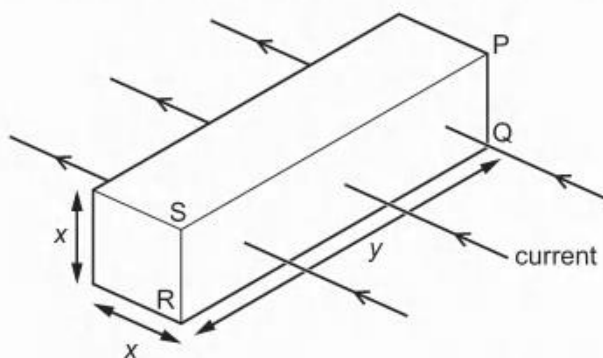
Electrons move clockwise around the circuit.

Which statement about the metal plate is correct?

- A The average drift speed of the conduction electrons decreases as they move from right to left through the plate.
- B The average drift speed of the conduction electrons increases as they move from right to left through the plate.
- C The number density of the conduction electrons decreases from right to left through the plate.
- D The number density of the conduction electrons increases from right to left through the plate.

63 - (9702/11_Winter_2019_Q31) - *Current Of Electricity*

The diagram shows the direction of the current in a metal block. The charge carriers enter the block through the face PQRS and leave the block through the opposite face.



The number density of charge carriers is n . Each charge carrier has charge e . The average drift speed of the charge carriers is v .

Which expression gives the current in the block?

- A $envx^2$
- B $envxy$
- C $envx^3y^2$
- D $envx^4y$

64 - (9702/12_Winter_2019_Q31) - Current Of Electricity

When the current in a wire is 5.0 A, the average drift speed of the conduction electrons in the wire is $7.4 \times 10^{-4} \text{ m s}^{-1}$.

Which row gives a possible cross-sectional area and number of conduction electrons per unit volume for this wire?

	cross-sectional area / m^2	number of conduction electrons per unit volume / m^{-3}
A	7.2×10^{-7}	1.2×10^{28}
B	7.2×10^{-7}	5.9×10^{28}
C	2.3×10^{-6}	7.3×10^{26}
D	2.3×10^{-6}	3.7×10^{27}

65 - (9702/11_Winter_2019_Q32) - Current Of Electricity

What could **not** be used as a unit of potential difference?

- A $\text{A } \Omega$ B $\text{N m}^{-1} \text{C}^{-1}$ C W A^{-1} D $(\Omega \text{ W})^{\frac{1}{2}}$

66 - (9702/12_Winter_2019_Q32) - Current Of Electricity

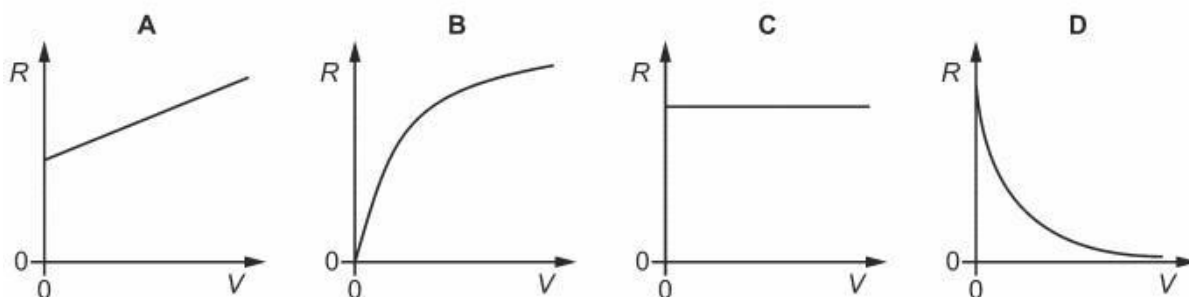
A fixed resistor of resistance 12Ω is connected to a battery. There is a current of 0.20 A in the resistor. The current is now doubled.

What is the new power dissipated in the resistor?

- A 0.48 W B 0.96 W C 1.9 W D 4.8 W

67 - (9702/11_Winter_2019_Q33) - Current Of Electricity

Which graph could show how the resistance R of a filament lamp varies with the applied potential difference (p.d.) V , as V is increased to the normal operating p.d.?



68 - (9702/12_Winter_2019_Q33) - *Current Of Electricity*

There is a current in a resistor for an unknown time.

Which two quantities can be used to calculate the energy dissipated by the resistor?

- A the current in the resistor and the potential difference across the resistor
- B the resistance of the resistor and the current in the resistor
- C the total charge passing through the resistor and the potential difference across the resistor
- D the total charge passing through the resistor and the resistance of the resistor

69 - (9702/13_Winter_2019_Q33) - *Current Of Electricity*

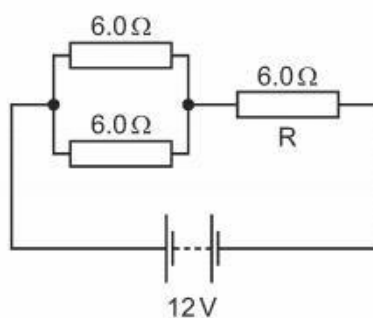
A metal electrical conductor has a resistance of $5.6\text{ k}\Omega$. A potential difference (p.d.) of 9.0 V is applied across its ends.

How many electrons pass a point in the conductor in one minute?

- A 6.0×10^{20} B 1.0×10^{19} C 6.0×10^{17} D 1.0×10^{16}

70 - (9702/13_Winter_2019_Q34) - *Current Of Electricity*

A battery of electromotive force (e.m.f.) 12 V and negligible internal resistance is connected to three resistors, each of resistance $6.0\ \Omega$, as shown.

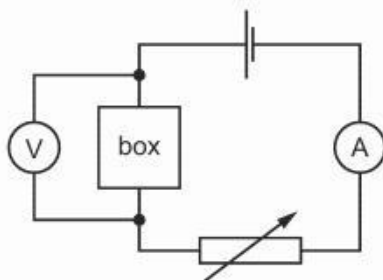


What is the power dissipated in resistor R ?

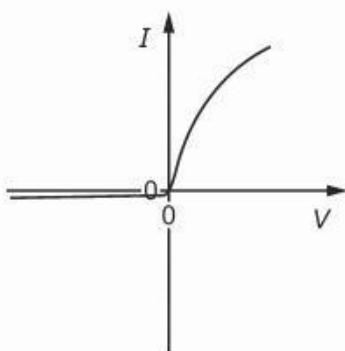
- A 2.7 W B 6.0 W C 11 W D 24 W

71 - (9702/13_Winter_2019_Q35) - *Current Of Electricity*

A box containing two electrical components is connected into a circuit.



The variable resistor is adjusted and measurements are taken to determine the I – V characteristic for the box, as shown.



Which arrangement of two electrical components in the box would create the best fit to the measured I – V characteristic?

- A a filament lamp and a fixed resistor in parallel
- B a filament lamp and a fixed resistor in series
- C a semiconductor diode and a filament lamp in parallel
- D a semiconductor diode and a filament lamp in series

72 - (9702/13_Winter_2019_Q36) - *Current Of Electricity*

A cell of internal resistance $0.5\,\Omega$ is connected to a fixed resistor of resistance $10\,\Omega$.

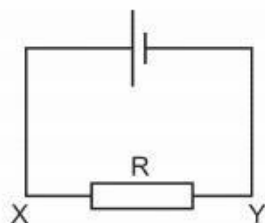
The resistance of the resistor is changed to $20\,\Omega$.

Which statement is **not** correct?

- A The current in the circuit will halve.
- B The e.m.f. of the cell will remain constant.
- C The power dissipated by the fixed resistor will decrease.
- D The terminal p.d. of the cell will increase.

73 - (9702/11_Summer_2020_Q33) - *Current Of Electricity*

The current in the circuit shown is 3.2 mA.



What are the direction of flow and the rate of flow of electrons through the resistor R?

	direction of flow	rate of flow / s^{-1}
A	X to Y	2.0×10^{16}
B	X to Y	5.1×10^{-22}
C	Y to X	2.0×10^{16}
D	Y to X	5.1×10^{-22}

74 - (9702/12_Summer_2020_Q33) - *Current Of Electricity*

The number density of free electrons in copper is $8.0 \times 10^{28} \text{ m}^{-3}$.

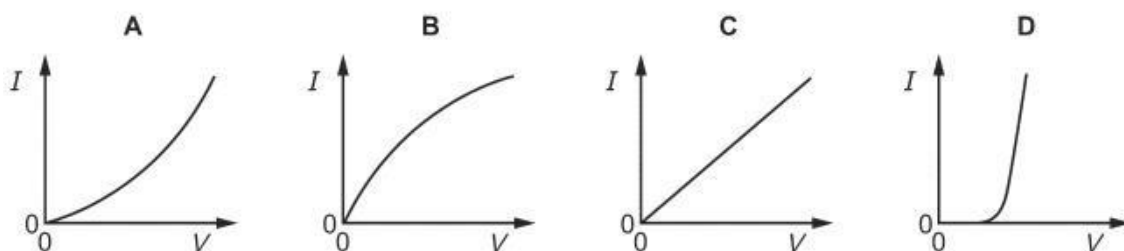
A copper wire has diameter 0.42 mm.

What is the average drift speed of the free electrons in the wire when the current in the wire is 0.57 A?

- A** $8.0 \times 10^{-11} \text{ ms}^{-1}$
- B** $3.2 \times 10^{-10} \text{ ms}^{-1}$
- C** $8.0 \times 10^{-5} \text{ ms}^{-1}$
- D** $3.2 \times 10^{-4} \text{ ms}^{-1}$

75 - (9702/11_Summer_2020_Q34) - *Current Of Electricity*

Which graph best represents the way the current I through a filament lamp varies with the potential difference V across it?



76 - (9702/12_Summer_2020_Q34) - *Current Of Electricity*

An electric kettle is rated at 2.0 kW, which describes the power supplied to the heating coil in the kettle.

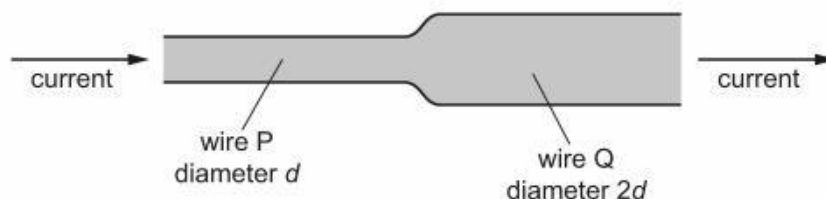
The coil has a resistance of 5.0 k Ω .

What is the current in the coil?

- A 0.40 A B 0.63 A C 1.6 A D 2.5 A

77 - (9702/13_Summer_2020_Q34) - *Current Of Electricity*

Two copper wires are joined together and carry a current, as shown.



Wire P has diameter d and wire Q has diameter $2d$.

What is the ratio $\frac{\text{average drift speed of the free electrons in wire P}}{\text{average drift speed of the free electrons in wire Q}}$?

- A $\frac{1}{4}$ B $\frac{1}{2}$ C 2 D 4

78 - (9702/11_Summer_2020_Q35) - *Current Of Electricity*

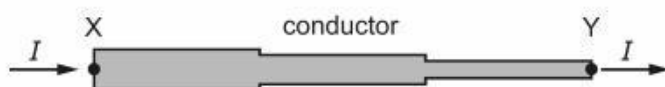
A cylindrical metal wire X has resistance R . The same volume of the same metal is made into a cylindrical wire Y of double the length.

What is the resistance of wire Y?

- A R B $2R$ C $4R$ D $8R$

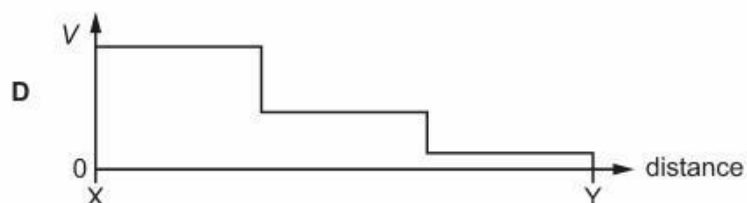
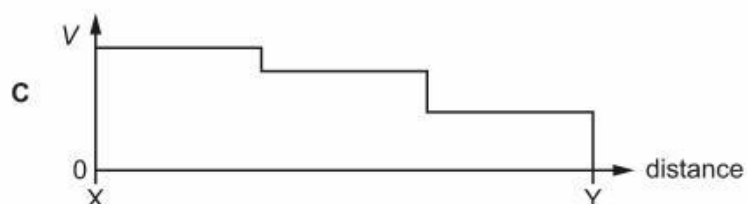
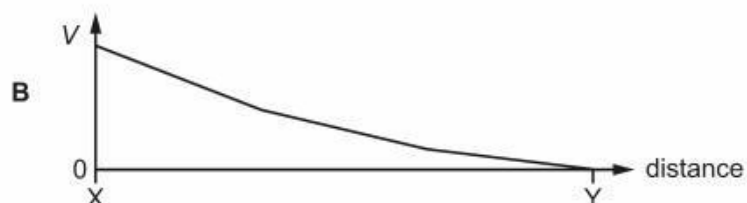
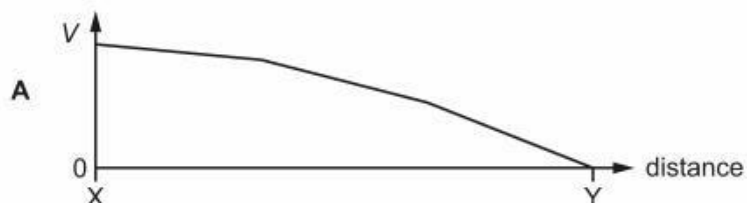
79 - (9702/12_Summer_2020_Q35) - *Current Of Electricity*

A conductor consists of three wires connected in series. The wires are all made of the same metal but have different cross-sectional areas. There is a current I in the conductor.



Point Y on the conductor is at zero potential.

Which graph best shows the variation of potential V with distance along the conductor?



80 - (9702/13_Summer_2020_Q36) - *Current Of Electricity*

The wire of a heating element has resistance R . The wire breaks and is replaced by a different wire.

Data for the original wire and for the replacement wire are shown in the table.

	length	diameter	resistivity of metal
original wire	l	d	ρ
replacement wire	l	$2d$	2ρ

What is the resistance of the replacement wire?

- A $\frac{R}{4}$ B $\frac{R}{2}$ C R D $2R$

81 - (9702/11_Summer_2020_Q37) - *Current Of Electricity*

Three identical resistors can be connected together in four different ways.

The resistances of two of these combinations are $4.0\ \Omega$ and $9.0\ \Omega$.

What is the resistance of each individual resistor?

- A $3.0\ \Omega$ B $6.0\ \Omega$ C $12\ \Omega$ D $18\ \Omega$

82 - (9702/11_Winter_2020_Q32) - *Current Of Electricity*

Free electrons flow along a copper wire X of radius $5.0 \times 10^{-5}\text{ m}$ with an average drift speed of $2.8 \times 10^{-2}\text{ m s}^{-1}$. The current in the wire is 3.0 A .

There is a current of 2.0 A in a copper wire Y of radius $1.0 \times 10^{-4}\text{ m}$.

What is the average drift speed of the free electrons in copper wire Y?

- A $4.7 \times 10^{-3}\text{ m s}^{-1}$
 B $9.3 \times 10^{-3}\text{ m s}^{-1}$
 C $1.1 \times 10^{-2}\text{ m s}^{-1}$
 D $1.9 \times 10^{-2}\text{ m s}^{-1}$

83 - (9702/11_Winter_2020_Q33) - *Current Of Electricity*

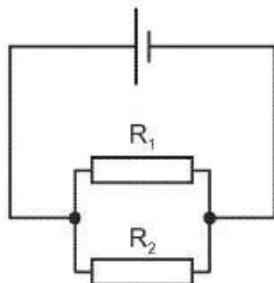
What is the definition of potential difference?

- A power per unit current
 B product of current and resistance
 C product of electric field strength and distance
 D work done per unit charge

84 - (9702/13_Winter_2020_Q33) - *Current Of Electricity*

Two resistors R_1 and R_2 are made from wire of the same material.

They are connected in parallel to each other in a circuit, as shown.



The diameter of R_2 is half the diameter of R_1 .

The resistance of R_2 is three times the resistance of R_1 .

What is the value of the ratio $\frac{\text{average drift speed of free electrons in } R_1}{\text{average drift speed of free electrons in } R_2}$?

A $\frac{3}{2}$

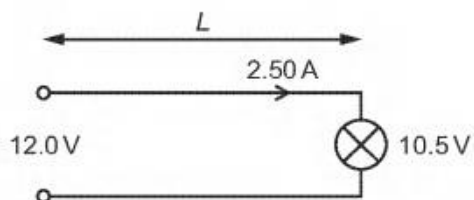
B $\frac{3}{4}$

C $\frac{1}{6}$

D $\frac{1}{12}$

85 - (9702/11_Winter_2020_Q34) - *Current Of Electricity*

A cable of length L consisting of two wires is used to connect a 12.0 V power supply of negligible internal resistance to a lamp, as shown.



The potential difference across the lamp is 10.5 V. The current in the wire is 2.50 A.

Each wire is made of metal of resistivity $1.70 \times 10^{-8} \Omega \text{ m}$ and has a cross-sectional area of $6.00 \times 10^{-7} \text{ m}^2$.

What is the length L of the cable?

A 10.6 m

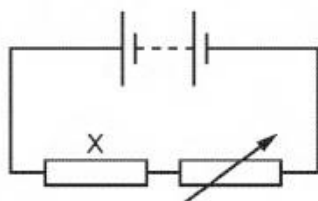
B 21.2 m

C 29.4 m

D 58.8 m

86 - (9702/12_Winter_2020_Q34) - Current Of Electricity

In the circuit shown, a fixed resistor X is connected in series with a battery and a variable resistor.



The power dissipated in resistor X is 7.2 W when a current of 3.0 A passes through it.

The variable resistor is adjusted so that the power dissipated in X increases by 50%.

What is the new current in the circuit?

- A 2.4 A B 3.7 A C 4.5 A D 14 A

87 - (9702/13_Winter_2020_Q34) - Current Of Electricity

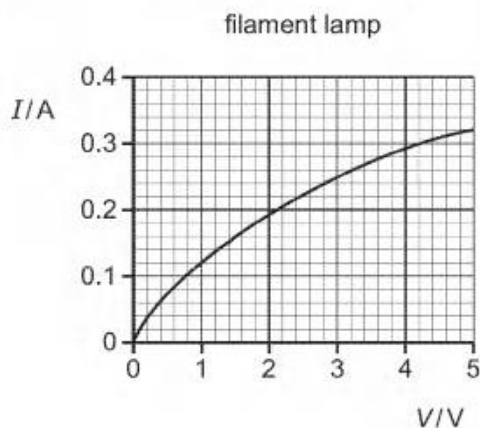
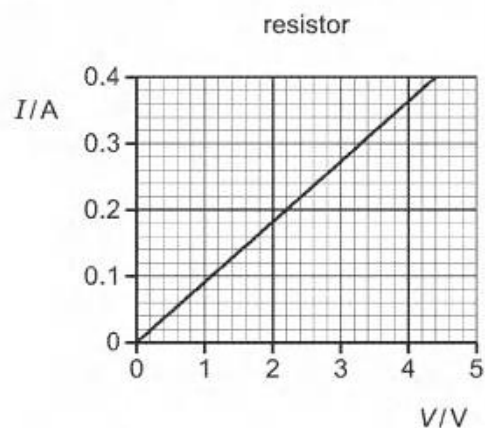
A student describes potential difference as the energy transferred per unit charge.

Which statement about the energy transfer is correct?

- A It is from electrical energy into other forms.
 B It is from other forms into electrical energy.
 C It only takes place inside a power supply.
 D It only takes place inside resistors.

88 - (9702/12_Winter_2020_Q35) - Current Of Electricity

A resistor and a filament lamp are connected in series with a power supply. The I - V characteristics of the resistor and of the lamp are shown below.



The potential difference (p.d.) across the resistor is 3.3 V.

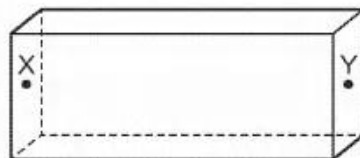
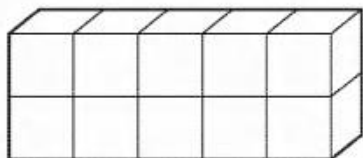
What is the resistance of the lamp?

- A 0.071Ω B 4.2Ω C 11Ω D 14Ω

89 - (9702/13_Winter_2020_Q35) - *Current Of Electricity*

A metal cube has a resistance of $4.0\ \Omega$ between opposite faces.

Ten of these cubes are put together to make a cuboid of $1 \times 2 \times 5$ cubes.



There is no extra resistance where the faces of the cubes touch each other.

What is the resistance of the cuboid when connected between faces X and Y?

- A $1.6\ \Omega$ B $2.0\ \Omega$ C $10\ \Omega$ D $40\ \Omega$

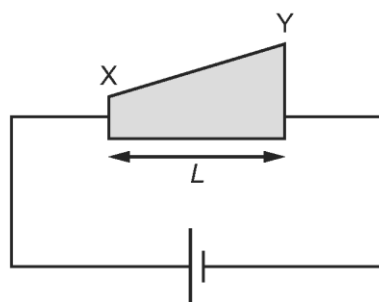
90 - (9702/11_Summer_2021_Q32) - *Current Of Electricity*

Which two units are used to define the coulomb?

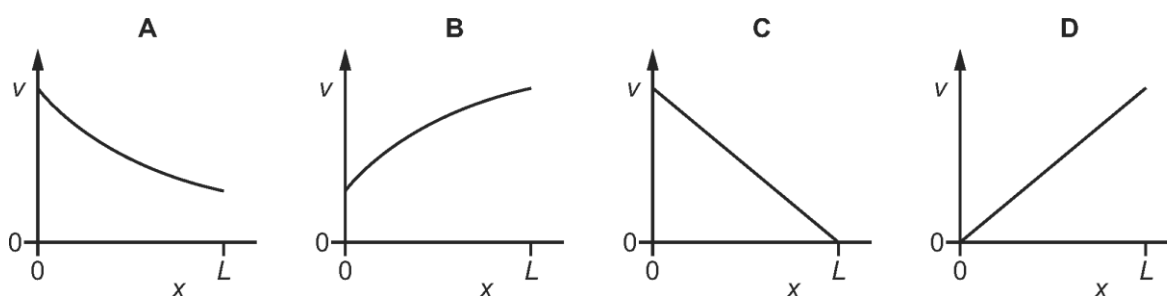
- A ampere and second
B ampere and volt
C volt and ohm
D volt and second

91 - (9702/12_Summer_2021_Q32) - *Current Of Electricity*

A wedge-shaped metal conductor of length L , varying width and uniform thickness is connected to a cell, as shown.

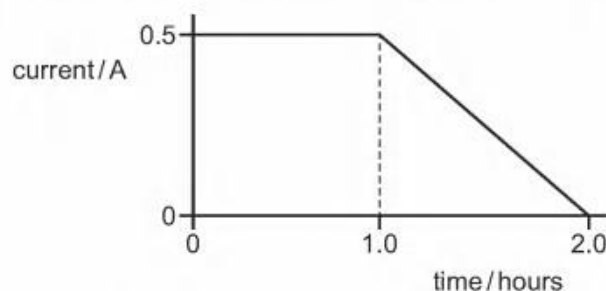


Which graph best shows how the average drift velocity v of electrons in the conductor varies with distance x from end X?



92 - (9702/11_Summer_2021_Q33) - Current Of Electricity

A mobile phone battery is charged by connecting it to a constant potential difference of 5.0 V. After a time of 1.0 hour, the initial current of 0.50 A slowly decreases to zero, as shown.

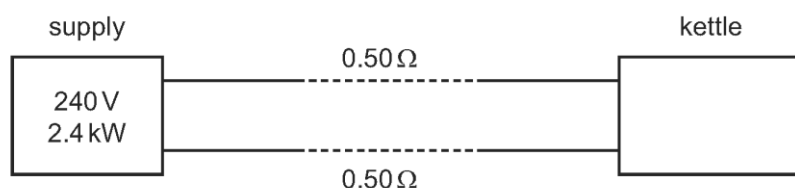


What is the best estimate of the energy transferred to the battery during the time of 2.0 hours shown in the graph?

- A 2700 J B 9000 J C 14 000 J D 18 000 J

93 - (9702/12_Summer_2021_Q33) - Current Of Electricity

The power output of an electrical supply is 2.4 kW at a potential difference (p.d.) of 240 V. The two wires between the supply and a kettle each have a resistance of 0.50Ω , as shown.



What is the power supplied to the kettle and what is the p.d. across the kettle?

	power / kW	p.d. / V
A	2.3	230
B	2.3	235
C	2.4	230
D	2.4	235

94 - (9702/13_Summer_2021_Q33) - Current Of Electricity

A wire has a length of 12 cm and contains a total of 5.1×10^{22} free electrons.

When a potential difference is applied across the ends of the wire, the free electrons move with an average drift speed of $4.0 \times 10^{-6} \text{ m s}^{-1}$.

What is the current in the wire?

- A 0.0027 A B 0.0039 A C 0.27 A D 0.39 A

95 - (9702/11_Summer_2021_Q34) - *Current Of Electricity*

A length of wire is connected into an electric circuit. The current in the wire is measured.

Which change on its own could increase the current in the wire?

- A an increase in the length of the wire
- B an increase in the radius of the wire
- C an increase in the resistance of the wire
- D an increase in the resistivity of the wire

96 - (9702/13_Summer_2021_Q34) - *Current Of Electricity*

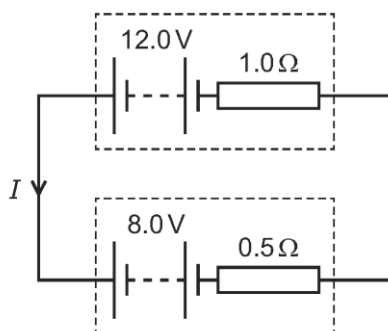
A battery is marked 9.0 V.

What does this mean?

- A Each coulomb of charge from the battery supplies 9.0 J of electrical energy to the whole circuit.
- B The battery supplies 9.0 J of electrical energy to an external circuit for each coulomb of charge.
- C The potential difference across any component connected to the battery will be 9.0 V.
- D There will always be a potential difference of 9.0 V across the battery terminals.

97 - (9702/13_Summer_2021_Q35) - *Current Of Electricity*

The diagram shows a circuit containing two batteries connected together.



What is the current I ?

- A 2.7 A
- B 4.0 A
- C 8.0 A
- D 13 A

98 - (9702/11_Winter_2021_Q32) - *Current Of Electricity*

The current I in a wire is given by the equation

$$I = nAvq$$

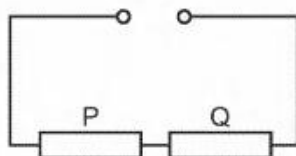
where n is the number density of the free electrons, A is the cross-sectional area of the wire, v is the average drift velocity of the free electrons and q is the charge of an electron.

Which relationship is **not** used in the derivation of this equation?

- A charge = current $\times$ time
- B distance = speed $\times$ time
- C number = number density $\times$ area
- D volume = length $\times$ area

99 - (9702/11_Winter_2021_Q33) - *Current Of Electricity*

A circuit contains two resistors, P and Q, and a power supply of negligible internal resistance, as shown.



The current in resistor P is 2.0 A and the power dissipated by resistor P is 18 W.

Resistor Q dissipates 240 J of energy when a charge of 40 C passes through it.

What is the electromotive force (e.m.f.) of the power supply?

- A 3.0 V B 6.0 V C 9.0 V D 15 V

100 - (9702/13_Winter_2021_Q33) - *Current Of Electricity*

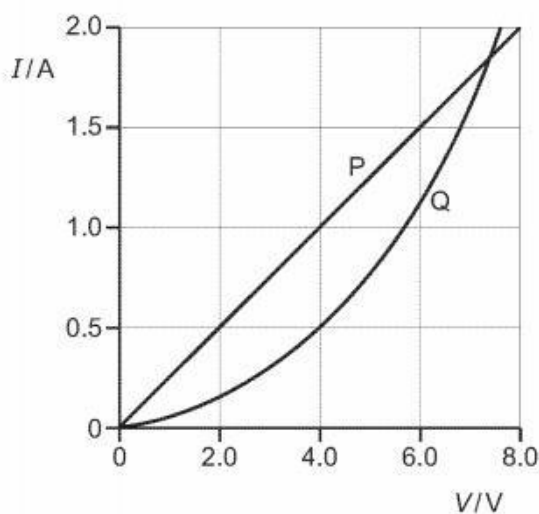
A lightning strike transfers 1×10^{20} electrons past a point in a time of 30 μs .

What is the average current during the lightning strike?

- A 0.5 mA B 0.5 A C 500 A D 500 kA

101 - (9702/11_Winter_2021_Q34) - *Current Of Electricity*

The I - V characteristics of two electrical components P and Q are shown.

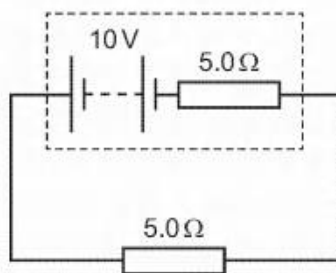


Which statement is correct?

- A For a current of 0.5 A, the power dissipated in Q is double that in P.
- B For a current of 1.9 A, the resistance of Q is approximately half that of P.
- C The resistance of Q increases as the current in it increases.
- D P is a fixed resistor and Q is a filament lamp.

102 - (9702/12_Winter_2021_Q34) - *Current Of Electricity*

A battery of electromotive force (e.m.f.) 10 V and internal resistance $5.0\ \Omega$ is connected to a $5.0\ \Omega$ load resistor.

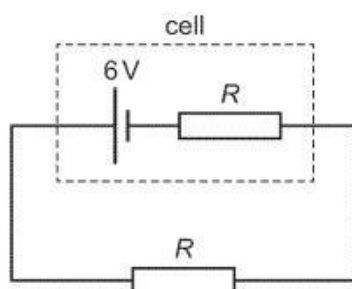


Which change occurs when the $5.0\ \Omega$ load resistor is replaced with a $50\ \Omega$ load resistor?

- A The current in the circuit increases.
- B The potential difference across the load resistor increases.
- C The power dissipated in the internal resistance of the battery increases.
- D The total power dissipated in the circuit increases.

103 - (9702/13_Winter_2021_Q34) - *Current Of Electricity*

A cell has an electromotive force (e.m.f.) of 6 V and internal resistance R . An external resistor, also of resistance R , is connected across this cell, as shown.



Power P is dissipated by the external resistor.

The cell is replaced by a different cell that has an e.m.f. of 6 V and negligible internal resistance.

What is the new power that is dissipated in the external resistor?

- A $0.5P$ B P C $2P$ D $4P$

104 - (9702/11_Winter_2021_Q35) - *Current Of Electricity*

Two copper wires S and T, of equal length, are connected in parallel. Wire S has a diameter of 3.0 mm. Wire T has a diameter of 1.5 mm.

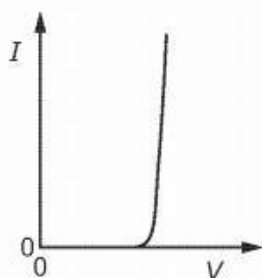
A potential difference is applied across the ends of this parallel arrangement.

What is the value of the ratio $\frac{\text{current in S}}{\text{current in T}}$?

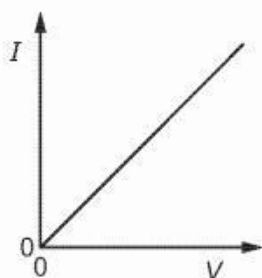
- A $\frac{1}{4}$ B $\frac{1}{2}$ C 2 D 4

105 - (9702/12_Winter_2021_Q35) - Current Of Electricity

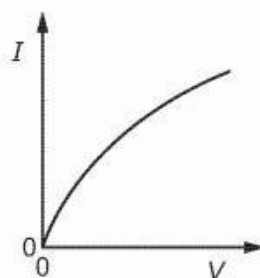
The graphs show the variation with potential difference V of the current I for three circuit components.



graph X



graph Y



graph Z

The components are a metal wire at constant temperature, a semiconductor diode and a filament lamp.

Which row correctly identifies these graphs?

	metal wire at constant temperature	semiconductor diode	filament lamp
A	X	Z	Y
B	Y	X	Z
C	Y	Z	X
D	Z	X	Y

106 - (9702/13_Winter_2021_Q35) - Current Of Electricity

A wire of uniform cross-section has resistance R .

A second wire is made of the same material but is twice as long and has twice the diameter of the first wire.

What is the resistance of the second wire?

- A $\frac{R}{8}$ B $\frac{R}{2}$ C R D $8R$

107 - (9702/12_Winter_2021_Q36) - *Current Of Electricity*

The electromotive force (e.m.f.) of a cell is 6.0 V. It has negligible internal resistance and is connected across a resistor. The potential difference (p.d.) across the resistor is also 6.0 V.

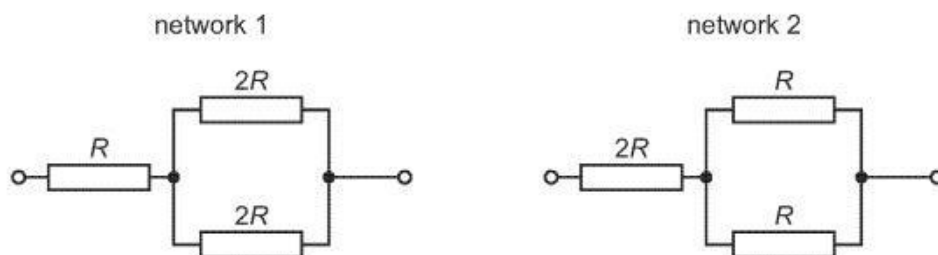
The e.m.f. and the p.d. have the same numerical value but represent different processes.

Which statement about the different processes is correct?

- A** The e.m.f. is the energy transferred from chemical energy to electrical energy in the cell and the p.d. is the energy transferred from electrical energy to thermal energy in the resistor.
- B** The p.d. is the energy transferred from chemical energy to electrical energy in the cell and the e.m.f. is the energy transferred from electrical energy to thermal energy in the resistor.
- C** The e.m.f. is the energy transferred per unit charge from chemical energy to electrical energy in the cell and the p.d. is the energy transferred per unit charge from electrical energy to thermal energy in the resistor.
- D** The p.d. is the energy transferred per unit charge from chemical energy to electrical energy in the cell and the e.m.f. is the energy transferred per unit charge from electrical energy to thermal energy in the resistor.

108 - (9702/13_Winter_2021_Q36) - *Current Of Electricity*

The diagram shows two resistor networks.

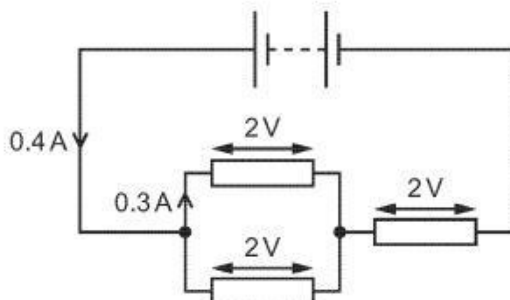


What is the ratio $\frac{\text{total resistance of network 1}}{\text{total resistance of network 2}}$?

- A** $\frac{4}{5}$
- B** $\frac{5}{4}$
- C** $\frac{1}{2}$
- D** $\frac{2}{1}$

109 - (9702/12_Winter_2021_Q37) - *Current Of Electricity*

A battery of negligible internal resistance is connected to three resistors, as shown.



The potential difference across each resistor is 2 V.

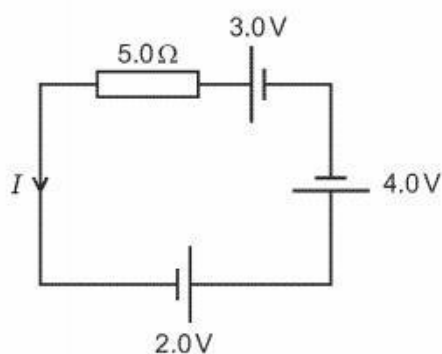
The current from the battery is 0.4 A and the current through one of the resistors connected in parallel is 0.3 A.

What is the current through the other resistor connected in parallel and what is the electromotive force (e.m.f.) of the battery?

	current / A	e.m.f. / V
A	0.1	4
B	0.3	4
C	0.1	6
D	0.3	6

110 - (9702/13_Winter_2021_Q37) - *Current Of Electricity*

The circuit shown contains three cells of electromotive forces 3.0 V, 2.0 V and 4.0 V, in series with a resistor of resistance $5.0\ \Omega$. The cells have negligible internal resistance.



What is the current I in the circuit?

- A 0.20 A B 0.60 A C 1.0 A D 1.8 A

111 - (9702/11_Summer_2022_Q31) - Current Of Electricity

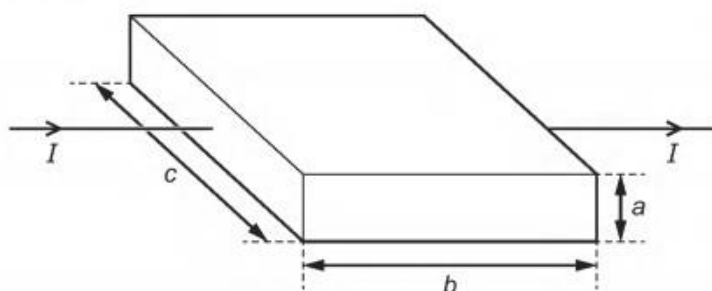
A straight copper wire of diameter $0.42 \times 10^{-3} \text{ m}$ has a number density of free electrons of $8.5 \times 10^{28} \text{ m}^{-3}$. In a given time interval, a charge of 0.15 C moves through the wire.

What is the average displacement of the free electrons along the wire in this time interval?

- A $3.3 \times 10^{-8} \text{ m}$ B $2.0 \times 10^{-5} \text{ m}$ C $8.0 \times 10^{-5} \text{ m}$ D $2.5 \times 10^{-4} \text{ m}$

112 - (9702/12_Summer_2022_Q31) - Current Of Electricity

The diagram shows a metal block.



The block has sides of length a , b and c as shown, and its volume is V . Each charge carrier has a charge $-q$ and the number density of the charge carriers in the metal is n . It takes each charge carrier an average time of t to pass through the block.

What is an expression for the current I ?

- A $I = nqabc$ B $I = \frac{nqV}{t}$ C $I = \frac{nqbc}{t}$ D $I = nqaV$

113 - (9702/11_Summer_2022_Q32) - Current Of Electricity

What is the definition of the potential difference (p.d.) across a component?

- A the electrical power supplied to the component
B the energy transferred to the component per unit charge
C the product of the current in the component and its resistance
D the voltage across the component

114 - (9702/13_Summer_2022_Q32) - Current Of Electricity

Two wires, X and Y, are made from the same metal.

The diameter of wire Y is twice that of wire X.

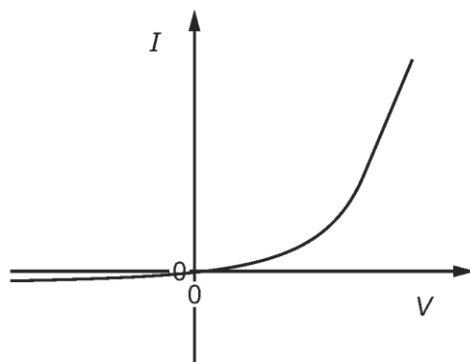
Wire X, wire Y and a battery are connected in series.

What is the ratio $\frac{\text{average drift speed of free electrons in wire X}}{\text{average drift speed of free electrons in wire Y}}$?

- A $\frac{1}{4}$ B $\frac{1}{2}$ C $\frac{2}{1}$ D $\frac{4}{1}$

115 - (9702/11_Summer_2022_Q33) - *Current Of Electricity*

The graph shows the I – V characteristic for a semiconductor diode.



Which statement can be deduced from the graph?

- A Above a certain positive potential difference the diode obeys Ohm's law.
- B Current is directly proportional to potential difference when the current in the diode is in one direction.
- C The diode has zero resistance when the current in the diode is in one direction.
- D The resistance of the diode depends upon the potential difference across it.

116 - (9702/12_Summer_2022_Q33) - *Current Of Electricity*

The intensity of light incident on a light-dependent resistor (LDR) is increased. The temperature of a thermistor is increased. In each case, the current in the component is maintained at a constant value.

What happens to the potential difference across each component?

	LDR	thermistor
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases

117 - (9702/13_Summer_2022_Q33) - *Current Of Electricity*

A resistor has resistance R . When the potential difference (p.d.) across the resistor is V , the current in the resistor is I . The power dissipated in the resistor is P . Work W is done when charge Q flows through the resistor.

What is **not** a valid relationship between these variables?

- A $I = \frac{P}{V}$
- B $Q = \frac{W}{V}$
- C $R = \frac{P}{I^2}$
- D $R = \frac{V}{P}$

118 - (9702/11_Summer_2022_Q34) - *Current Of Electricity*

A wire has a resistance of $30\ \Omega$. A second wire is made from the same material, has the same mass and is three times as long as the first wire.

What is the resistance of the second wire?

- A $10\ \Omega$ B $30\ \Omega$ C $90\ \Omega$ D $270\ \Omega$

119 - (9702/12_Summer_2022_Q34) - *Current Of Electricity*

An iron wire has length $8.0\ \text{m}$ and diameter $0.50\ \text{mm}$. The wire has resistance R .

A second iron wire has length $2.0\ \text{m}$ and diameter $1.0\ \text{mm}$.

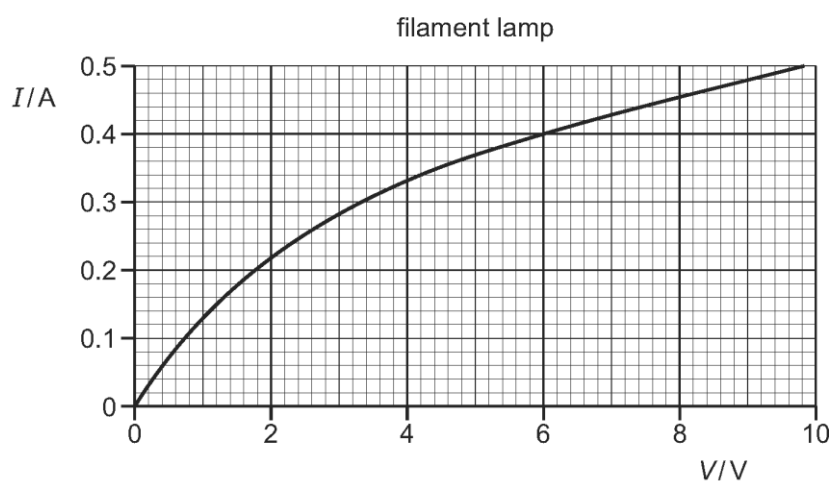
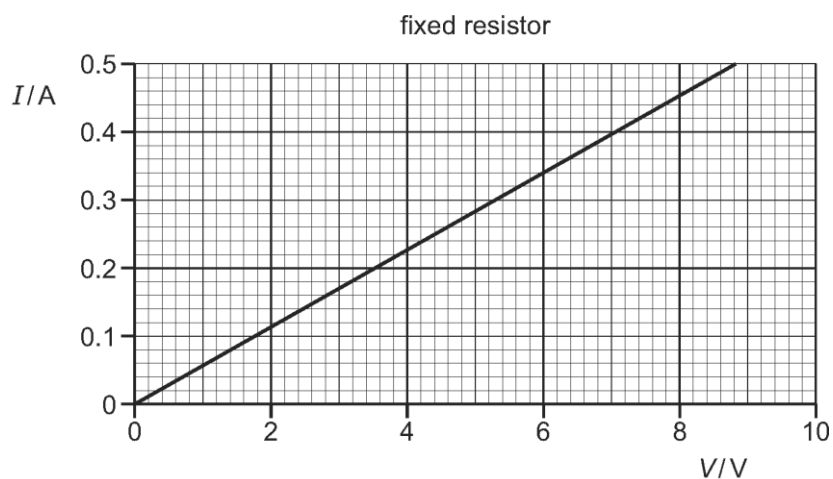
What is the resistance of the second wire?

- A $\frac{R}{16}$ B $\frac{R}{8}$ C $\frac{R}{2}$ D R

120 - (9702/13_Summer_2022_Q34) - Current Of Electricity

A fixed resistor and a filament lamp are connected in series to a power supply.

The I – V characteristics for the two components are shown.



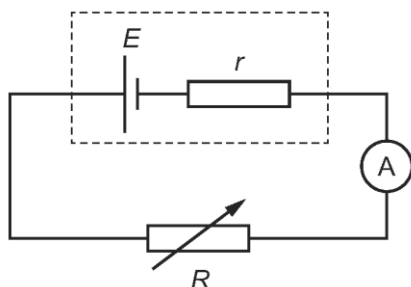
The current in the fixed resistor is 0.34 A.

What is the resistance of the filament lamp?

- A 0.081Ω B 12Ω C 15Ω D 18Ω

121 - (9702/11_Summer_2022_Q35) - Current Of Electricity

A cell has internal resistance r and electromotive force (e.m.f.) E . The cell is connected in series with an ammeter and a variable resistor of resistance R .



When R is $10\ \Omega$ the ammeter reads $0.3\ \text{A}$.

When R is $5\ \Omega$ the ammeter reads $0.4\ \text{A}$.

What is the value of E ?

- A $0.5\ \text{V}$ B $2\ \text{V}$ C $3\ \text{V}$ D $6\ \text{V}$

122 - (9702/13_Winter_2022_Q30) - Current Of Electricity

There is an electric current in a copper wire.

Which statement describing the average drift speed of the charge carriers in the wire is correct?

- A It is nearly $3 \times 10^8\ \text{m s}^{-1}$.
B It is proportional to the cross-sectional area of the wire.
C It is proportional to the length of the wire.
D It is proportional to the magnitude of the current.

123 - (9702/11_Winter_2022_Q31) - *Current Of Electricity*

A length of wire RS has a circular cross-section.



At end R of the wire, the cross-sectional area is A .

At end S of the wire, the cross-sectional area is $\frac{A}{2}$.

Charge Q takes time t to pass through end R of the wire. There is a constant electric current in the wire.

How much charge will pass through end S in a time interval of $\frac{t}{4}$?

- A $\frac{Q}{8}$ B $\frac{Q}{4}$ C $\frac{Q}{2}$ D Q

124 - (9702/12_Winter_2022_Q31) - *Current Of Electricity*

A nichrome wire has a resistance of 15Ω and a diameter of 3.0 mm . The number density of the free electrons in nichrome is $9.0 \times 10^{28}\text{ m}^{-3}$.

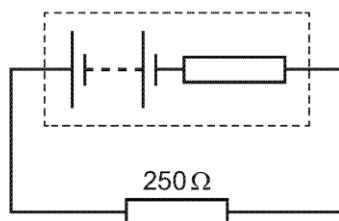
A potential difference (p.d.) of 6.0 V is applied between the ends of the wire.

What is the average drift speed of the free electrons in the wire?

- A $9.8 \times 10^{-7}\text{ m s}^{-1}$
B $3.9 \times 10^{-6}\text{ m s}^{-1}$
C $6.1 \times 10^{-6}\text{ m s}^{-1}$
D $2.5 \times 10^{-5}\text{ m s}^{-1}$

125 - (9702/13_Winter_2022_Q31) - Current Of Electricity

A battery with a constant internal resistance is connected to a resistor of resistance 250Ω , as shown.



The current in the resistor is 40 mA for a time of 60 s . During this time 6.0 J of energy is dissipated by the internal resistance.

What is the energy supplied to the external resistor during the 60 s and the electromotive force (e.m.f.) of the battery?

	energy / J	e.m.f. / V
A	30	2.5
B	30	7.5
C	24	10.0
D	24	12.5

126 - (9702/11_Winter_2022_Q32) - Current Of Electricity

A power supply is connected to a component by connecting wires of total resistance 4.9Ω .

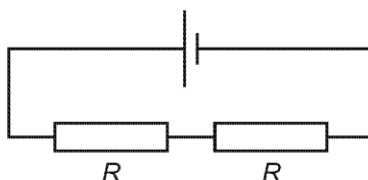
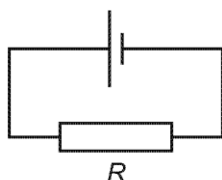
The power supply has an output power of 3.6 W and a terminal potential difference of 12 V .

How much thermal energy is dissipated in the connecting wires in a time of 1.0 hour ?

- A 0.44 J B 29 J C 1.6 kJ D 11 kJ

127 - (9702/12_Winter_2022_Q32) - Current Of Electricity

The diagrams show two different circuits.



The cells in each circuit have the same electromotive force (e.m.f.) and negligible internal resistance. The three resistors each have the same resistance R .

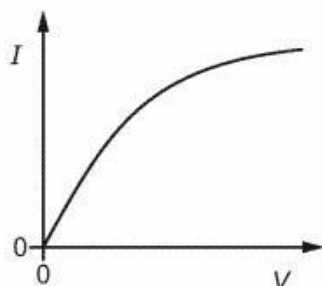
In the circuit on the left, the power dissipated in the resistor is P .

What is the total power dissipated in the circuit on the right?

- A $\frac{P}{4}$ B $\frac{P}{2}$ C P D $2P$

128 - (9702/13_Winter_2022_Q32) - *Current Of Electricity*

Which component has the I – V graph shown?



- A filament lamp
- B metallic conductor at constant temperature
- C resistor of fixed resistance
- D semiconductor diode

129 - (9702/11_Winter_2022_Q33) - *Current Of Electricity*

A copper wire is to be replaced by an aluminium alloy wire of the same length and resistance. Copper has half the resistivity of the alloy.

What is the ratio $\frac{\text{diameter of alloy wire}}{\text{diameter of copper wire}}$?

- A $\sqrt{2}$ B 2 C $2\sqrt{2}$ D 4

130 - (9702/12_Winter_2022_Q33) - *Current Of Electricity*

The potential difference (p.d.) across a filament lamp is increased.

Which statement is correct?

- A The resistance of the lamp decreases because the temperature decreases.
- B The resistance of the lamp decreases because the temperature increases.
- C The resistance of the lamp increases because the temperature decreases.
- D The resistance of the lamp increases because the temperature increases.

131 - (9702/13_Winter_2022_Q33) - *Current Of Electricity*

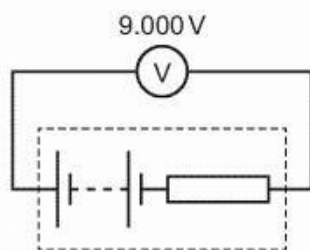
Two wires, P and Q, have the same resistance. Wire Q is made of material that has twice the resistivity of the material used to make wire P. The diameter of wire Q is twice the diameter of wire P.

What is the ratio $\frac{\text{length of wire P}}{\text{length of wire Q}}$?

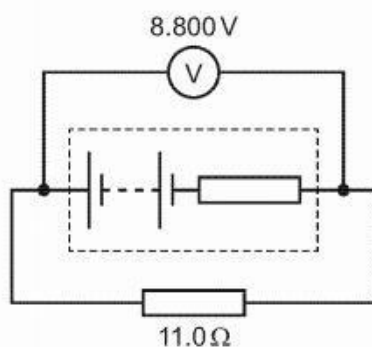
- A $\frac{1}{8}$ B $\frac{1}{4}$ C $\frac{1}{2}$ D $\frac{2}{1}$

132 - (9702/13_Winter_2022_Q34) - *Current Of Electricity*

A voltmeter reads 9.000 V when it is connected across the terminals of a battery.



When a resistor of resistance $11.0\ \Omega$ is connected in parallel with the battery, the voltmeter reading changes to 8.800 V.



What is the internal resistance of the battery?

- A $0.244\ \Omega$ B $0.250\ \Omega$ C $10.8\ \Omega$ D $11.3\ \Omega$

133 - (9702/11_Summer_2023_Q30) - *Current Of Electricity*

The electric current in a metal wire is 4.0 mA.

How many electrons pass a fixed point in the wire in a time of 10 hours?

- A 2.5×10^{17} B 2.5×10^{20} C 9.0×10^{20} D 9.0×10^{23}

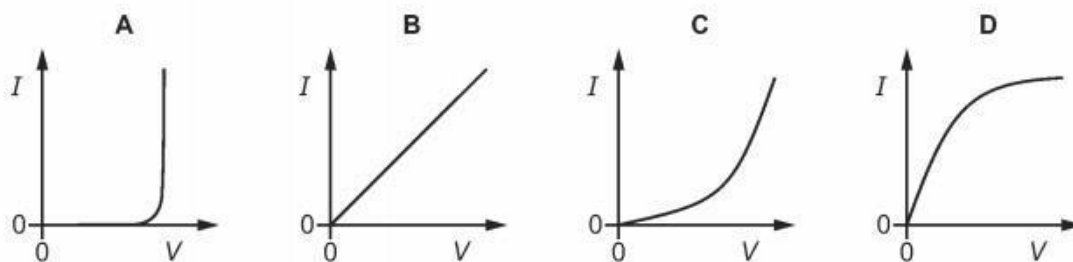
134 - (9702/11_Summer_2023_Q31) - *Current Of Electricity*

What is the definition of the potential difference across an electrical component?

- A the charge per unit time passing through the component
B the energy transferred per unit charge
C the force per unit charge
D the resistance per unit current

135 - (9702/11_Summer_2023_Q32) - *Current Of Electricity*

Which graph shows the I – V characteristic of a filament lamp?



136 - (9702/11_Summer_2023_Q33) - *Current Of Electricity*

A metal wire has a length of 2.50 m and a cross-sectional area of $4.50 \times 10^{-6} \text{ m}^2$. The resistivity of the metal is $3.50 \times 10^{-7} \Omega \text{ m}$.

The wire is stretched so that its length increases to 2.65 m. The wire remains cylindrical and the **volume** of the wire remains constant.

What is the change in the resistance of the wire?

- A 0.012Ω B 0.024Ω C 0.19Ω D 0.22Ω

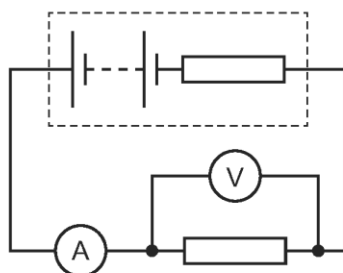
137 - (9702/11_Summer_2023_Q34) - *Current Of Electricity*

Which circuit symbol represents a microphone?



138 - (9702/11_Summer_2023_Q35) - *Current Of Electricity*

A battery with internal resistance is connected to a fixed resistor, an ammeter and a voltmeter, as shown.



The battery is replaced by a different battery that has the same electromotive force (e.m.f.) but a greater internal resistance.

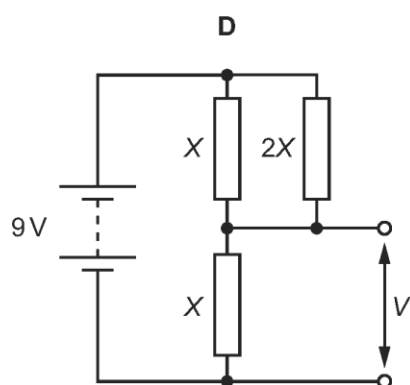
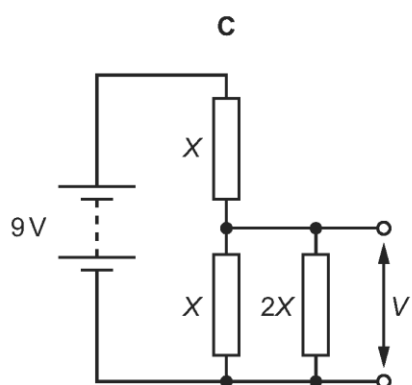
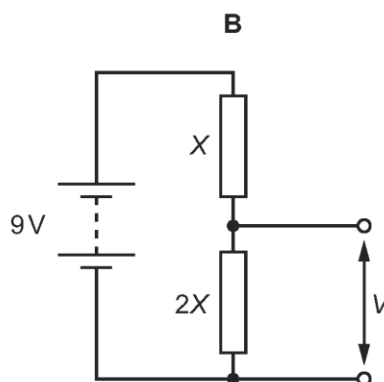
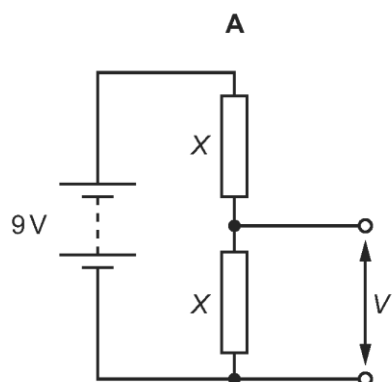
What happens to the readings on the ammeter and voltmeter?

	ammeter reading	voltmeter reading
A	decreases	decreases
B	decreases	stays the same
C	stays the same	decreases
D	stays the same	stays the same

139 - (9702/11_Summer_2023_Q36) - Current Of Electricity

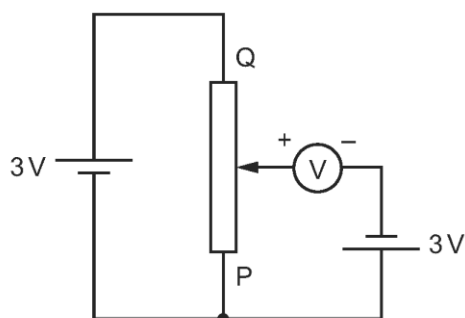
Four potential divider circuits each consist of a battery of electromotive force (e.m.f.) 9 V and negligible internal resistance connected to a combination of resistors. Each of the resistors in the circuits has a resistance of X or $2X$.

Which circuit has the largest output voltage V ?



140 - (9702/11_Summer_2023_Q37) - *Current Of Electricity*

A voltmeter is connected into a circuit with the polarity shown.



The sliding contact is moved to end P of the potentiometer and then to end Q.

What are the two readings of the voltmeter?

	sliding contact at end P	sliding contact at end Q
A	0 V	3 V
B	0 V	6 V
C	3 V	3 V
D	3 V	6 V

141 - (9702/12_Summer_2023_Q30) - *Current Of Electricity*

Which charge can be carried by a charge carrier?

- A $1.1 \times 10^{-19} \text{ C}$
- B $4.0 \times 10^{-19} \text{ C}$
- C $4.8 \times 10^{-19} \text{ C}$
- D $9.1 \times 10^{-19} \text{ C}$

142 - (9702/12_Summer_2023_Q31) - *Current Of Electricity*

A resistor of resistance R is connected across a cell of electromotive force (e.m.f.) E and negligible internal resistance.

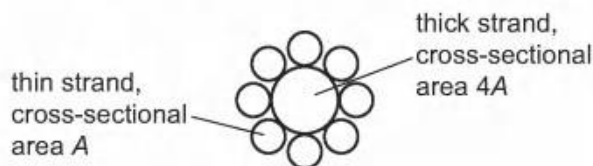
Which single change to the circuit would lead to the largest increase in the power dissipated in the resistor?

- A doubling the value of E
- B doubling the value of R
- C halving the value of E
- D halving the value of R

143 - (9702/12_Summer_2023_Q32) - *Current Of Electricity*

An electrical cable is made up of one thick strand of copper wire that is surrounded by eight thin strands of copper wire. All nine strands of wire are connected in parallel with each other.

A cross-section of the cable is shown.



Each thin strand of wire has cross-sectional area A and length L .

The thick strand of wire has cross-sectional area $4A$ and length L .

The cable has total resistance R .

Which expression gives the resistivity of copper?

A $\frac{4A}{33RL}$

B $\frac{12A}{RL}$

C $\frac{4AR}{L}$

D $\frac{12AR}{L}$

144 - (9702/12_Summer_2023_Q33) - *Current Of Electricity*

A car has sensors for detecting the light intensity and temperature of its environment.

The sensors make use of a light-dependent resistor (LDR) and a thermistor.

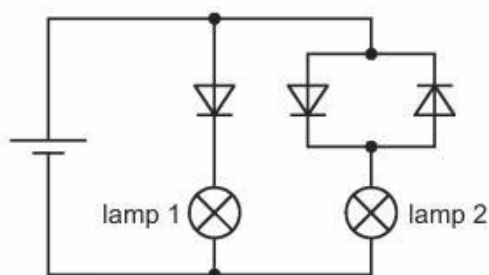
The car moves from a warm and dark environment into a cold and bright environment.

What are the changes to the resistances of the LDR and thermistor?

	resistance of LDR	resistance of thermistor
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases

145 - (9702/12_Summer_2023_Q34) - Current Of Electricity

A student assembles the circuit shown.



Which row describes the state of the two lamps?

	lamp 1	lamp 2
A	off	off
B	on	off
C	off	on
D	on	on

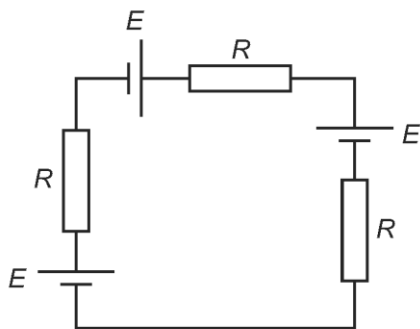
146 - (9702/12_Summer_2023_Q35) - Current Of Electricity

Kirchhoff's first law is a consequence of the conservation of which quantity?

- A charge
- B energy
- C momentum
- D potential difference

147 - (9702/12_Summer_2023_Q36) - Current Of Electricity

Three identical cells each have electromotive force (e.m.f.) E and negligible internal resistance. The cells are connected to three identical resistors, each of resistance R , as shown.

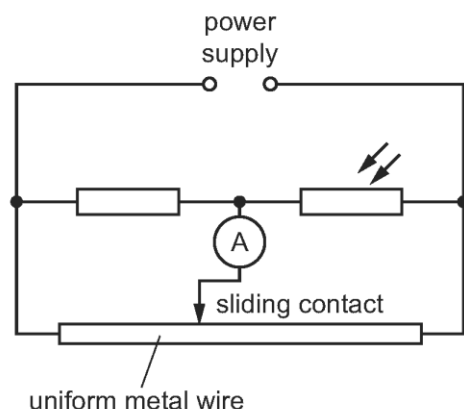


What is the potential difference across one of the resistors?

- A 0
- B $\frac{E}{3}$
- C $\frac{2E}{3}$
- D E

148 - (9702/12_Summer_2023_Q37) - *Current Of Electricity*

In the potentiometer circuit shown, the reading on the ammeter is zero.



The light-dependent resistor (LDR) is then covered and the ammeter gives a non-zero reading.

Which change could return the ammeter reading to zero?

- A decreasing the supply voltage
- B increasing the supply voltage
- C moving the sliding contact to the left
- D moving the sliding contact to the right

149 - (9702/13_Summer_2023_Q30) - *Current Of Electricity*

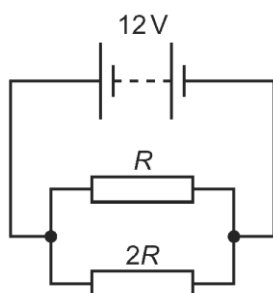
A metal wire is connected between the terminals of a cell so that there is a current in the wire.

Which statement is correct?

- A Negatively charged electrons in the wire move from the negative terminal to the positive terminal.
- B Negatively charged nuclei in the wire move from the negative terminal to the positive terminal.
- C Positively charged electrons in the wire move from the positive terminal to the negative terminal.
- D Positively charged nuclei in the wire move from the positive terminal to the negative terminal.

150 - (9702/13_Summer_2023_Q31) - *Current Of Electricity*

Two resistors of resistances R and $2R$ are connected in parallel with a battery of electromotive force (e.m.f.) 12 V and negligible internal resistance.



The total power dissipated by the two resistors is 36 W.

What is the value of R ?

- A $0.50\,\Omega$ B $2.7\,\Omega$ C $4.0\,\Omega$ D $6.0\,\Omega$

151 - (9702/13_Summer_2023_Q32) - *Current Of Electricity*

A wire has a length of 3.0 m and is made of metal of resistivity $4.9 \times 10^{-7}\,\Omega\text{ m}$.

A potential difference (p.d.) of 12 V is applied across the wire so that it has a current of 1.4 A.

What is the cross-sectional area of the wire?

- A $1.2 \times 10^{-7}\text{ m}^2$
B $1.7 \times 10^{-7}\text{ m}^2$
C $1.1 \times 10^{-6}\text{ m}^2$
D $1.3 \times 10^{-5}\text{ m}^2$

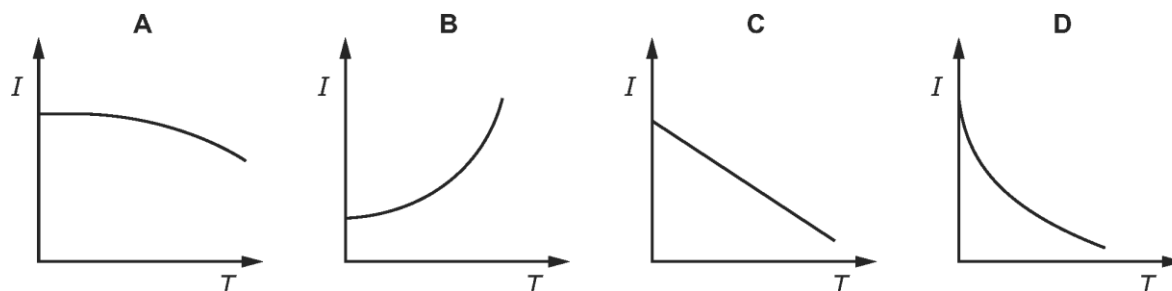
152 - (9702/13_Summer_2023_Q33) - Current Of Electricity

A cell of negligible internal resistance is connected in series with a thermistor, a fixed resistor and an ammeter.

The thermistor is placed in a beaker of water and the temperature of the water is slowly increased.

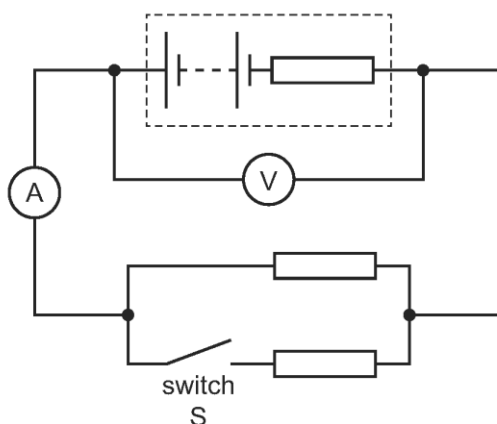
A graph of current I against the temperature T of the thermistor is plotted.

Which graph could show the variation of I with T ?



153 - (9702/13_Summer_2023_Q34) - Current Of Electricity

A battery with internal resistance is connected to a parallel arrangement of two resistors and a switch S, as shown.



Initially, switch S is open.

What happens to the voltmeter and ammeter readings when switch S is closed?

	voltmeter reading	ammeter reading
A	decreases	increases
B	decreases	decreases
C	increases	increases
D	increases	decreases

154 - (9702/13_Summer_2023_Q35) - *Current Of Electricity*

Kirchhoff's first law states that the sum of the currents entering a junction in a circuit is equal to the sum of the currents leaving it.

The law is based on the conservation of a physical quantity.

What is this physical quantity?

- A charge
- B energy
- C mass
- D momentum

155 - (9702/13_Summer_2023_Q36) - *Current Of Electricity*

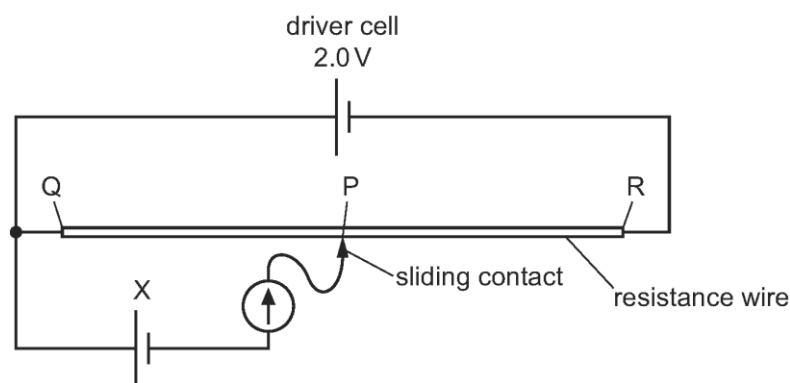
Two resistors have a combined resistance of 34Ω when connected in series. The same resistors have a combined resistance of 7.4Ω when connected in parallel.

What is the resistance of one of the resistors?

- A 15Ω B 17Ω C 23Ω D 27Ω

156 - (9702/13_Summer_2023_Q37) - *Current Of Electricity*

A potentiometer circuit is used to investigate the electromotive force (e.m.f.) of a cell X.



The e.m.f. of cell X is known to be approximately 0.50 V .

The driver cell has negligible internal resistance and an e.m.f. of 2.0 V . The sliding contact is moved along the uniform resistance wire between ends Q and R to a point P where the reading on the galvanometer is zero.

What is an expression for the approximate length QP?

- A $\frac{QR}{4}$ B $\frac{QR}{3}$ C $\frac{2QR}{3}$ D $\frac{3QR}{4}$

157 - (9702/11_Winter_2023_Q30) - *Current Of Electricity*

The current I in a conductor is given by the equation shown.

$$I = Anvq$$

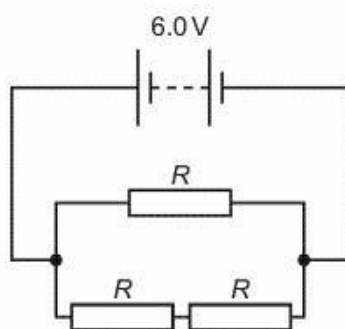
What does the letter n represent in this equation?

- A charge carried per charge carrier
- B number of charge carriers per unit area
- C number of charge carriers per unit volume
- D total mass of charge carriers per unit volume

158 - (9702/11_Winter_2023_Q31) - *Current Of Electricity*

In the circuit shown, the battery has an electromotive force (e.m.f.) of 6.0 V and negligible internal resistance.

The three resistors each have resistance R .



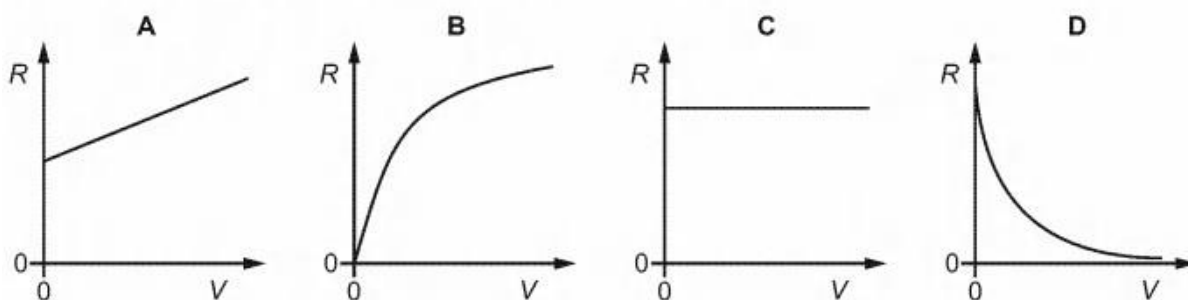
The total power dissipated in the resistor network is 24 W.

What is the value of R ?

- A $0.50\ \Omega$
- B $1.0\ \Omega$
- C $1.5\ \Omega$
- D $2.3\ \Omega$

159 - (9702/11_Winter_2023_Q32) - *Current Of Electricity*

Which graph could show how the resistance R of a filament lamp varies with the applied potential difference (p.d.) V , as V is increased to the normal operating p.d.?



160 - (9702/11_Winter_2023_Q33) - *Current Of Electricity*

A piece of conducting putty is in the shape of a cylinder of length 60 mm and diameter 20 mm. The resistance between the ends of the cylinder is $20\ \Omega$.

What is the resistivity of the putty?

- A $0.033\ \Omega\text{ m}$ B $0.10\ \Omega\text{ m}$ C $0.42\ \Omega\text{ m}$ D $5.2\ \Omega\text{ m}$

161 - (9702/11_Winter_2023_Q34) - *Current Of Electricity*

Which statement about the electromotive force (e.m.f.) of a cell is **always** correct?

- A The e.m.f. is the energy converted from electrical to other forms in the cell.
B The e.m.f. is the energy provided by the cell per unit charge passing through it.
C The e.m.f. is the potential difference across the internal resistance of the cell.
D The e.m.f. is the potential difference across the terminals of the cell.

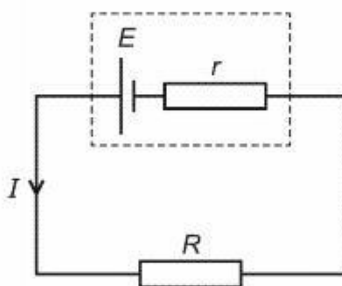
162 - (9702/11_Winter_2023_Q35) - *Current Of Electricity*

Kirchhoff's first and second laws are a consequence of the conservation of which quantities?

- A charge and energy
B charge and resistance
C mass and energy
D mass and resistance

163 - (9702/11_Winter_2023_Q36) - *Current Of Electricity*

A circuit contains a cell of electromotive force E and internal resistance r connected to a resistor of resistance R . The current in the circuit is I .

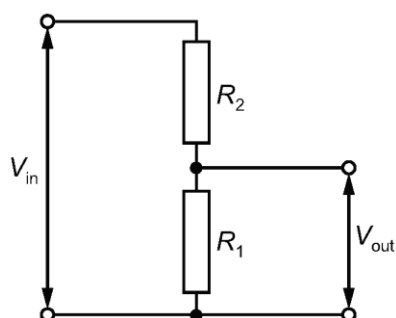


Which equation is correct?

- A $E - Ir = IR$ B $E = Ir - IR$ C $E + Ir = IR$ D $E = IR$

164 - (9702/11_Winter_2023_Q37) - Current Of Electricity

A potential divider consists of two resistors of resistances R_1 and R_2 connected in series across a source of potential difference (p.d.) V_{in} . The p.d. across R_1 is V_{out} .

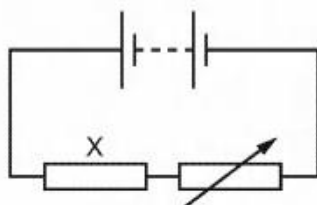


Which changes to R_1 and R_2 will increase the value of V_{out} ?

	R_1	R_2
A	doubled	doubled
B	doubled	halved
C	halved	doubled
D	halved	halved

165 - (9702/12_Winter_2023_Q31) - Current Of Electricity

In the circuit shown, a fixed resistor X is connected in series with a battery and a variable resistor.



The power dissipated in resistor X is 7.2 W when a current of 3.0 A passes through it.

The variable resistor is adjusted so that the power dissipated in X increases by 50%.

What is the new current in the circuit?

- A 2.4 A B 3.7 A C 4.5 A D 14 A

166 - (9702/12_Winter_2023_Q32) - *Current Of Electricity*

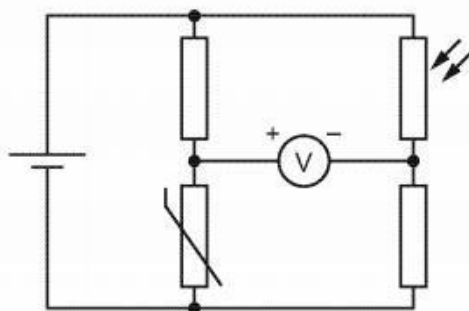
The potential difference across a metal wire is kept constant. The length l and the diameter d of the wire are both varied. The type of metal is kept the same.

How is the current in the wire related to l and d ?

- A It is directly proportional to l and inversely proportional to d .
- B It is directly proportional to l and inversely proportional to d^2 .
- C It is inversely proportional to l and directly proportional to d .
- D It is inversely proportional to l and directly proportional to d^2 .

167 - (9702/12_Winter_2023_Q33) - *Current Of Electricity*

A student sets up a circuit. The circuit diagram shows how the positive and negative terminals of a voltmeter are connected to the circuit. The voltmeter has an initial reading that is positive.

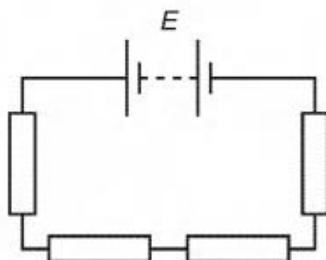


Which changes, if any, in temperature and light intensity would cause the voltmeter reading to **decrease**?

	temperature	light intensity
A	increase	increase
B	no change	decrease
C	decrease	no change
D	decrease	decrease

168 - (9702/12_Winter_2023_Q34) - *Current Of Electricity*

Some resistors and a battery of electromotive force (e.m.f.) E and negligible internal resistance are connected in series, as shown.



Which statement is correct?

- A The e.m.f. across each resistor equals the potential difference across the battery.
- B The potential difference across each resistor equals the e.m.f. E of the battery.
- C The sum of the e.m.f.s across the resistors equals the potential difference across the battery.
- D The sum of the potential differences across the resistors equals the e.m.f. E of the battery.

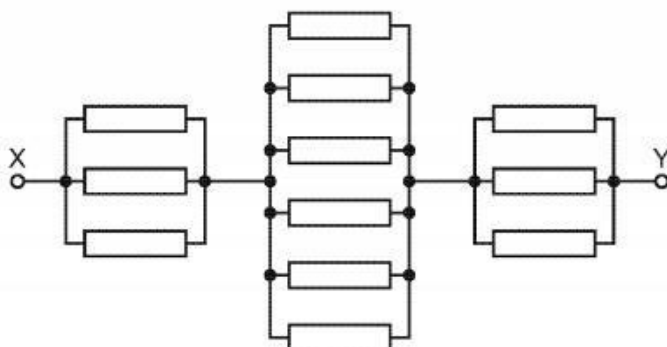
169 - (9702/12_Winter_2023_Q35) - *Current Of Electricity*

Kirchhoff's first law is a consequence of the conservation of which physical quantity?

- A charge
- B energy
- C linear momentum
- D potential difference

170 - (9702/12_Winter_2023_Q36) - *Current Of Electricity*

The diagram shows a network of resistors. Each resistor has a resistance of 6.0Ω .

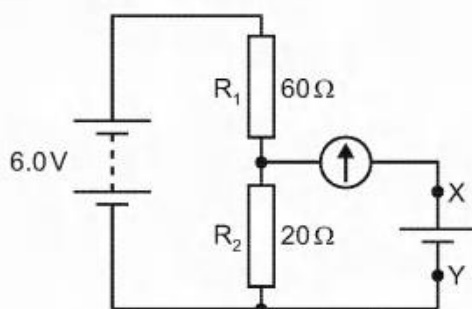


What is the total resistance of the network between points X and Y?

- A 3.0Ω
- B 5.0Ω
- C 7.2Ω
- D 18Ω

171 - (9702/12_Winter_2023_Q37) - *Current Of Electricity*

In the circuit shown, a battery of negligible internal resistance is connected in series with a pair of fixed resistors R_1 and R_2 .



The circuit is to be used to test whether the electromotive force (e.m.f.) of a particular cell is 1.5 V. The cell is connected between terminals X and Y in parallel with R_2 and in series with a galvanometer.

Which statement about the test is correct?

- A Any non-zero reading on the galvanometer means the cell has an e.m.f. of 1.5 V.
- B The battery does not need to have an e.m.f. of 6.0 V.
- C The cell may be connected either way round between X and Y.
- D The galvanometer does not need a scale calibrated in amperes.

172 - (9702/13_Winter_2023_Q30) - *Current Of Electricity*

What could **not** be used to create an electric current?

- A alpha-particles
- B beta-particles
- C neutrons
- D protons

173 - (9702/13_Winter_2023_Q31) - *Current Of Electricity*

What is the definition of the potential difference (p.d.) across a component?

- A the energy transferred per unit charge
- B the energy transferred per unit current
- C the power transferred per unit charge
- D the power transferred per unit current

174 - (9702/13_Winter_2023_Q32) - *Current Of Electricity*

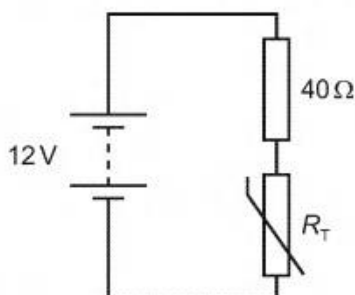
The resistance of a filament lamp increases as the current in it increases.

What is the reason for this?

- A The charge of each charge carrier increases.
- B The potential difference across the filament decreases.
- C The power dissipated by the filament decreases.
- D The temperature of the filament increases.

175 - (9702/13_Winter_2023_Q33) - *Current Of Electricity*

A battery of electromotive force (e.m.f.) 12 V and negligible internal resistance is connected to a fixed resistor of resistance $40\ \Omega$ and a thermistor of resistance R_T , as shown.



Initially, the temperature of the thermistor is 15°C and the current in the circuit is 0.10 A .

The temperature of the thermistor then changes, which causes the current to increase to 0.12 A .

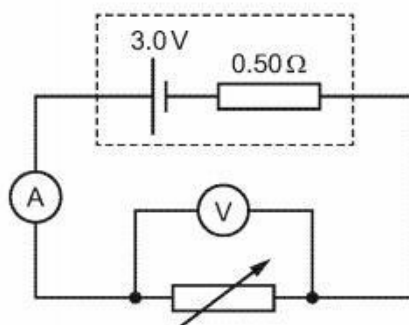
How does the temperature of the thermistor change and what is R_T at the new temperature?

	temperature of thermistor	R_T at new temperature / Ω
A	increases	60
B	decreases	60
C	increases	100
D	decreases	100

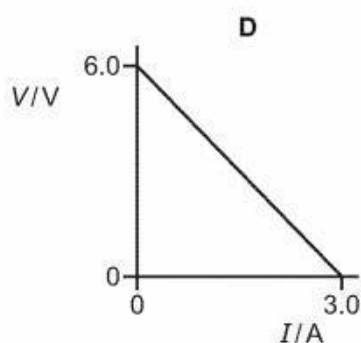
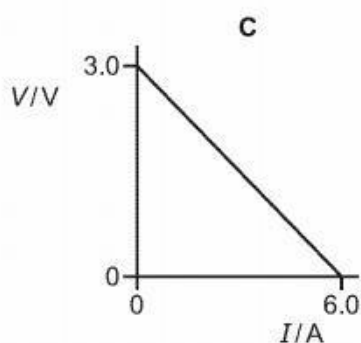
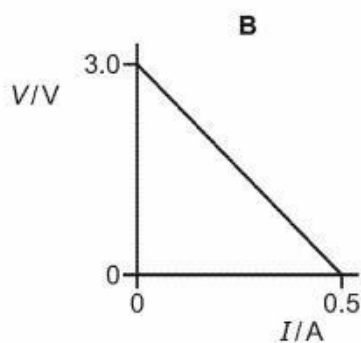
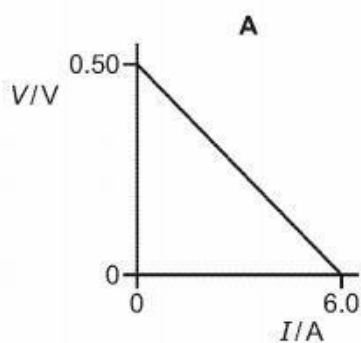
176 - (9702/13_Winter_2023_Q34) - Current Of Electricity

A cell of electromotive force (e.m.f.) 3.0V and internal resistance 0.50Ω is connected to a variable resistor, a voltmeter and an ammeter, as shown. The resistance of the variable resistor is varied.

The reading on the ammeter I and the reading on the voltmeter V are recorded.

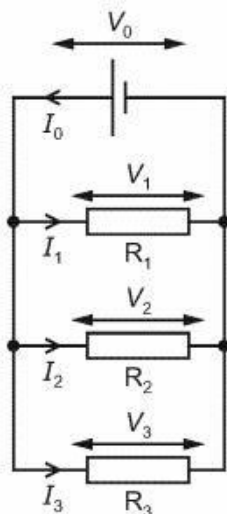


Which graph shows how V varies with I ?



177 - (9702/13_Winter_2023_Q35) - *Current Of Electricity*

Three resistors, R_1 , R_2 and R_3 , are connected in parallel to a cell. The currents in the resistors are I_1 , I_2 and I_3 . The potential differences across the resistors are V_1 , V_2 and V_3 . The current in the cell is I_0 . The potential difference across the cell is V_0 , as shown.

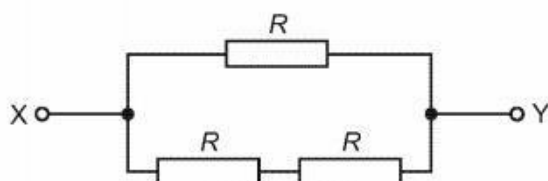


Which equation can be obtained by applying Kirchhoff's second law to the circuit?

- A $I_0 = I_1 = I_2 = I_3$
- B $I_0 = I_1 + I_2 + I_3$
- C $V_0 = V_1 = V_2 = V_3$
- D $V_0 = V_1 + V_2 + V_3$

178 - (9702/13_Winter_2023_Q36) - *Current Of Electricity*

Three resistors, each of resistance R , are connected in a network, as shown.



The total resistance between points X and Y is 8.0Ω .

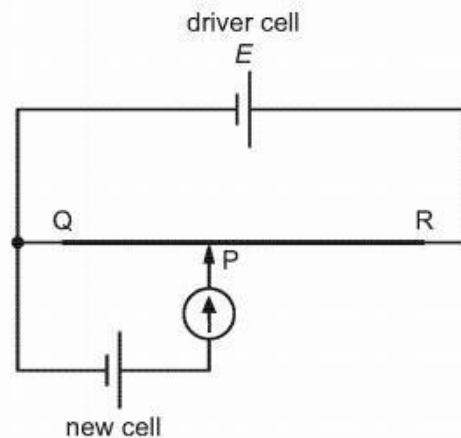
What is the value of R ?

- A 2.7Ω
- B 4.0Ω
- C 5.3Ω
- D 12Ω

179 - (9702/13_Winter_2023_Q37) - *Current Of Electricity*

A potentiometer and a driver cell of electromotive force (e.m.f.) E are used to measure the e.m.f. of a new cell.

A sliding contact at P is moved along a resistance wire QR until the reading on the galvanometer is zero.

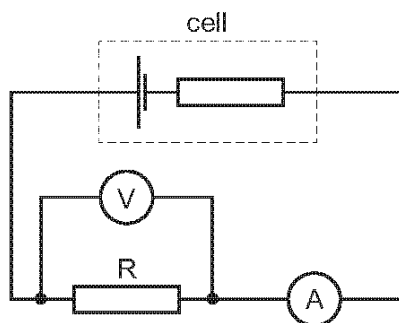


What is an essential requirement for the e.m.f. of the new cell to be measured accurately?

- A The e.m.f. of the driver cell must be less than the e.m.f. of the new cell.
- B The galvanometer must have a large resistance.
- C The internal resistance of the new cell must be zero.
- D The resistance per unit length of the wire QR must be constant.

1 – (9702/11_Summer_2017_Q35) – D.c. Circuits

The circuit shown includes a cell of constant internal resistance and an external resistor R.



A student records the ammeter and voltmeter readings. She then connects a second identical external resistor in parallel with the first external resistor.

What happens to the ammeter reading and to the voltmeter reading?

	ammeter reading	voltmeter reading
A	decreases	decreases
B	decreases	stays the same
C	increases	decreases
D	increases	stays the same

2 – (9702/12_Summer_2017_Q35) – D.c. Circuits

A cell has a constant electromotive force.

A variable resistor is connected between the terminals of the cell.

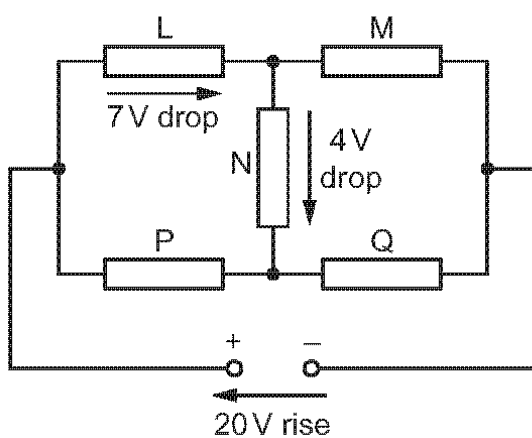
The resistance of the variable resistor is decreased.

Which statement about the change of the cell's terminal potential difference (p.d.) is correct?

- A** The terminal p.d. is decreased because more work is done moving unit charge through the internal resistance of the cell.
- B** The terminal p.d. is decreased because the current in the variable resistor is decreased.
- C** The terminal p.d. is increased because more work is done moving unit charge through the variable resistor.
- D** The terminal p.d. is increased because the current in the variable resistor is increased.

3 - (9702/13_Summer_2017_Q35) - D.c. Circuits

A 20 V d.c. supply is connected to a circuit consisting of five resistors L, M, N, P and Q.



There is a potential drop of 7 V across L and a further 4 V potential drop across N.

What are the potential drops across M, P and Q?

	potential drop across M/V	potential drop across P/V	potential drop across Q/V
A	9	7	13
B	13	7	13
C	13	11	9
D	17	3	17

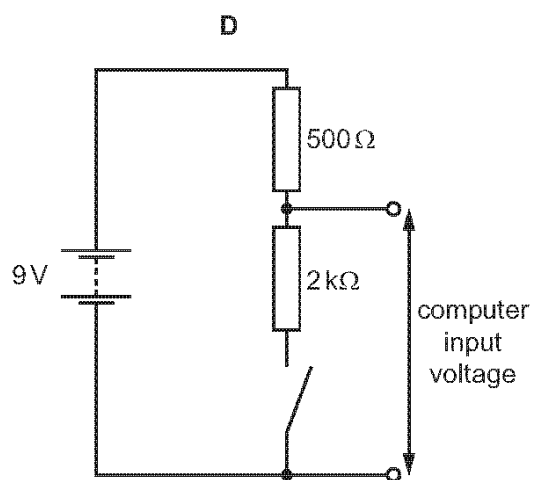
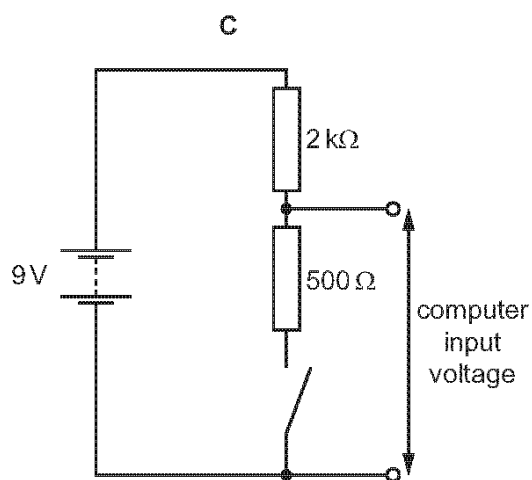
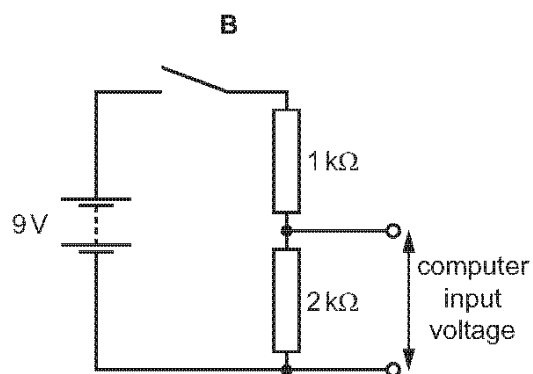
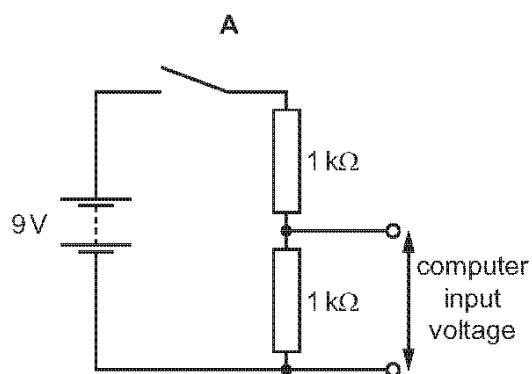
4 - (9702/11_Summer_2017_Q36) - D.c. Circuits

A computer is used to detect the change of position of a switch.

To detect the change of position, the computer requires a potential difference (p.d.) of 0 V to its input at one switch position and a p.d. of between 5 V and 7 V at the other switch position.

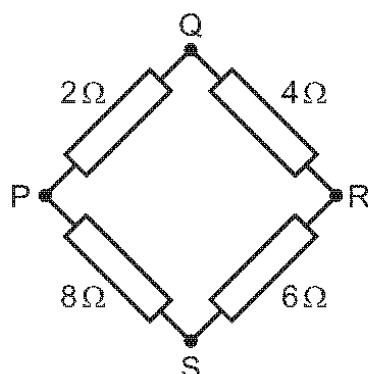
For each of the circuits, assume the battery has negligible internal resistance.

Which circuit provides an input voltage to the computer that enables it to detect the change of position of the switch?



5 – (9702/12_Summer_2017_Q36) – D.c. Circuits

Four resistors are connected in a square as shown.



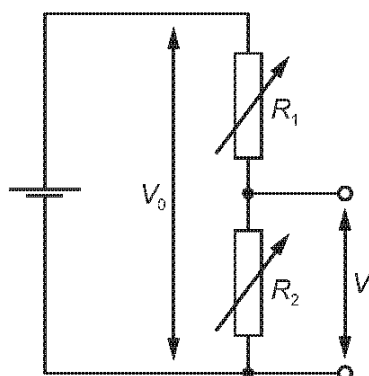
The resistance may be measured between any two junctions.

Between which two junctions is the measured resistance greatest?

- A** P and Q **B** Q and S **C** R and S **D** S and P

6 – (9702/13_Summer_2017_Q36) – D.c. Circuits

A potential divider circuit consists of a cell of negligible internal resistance in series with two variable resistors of resistances R_1 and R_2 . The potential difference (p.d.) across the cell is V_0 . The p.d. at the output is V .

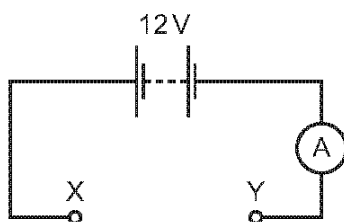


Which statement is correct?

- A** When R_1 increases, it takes a greater proportion of V_0 , so V decreases.
B When R_1 increases, the current through R_1 and R_2 decreases, so V increases.
C When R_2 decreases, it takes a smaller proportion of V_0 , so V increases.
D When R_2 increases, the current through R_1 and R_2 decreases, so V decreases.

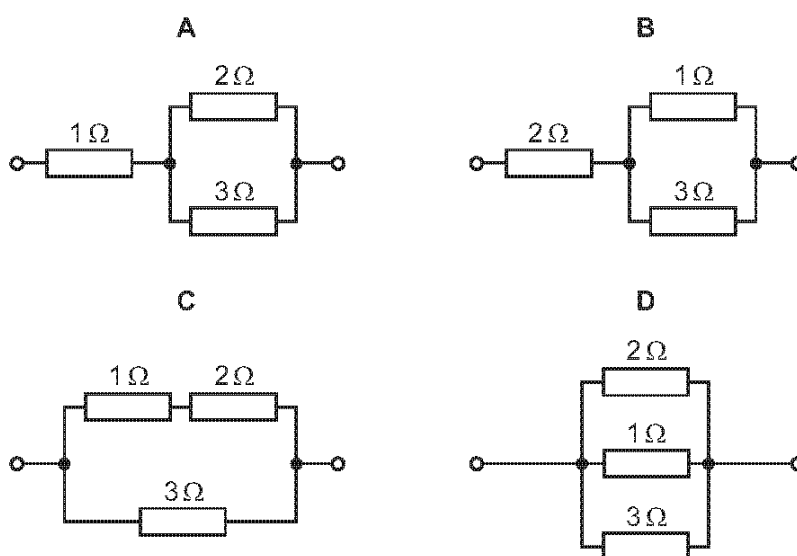
7 - (9702/11_Summer_2017_Q37) - D.c. Circuits

In the circuit shown, the battery and ammeter have negligible resistance.



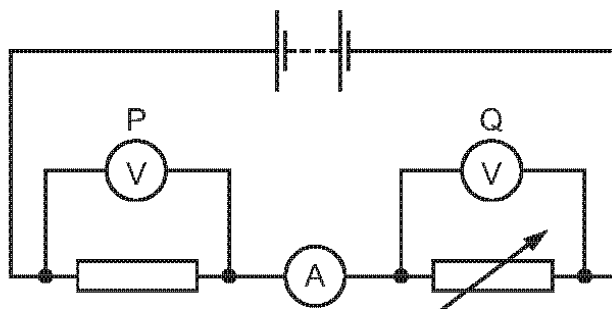
The following combinations of resistors are each separately placed between the terminals X and Y of the circuit.

Which combination would give an ammeter reading of 8 A?



8 - (9702/12_Summer_2017_Q37) - D.c. Circuits

A circuit is set up as shown.



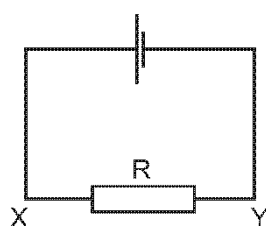
The variable resistor is adjusted so that the ammeter reading decreases.

How do the readings of the voltmeters change?

	reading on voltmeter P	reading on voltmeter Q
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

9 - (9702/11_Winter_2017_Q33) - Current Of Electricity, D.c. Circuits

The current in the circuit shown is 3.2 mA.

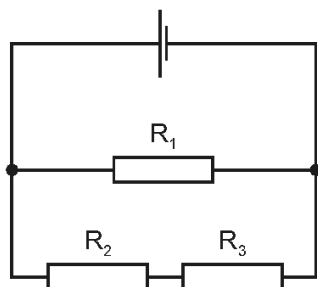


What are the direction of flow and the rate of flow of electrons through the resistor R?

	direction of flow	rate of flow / s ⁻¹
A	X to Y	2.0×10^{16}
B	X to Y	5.1×10^{-22}
C	Y to X	2.0×10^{16}
D	Y to X	5.1×10^{-22}

10 - (9702/12_Winter_2017_Q34) - D.c. Circuits

A cell of negligible internal resistance is connected to resistors R_1 , R_2 and R_3 , as shown. The cell provides power to the circuit and power is dissipated in the resistors.



Which word equation **must** be correct?

- A power loss in R_1 = power loss in R_2 + power loss in R_3
- B power loss in R_2 = power loss in R_3
- C power output of cell = power loss in R_1 + power loss in R_2 + power loss in R_3
- D power output of cell = power loss in R_1

11 - (9702/13_Winter_2017_Q34) - D.c. Circuits

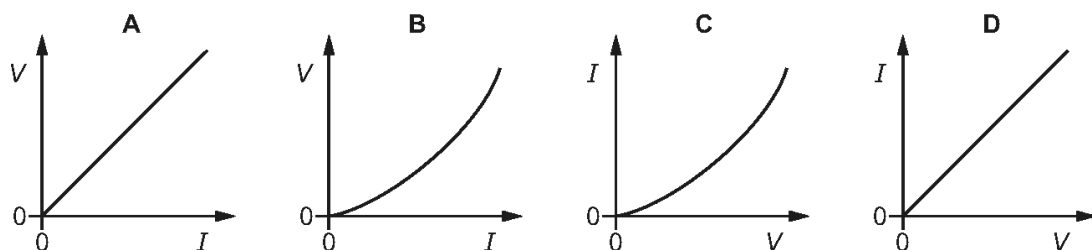
A simple circuit comprises a source of electromotive force (e.m.f.) connected to a load.

How does the output power P of the source depend on the internal resistance r of the source and the resistance R of the load?

- A P is independent of both r and R .
- B P depends on r but not on R .
- C P depends on R but not on r .
- D P depends on both r and R .

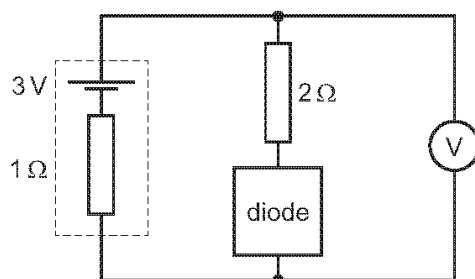
12 - (9702/12_Winter_2017_Q35) - Current Of Electricity, D.c. Circuits

Which graph represents a metallic conductor, where the resistance of the conductor is given by the gradient of the graph?



13 – (9702/13_Winter_2017_Q35) – D.c. Circuits, Electronics

An ideal diode has zero resistance when forward biased and infinite resistance when reverse biased. The diode is connected in series with a $2\ \Omega$ resistor across the terminals of a source having electromotive force (e.m.f.) 3 V and internal resistance $1\ \Omega$, as shown.



A high-resistance voltmeter is connected across the diode and resistor.

Which row gives the readings of the voltmeter for the two ways of connecting the diode?

	forward biased	reverse biased
A	1 V	3 V
B	2 V	0 V
C	2 V	3 V
D	3 V	0 V

14 – (9702/12_Winter_2017_Q36) – Current Of Electricity, D.c. Circuits

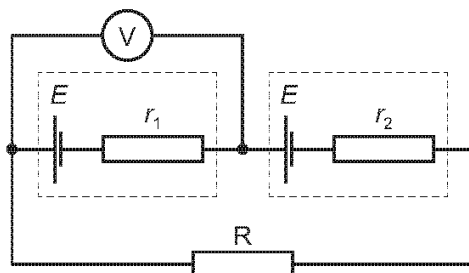
A typical mobile phone battery has an e.m.f. of 5.0 V and an internal resistance of $200\text{ m}\Omega$.

What is the terminal p.d. of the battery when it supplies a current of 500 mA ?

- A 4.8 V B 4.9 V C 5.0 V D 5.1 V

15 – (9702/13_Winter_2017_Q36) – D.c. Circuits

Two cells, each with electromotive force (e.m.f.) E , but different internal resistances r_1 and r_2 , are connected in series to a resistor R . The reading on the voltmeter is 0 V .

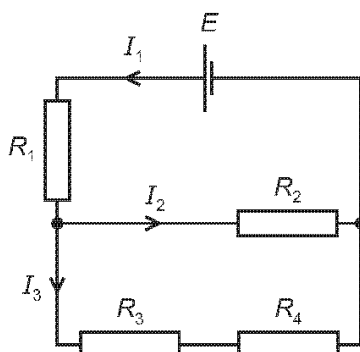


What is the resistance of R ?

- A 0 B $r_1 - r_2$ C $r_1 + r_2$ D $\frac{r_1 r_2}{r_1 + r_2}$

16 - (9702/11_Winter_2017_Q37) - D.c. Circuits

A cell of electromotive force E and negligible internal resistance is connected to a network of resistors of resistances R_1 , R_2 , R_3 and R_4 as shown.



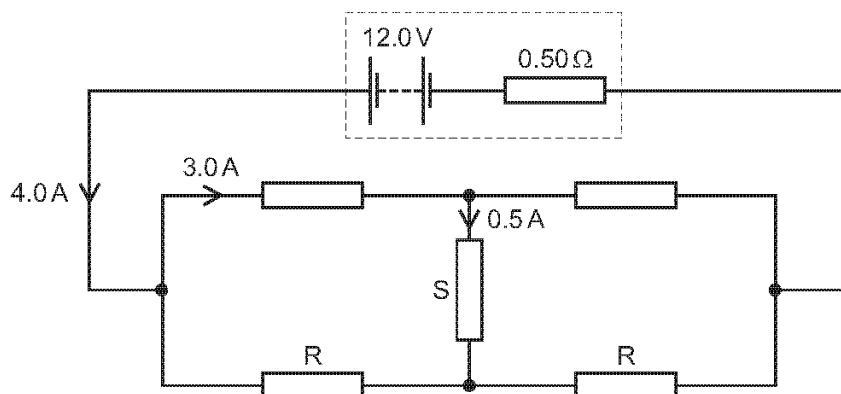
The branches of the circuit have currents I_1 , I_2 and I_3 .

Which equation is correct?

- A $I_1 R_1 + I_2 R_2 = I_3 R_3 + I_3 R_4$
- B $I_2 R_2 - I_3 R_4 - I_3 R_3 = 0$
- C $E = I_1 R_1 + I_2 R_2 + I_3 R_3 + I_3 R_4$
- D $E = I_1 R_1 + I_2 R_2 - I_3 R_3 - I_3 R_4$

17 - (9702/12_Winter_2017_Q37) - Current Of Electricity, D.c. Circuits

The circuit shown contains a resistor S that is neither in series nor in parallel with the other resistors.



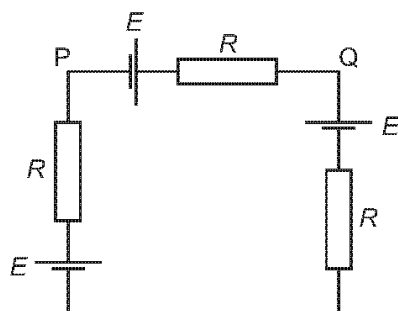
Kirchhoff's laws can be used with the data in the diagram to deduce the resistance of each of the two identical resistors labelled R .

What is the resistance of each resistor R ?

- A $3.0\ \Omega$
- B $4.0\ \Omega$
- C $4.8\ \Omega$
- D $5.0\ \Omega$

18 – (9702/13_Winter_2017_Q37) – D.c. Circuits

Three identical cells each have electromotive force (e.m.f.) E and negligible internal resistance. The cells are connected to three identical resistors, each of resistance R , as shown.

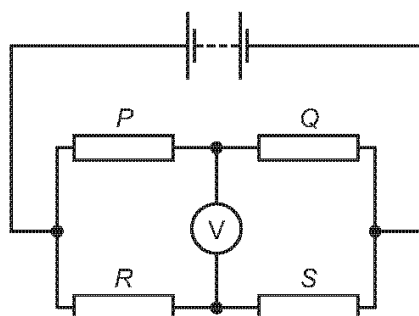


What is the potential difference between P and Q?

- A 0 B $\frac{E}{3}$ C $\frac{2E}{3}$ D E

19 – (9702/11_Winter_2017_Q38) – D.c. Circuits

The circuit diagram shows four resistors of different resistances P , Q , R and S connected to a battery.



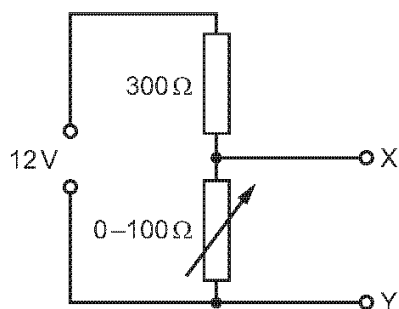
The voltmeter reading is zero.

Which equation is correct?

- A $P - Q = R - S$
 B $P - S = Q - R$
 C $PQ = RS$
 D $PS = QR$

20 – (9702/12_Winter_2017_Q38) – D.c. Circuits

The diagram shows a potential divider connected to a 12V supply of negligible internal resistance.



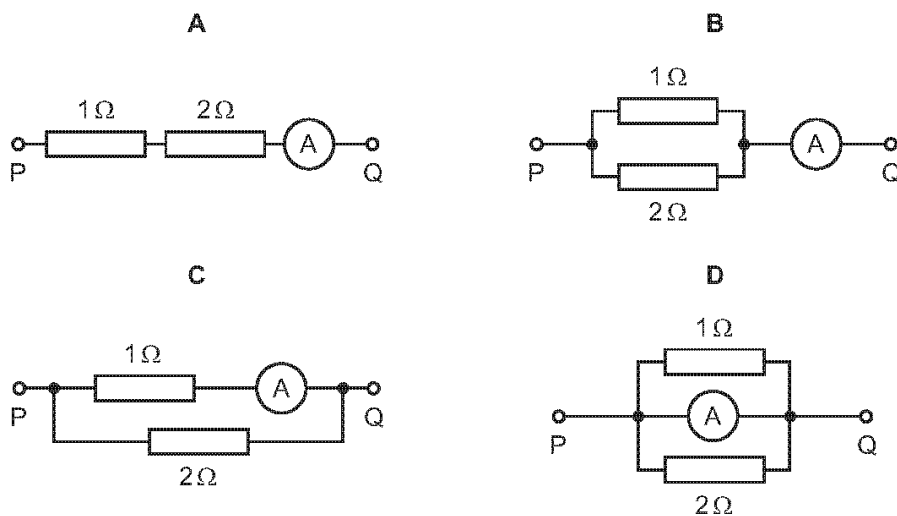
Which range of voltages can be obtained between X and Y?

- A 0 to 3V B 0 to 4V C 0 to 8V D 0 to 9V

21 – (9702/13_Winter_2017_Q38) – Current Of Electricity, D.c. Circuits

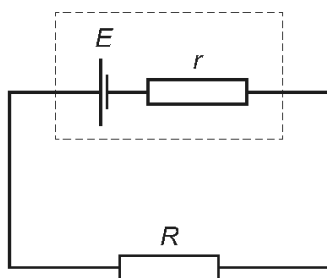
In each arrangement of resistors, the ammeter has a resistance of $2\ \Omega$.

Which arrangement gives the largest reading on the ammeter when the same potential difference is applied between points P and Q?



22 – (9702/13_Summer_2018_Q31) – *Current Of Electricity, D.c. Circuits*

A cell of electromotive force (e.m.f.) E and internal resistance r is connected to an external resistor of resistance R , as shown.



What is the power dissipated in the external resistor?

- A $\frac{E^2(R+r)}{R^2}$ B $\frac{E^2R}{(R+r)^2}$ C $\frac{E^2(R+r)}{r^2}$ D $\frac{E^2r}{(R+r)^2}$

23 – (9702/11_Summer_2018_Q33) – *D.c. Circuits*

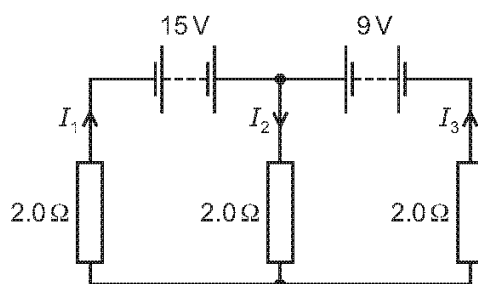
The sum of the electrical currents into a point in a circuit is equal to the sum of the currents out of the point.

Which statement is correct?

- A This is Kirchhoff's first law, which results from the conservation of charge.
 B This is Kirchhoff's first law, which results from the conservation of energy.
 C This is Kirchhoff's second law, which results from the conservation of charge.
 D This is Kirchhoff's second law, which results from the conservation of energy.

24 – (9702/11_Summer_2018_Q34) – *D.c. Circuits*

In the circuit shown, the batteries have negligible internal resistance.



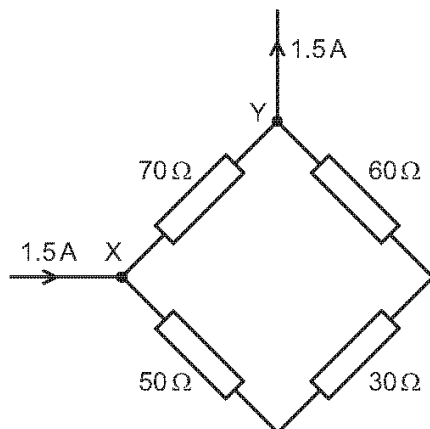
What are the values of the currents I_1 , I_2 and I_3 ?

	I_1 / A	I_2 / A	I_3 / A
A	-5.5	1.0	6.5
B	0.5	4.0	3.5
C	3.5	4.0	0.5
D	6.5	1.0	-5.5

25 - (9702/12_Summer_2018_Q34) - D.c. Circuits

Four different resistors are arranged as shown.

A current of 1.5 A enters the network at junction X and leaves through junction Y.



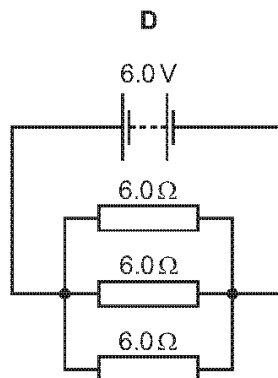
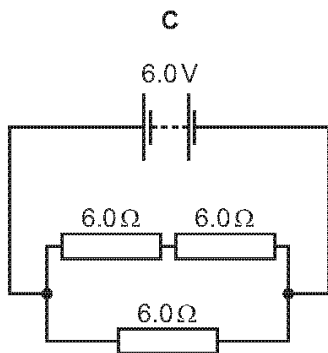
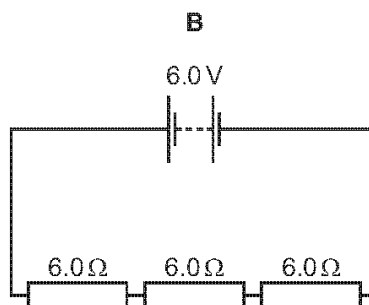
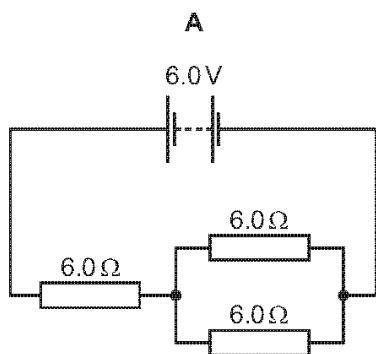
What is the current in the resistor of resistance $30\ \Omega$?

- A 0.21 A B 0.50 A C 0.75 A D 1.0 A

26 - (9702/13_Summer_2018_Q34) - Current Of Electricity, D.c. Circuits

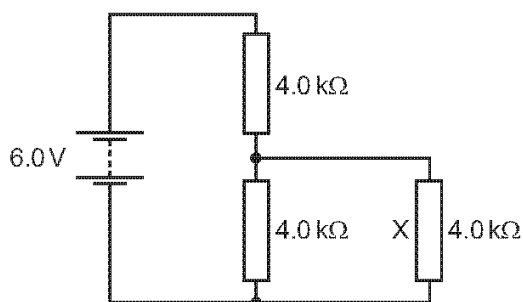
A battery of electromotive force (e.m.f.) 6.0 V and negligible internal resistance is connected to three resistors each of resistance $6.0\ \Omega$.

Which circuit will produce a current through the battery of 0.67 A ?



27 - (9702/11_Summer_2018_Q35) - D.c. Circuits

A battery of electromotive force (e.m.f.) 6.0V and negligible internal resistance is connected to three resistors as shown.



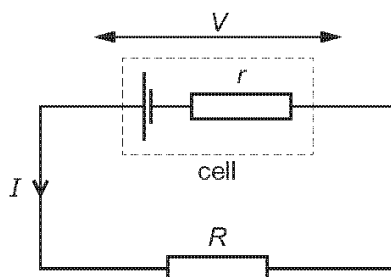
Each resistor has a resistance of $4.0\text{ k}\Omega$.

What is the current in resistor X ?

- A 0.25 mA B 0.50 mA C 0.75 mA D 1.0 mA

28 - (9702/12_Summer_2018_Q35) - D.c. Circuits

A cell of constant electromotive force drives a current I through an external resistor of resistance R . The terminal potential difference (p.d.) across the cell is V .

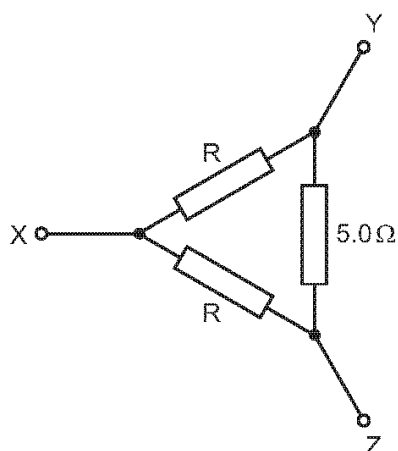


When the internal resistance r of the cell increases, what is the effect on V and on I ?

	V	I
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

29 – (9702/13_Summer_2018_Q35) – D.c. Circuits

The diagram shows a network of three resistors. Two of these, marked R , are identical. The other resistor has a resistance of $5.0\ \Omega$.



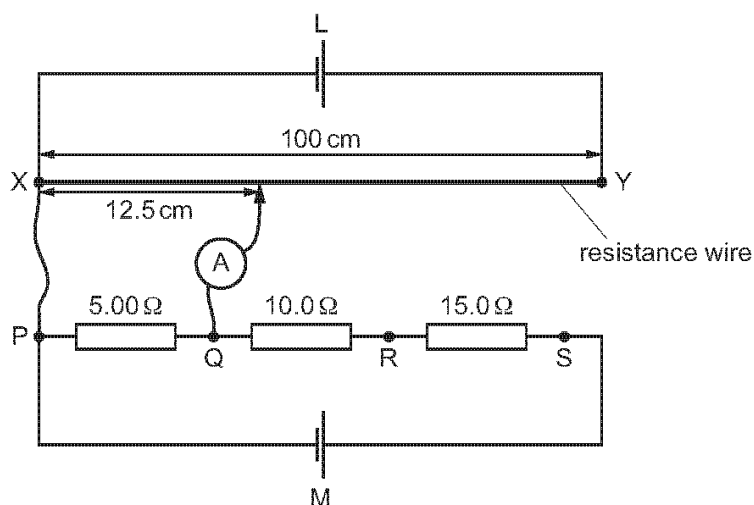
The resistance between Y and Z is found to be $2.5\ \Omega$.

What is the resistance between X and Y?

- A** $0.30\ \Omega$ **B** $0.53\ \Omega$ **C** $1.9\ \Omega$ **D** $3.3\ \Omega$

30 - (9702/11_Summer_2018_Q36) - D.c. Circuits

A uniform resistance wire XY of length 100 cm is connected in series with a cell L. Another cell M is connected in series with resistors of resistances $5.00\ \Omega$, $10.0\ \Omega$ and $15.0\ \Omega$.



The potential difference (p.d.) between P and Q is balanced against 12.5 cm of the resistance wire, so that the ammeter reads zero.

The p.d. across the other resistors is then balanced against other lengths of the resistance wire.

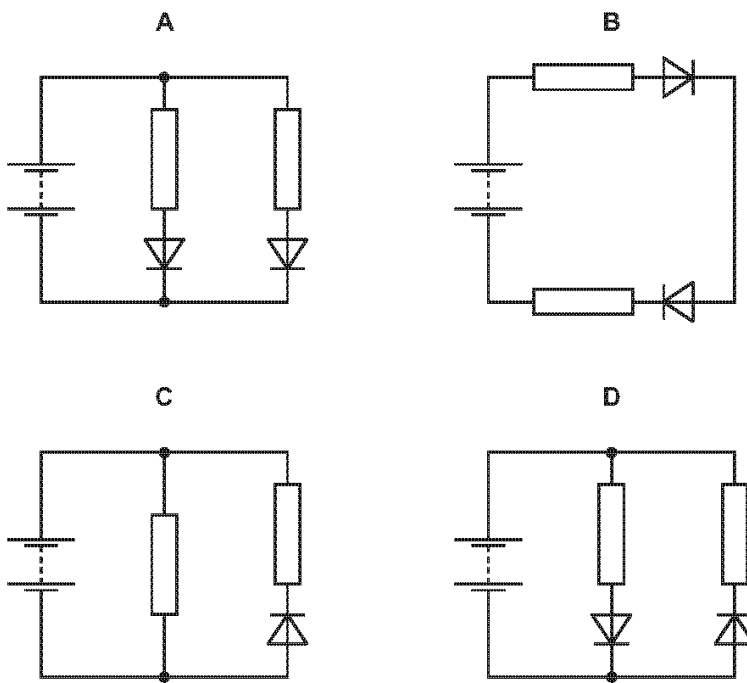
Which balanced lengths of resistance wire correspond to the connection points given in the table?

connection points	balanced length / cm			
	A	B	C	D
Q and R	12.5	25.0	25.0	25.0
Q and S	62.5	62.5	75.0	62.5
P and R	37.5	37.5	37.5	12.5

31 - (9702/12_Summer_2018_Q36) - D.c. Circuits

In the circuits shown, the batteries are identical and all have negligible internal resistance. All of the resistors have the same resistance. The diodes have zero resistance when conducting and infinite resistance when not conducting.

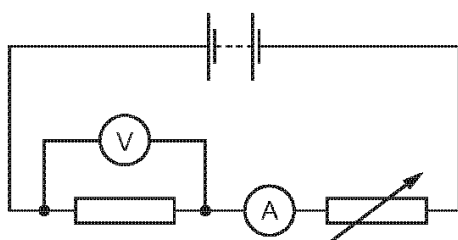
In which circuit is the current in the battery greatest?



32 - (9702/13_Summer_2018_Q36) - Current Of Electricity, D.c. Circuits

The diagram shows a battery, a fixed resistor, an ammeter and a variable resistor connected in series.

A voltmeter is connected across the fixed resistor.



The resistance of the variable resistor is reduced.

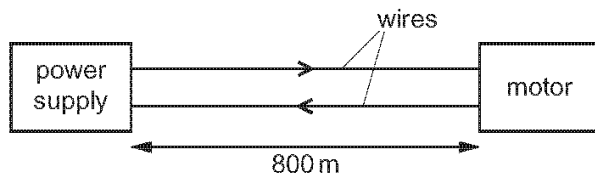
Which row describes the changes in the readings of the ammeter and of the voltmeter?

	ammeter	voltmeter
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

33 - (9702/11_Summer_2018_Q37) - *Current Of Electricity, D.c. Circuits*

A motor is required to operate at a distance of 800 m from its power supply. The motor requires a potential difference (p.d.) of 16.0 V and a current of 0.60 A to operate.

Two wires are used to supply power to the motor as shown.



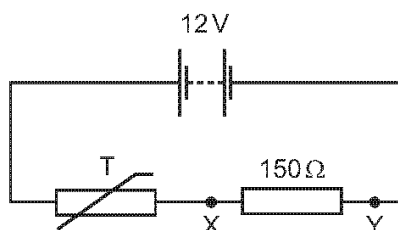
The resistance of each of these wires is 0.0050Ω per metre.

What is the minimum output p.d. of the power supply?

- A** 11.2 V **B** 16.0 V **C** 18.4 V **D** 20.8 V

34 - (9702/12_Summer_2018_Q37) - *D.c. Circuits*

A thermistor is an electrical component with a resistance that varies with temperature. A thermistor T is used in a fire alarm system. The alarm is triggered when the potential difference between X and Y is 4.5 V.

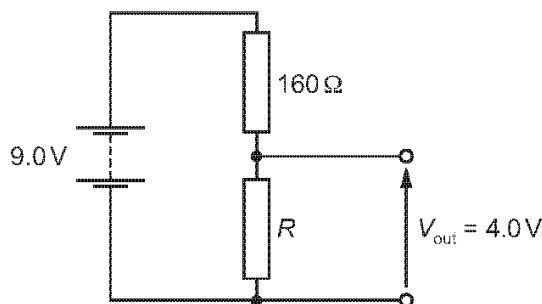


What is the resistance of T when the alarm is triggered?

- A** 90Ω **B** 150Ω **C** 250Ω **D** 400Ω

35 - (9702/13_Summer_2018_Q37) - *D.c. Circuits*

The circuit diagram shows a battery of electromotive force (e.m.f.) 9.0 V and negligible internal resistance. It is connected to two resistors of resistances 160Ω and R . The output potential difference V_{out} is 4.0 V.

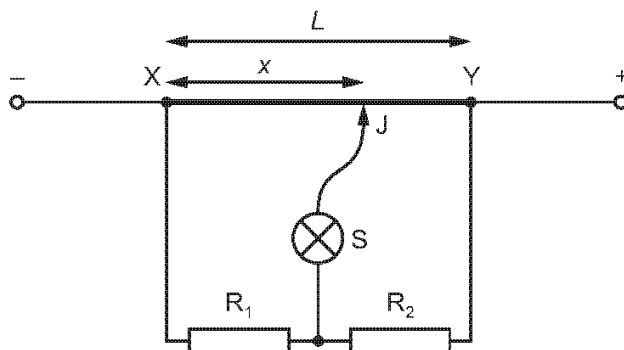


What is the resistance R ?

- A** 32Ω **B** 49Ω **C** 71Ω **D** 128Ω

36 - (9702/13_Summer_2018_Q38) - D.c. Circuits

In the circuit shown, XY is a length L of uniform resistance wire. A potential difference is applied across XY. R_1 and R_2 are unknown resistors. J is a sliding contact that joins the junction of R_1 and R_2 to points on XY through a lamp S.



J is moved along XY to a point at which the lamp is off. This point is at a distance x from X.

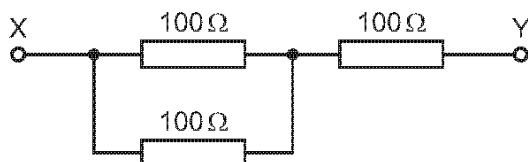
The potential difference across R_1 is V_1 and the potential difference across R_2 is V_2 .

What is the value of the ratio $\frac{V_1}{V_2}$?

- A $\frac{L}{x}$ B $\frac{x}{L}$ C $\frac{L-x}{x}$ D $\frac{x}{L-x}$

37 - (9702/13_Winter_2018_Q33) - Current Of Electricity, D.c. Circuits

Three resistors are to be connected into a circuit with the arrangement shown.



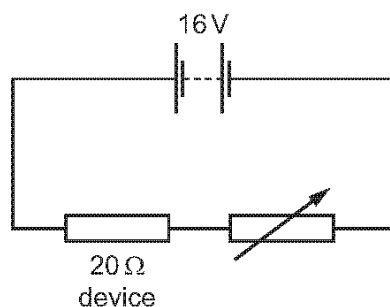
The power in any resistor must not be greater than 4.0W.

What is the maximum voltage across XY?

- A 24V B 30V C 40V D 60V

38 - (9702/12_Winter_2018_Q34) - *Current Of Electricity, D.c. Circuits*

An electrical device of fixed resistance $20\ \Omega$ is connected in series with a variable resistor and a battery of electromotive force (e.m.f.) 16 V and negligible internal resistance.

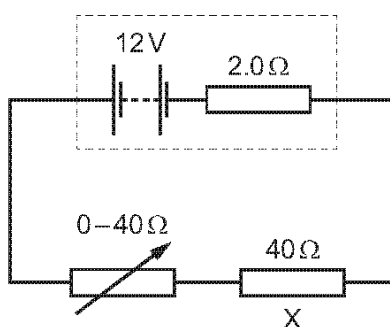


What is the resistance of the variable resistor when the power dissipated in the electrical device is 4.0 W ?

- A $16\ \Omega$ B $36\ \Omega$ C $44\ \Omega$ D $60\ \Omega$

39 - (9702/13_Winter_2018_Q35) - *Current Of Electricity, D.c. Circuits*

A resistor X of resistance $40\ \Omega$ and a variable resistor are connected to a battery of electromotive force (e.m.f.) 12 V and internal resistance $2.0\ \Omega$, as shown.



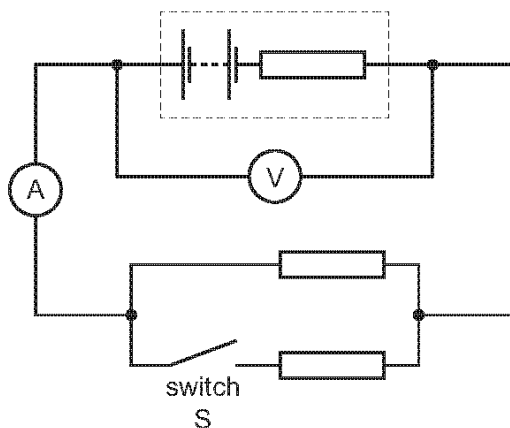
The resistance of the variable resistor is changed from 0 to $40\ \Omega$.

What is the change in power dissipated in resistor X?

- A 2.4 W B 2.7 W C 3.6 W D 5.6 W

40 - (9702/11_Winter_2018_Q36) - *Current Of Electricity, D.c. Circuits*

A battery, with internal resistance, is connected to a parallel arrangement of two resistors and a switch S, as shown.



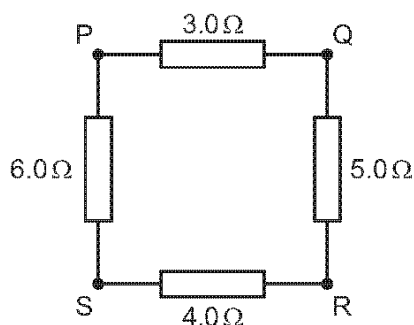
Initially switch S is open.

What happens to the voltmeter and ammeter readings when switch S is closed?

	voltmeter reading	ammeter reading
A	decreases	increases
B	decreases	decreases
C	increases	increases
D	increases	decreases

41 – (9702/12_Winter_2018_Q36) – *Current Of Electricity, D.c. Circuits*

A battery of negligible internal resistance may be connected between any two points P, Q, R and S of the network of resistors shown.

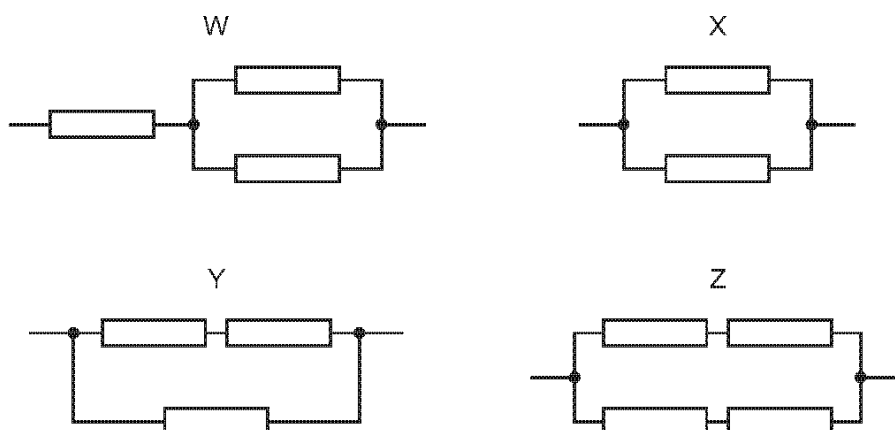


Which connections will give the largest current and the smallest current in the battery?

	largest current	smallest current
A	PQ	PR
B	PQ	QS
C	RS	PR
D	RS	QS

42 – (9702/13_Winter_2018_Q36) – *D.c. Circuits*

All the resistors shown in the resistor networks W, X, Y and Z have the same resistance.

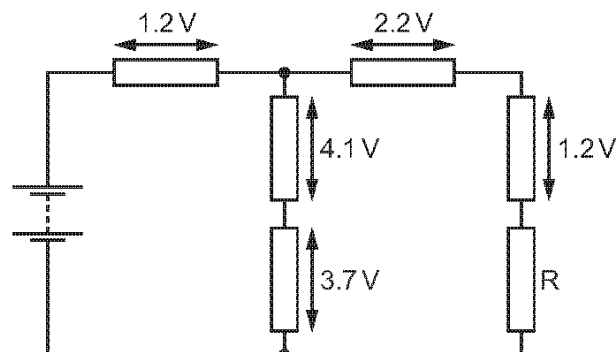


Which list gives the networks in order of increasing total resistance?

- A W → Z → Y → X
- B X → W → Y → Z
- C X → Y → W → Z
- D X → Y → Z → W

43 - (9702/11_Winter_2018_Q37) - *Current Of Electricity, D.c. Circuits*

A battery is connected to a network of six resistors, as shown.



The potential differences across five of the resistors are labelled on the diagram.

What is the potential difference across resistor R?

- A 4.4V B 4.6V C 6.6V D 11.2V

44 - (9702/12_Winter_2018_Q37) - *D.c. Circuits*

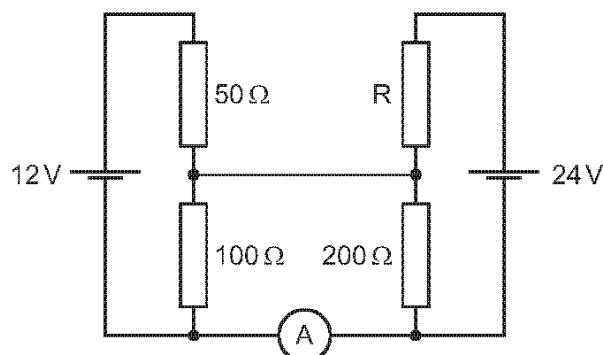
Kirchhoff's second law is a consequence of a basic principle.

What is this principle?

- A The charge flowing in an electric circuit is conserved.
 B The energy in an electric circuit is conserved.
 C The sum of the electric currents entering a point in an electrical circuit is equal to the sum of the electric currents leaving that point.
 D The sum of the potential differences in a circuit is equal to the sum of the products of the current and resistance.

45 - (9702/13_Winter_2018_Q37) - *D.c. Circuits*

In the circuit shown, the ammeter reading is zero.

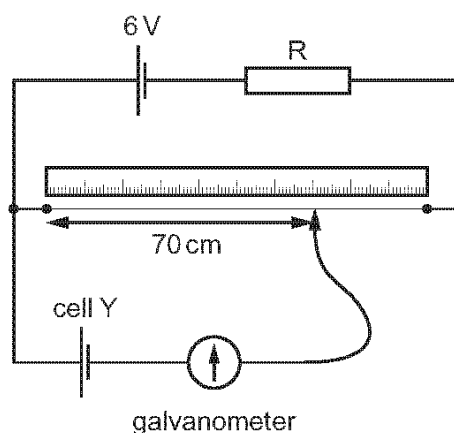
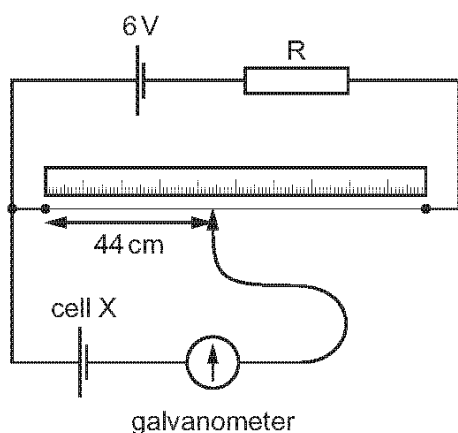


What is the resistance of resistor R?

- A 100Ω B 200Ω C 400Ω D 600Ω

46 - (9702/12_Winter_2018_Q38) - *Current Of Electricity, D.c. Circuits*

Two cells are investigated using a potentiometer. At the balance point, cell X gives a reading of 44 cm and cell Y gives a reading of 70 cm.



Which statement is **not** correct?

- A A potentiometer balance point results in zero current through the galvanometer.
- B At the balance point, the current through resistor R in both circuits is the same.
- C The electromotive force (e.m.f.) of cell X is larger than that of cell Y.
- D The value of the e.m.f. of each of the cells X and Y is less than 6 V.

47 - (9702/11_Summer_2019_Q35) - *Current Of Electricity, D.c. Circuits*

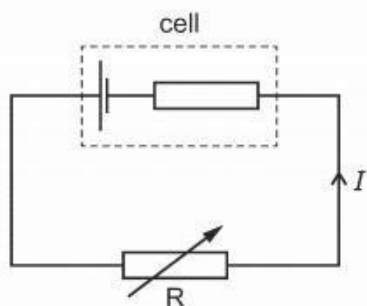
When a battery is connected to a resistor, the battery gradually becomes warm. This causes the internal resistance of the battery to increase whilst its electromotive force (e.m.f.) stays unchanged.

As the internal resistance of the battery increases, how do the terminal potential difference and the output power change, if at all?

	terminal potential difference	output power
A	decreases	decreases
B	decreases	unchanged
C	unchanged	decreases
D	unchanged	unchanged

48 - (9702/12_Summer_2019_Q35) - *Current Of Electricity, D.c. Circuits*

A cell with internal resistance is connected to a variable resistor R as shown.



The resistance of R is gradually decreased.

How do the current I and the terminal potential difference across the cell change?

	current I	terminal potential difference across cell
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

49 - (9702/11_Summer_2019_Q36) - *Current Of Electricity, D.c. Circuits*

A cell is connected to a resistor of resistance $3.00\ \Omega$. The current in the resistor is 1.00 A .

A second identical resistor is added in parallel. The current becomes 1.93 A .

What are the e.m.f. E and internal resistance r of the cell?

	E/V	r/Ω
A	0.113	3.11
B	3.04	0.0358
C	3.11	0.113
D	9.34	6.34

50 - (9702/12_Summer_2019_Q36) - D.c. Circuits

Kirchhoff's first law states that the sum of the currents entering a junction in a circuit is equal to the sum of the currents leaving it.

The law is based on the conservation of a physical quantity.

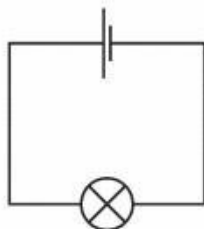
What is this physical quantity?

- A charge
- B energy
- C mass
- D momentum

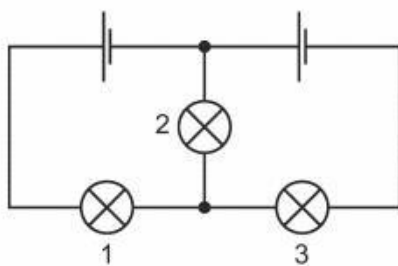
51 - (9702/13_Summer_2019_Q36) - D.c. Circuits

A student has a set of identical cells and identical lamps. The cells have negligible internal resistance.

A lamp connected to a cell lights with normal brightness.



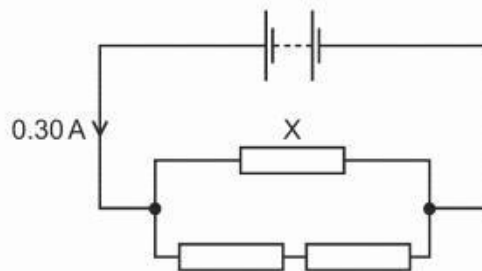
What happens when the student connects the lamps and the cells as shown?



- A All three lamps light with normal brightness.
- B Only lamp 2 lights with normal brightness.
- C Only lamps 1 and 3 light with normal brightness.
- D None of the lamps light with normal brightness.

52 - (9702/11_Summer_2019_Q37) - *Current Of Electricity, D.c. Circuits*

A battery with negligible internal resistance is connected to three resistors, as shown.



All three resistors have the same resistance.

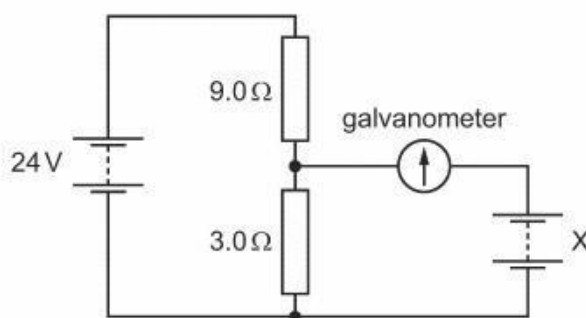
The current in the battery is 0.30 A.

What is the current in resistor X?

- A** 0.10 A **B** 0.15 A **C** 0.20 A **D** 0.30 A

53 - (9702/12_Summer_2019_Q37) - *D.c. Circuits*

A circuit contains two batteries, each of negligible internal resistance, and two resistors as shown.



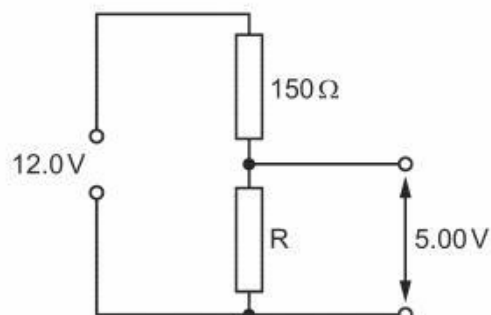
The galvanometer has a current reading of zero.

What is the electromotive force (e.m.f.) of battery X?

- A** 6.0 V **B** 8.0 V **C** 16.0 V **D** 18.0 V

54 – (9702/13_Summer_2019_Q37) – *D.c. Circuits*

A potential divider circuit is shown.

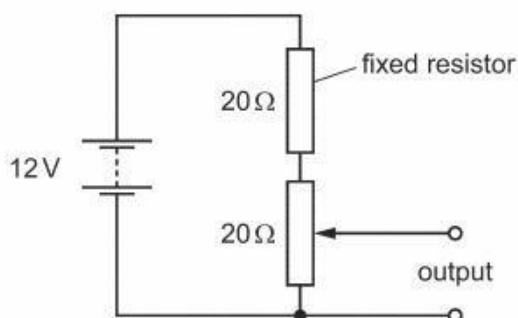


What is the resistance of resistor R in the potential divider circuit?

- A** 62.5Ω **B** 107Ω **C** 210Ω **D** 360Ω

55 – (9702/11_Summer_2019_Q38) – *D.c. Circuits*

The diagram shows a potentiometer and a fixed resistor connected across a 12V battery of negligible internal resistance.



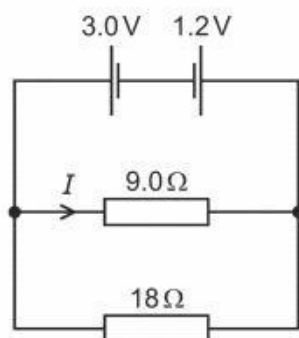
The fixed resistor and the potentiometer each have resistance 20Ω. The circuit is designed to provide a variable output voltage.

What is the range of output voltages?

- A** 0–6V **B** 0–12V **C** 6–12V **D** 12–20V

56 - (9702/13_Summer_2019_Q38) - *D.c. Circuits*

Two cells of electromotive force (e.m.f.) 3.0V and 1.2V and negligible internal resistance are connected to resistors of resistance 9.0Ω and 18Ω as shown.



What is the current I in the 9.0Ω resistor?

- A** 0.10 A **B** 0.20 A **C** 0.30 A **D** 0.47 A

57 - (9702/11_Winter_2019_Q34) - *D.c. Circuits*

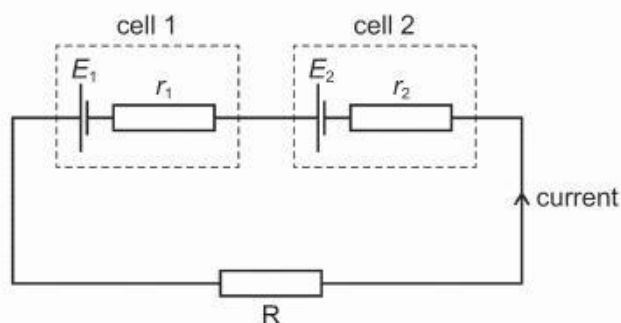
Kirchhoff's two laws for electric circuits can be derived by using conservation laws.

On which conservation laws do Kirchhoff's laws depend?

	Kirchhoff's first law	Kirchhoff's second law
A	charge	current
B	charge	energy
C	current	mass
D	energy	current

58 - (9702/12_Winter_2019_Q34) - D.c. Circuits

Two cells with electromotive forces E_1 and E_2 and internal resistances r_1 and r_2 are connected to a resistor R as shown.



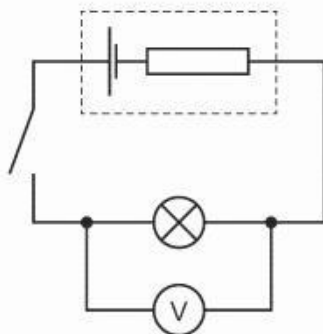
The terminal potential difference across cell 1 is zero.

Which expression gives the resistance of resistor R ?

- A $\frac{E_2 r_1 - E_1 r_2}{E_1}$ B $\frac{E_2 r_1 - E_1 r_2}{E_2}$ C $\frac{E_1 r_2 - E_2 r_1}{E_1}$ D $\frac{E_1 r_2 - E_2 r_1}{E_2}$

59 - (9702/11_Winter_2019_Q35) - D.c. Circuits

The diagram shows a circuit.

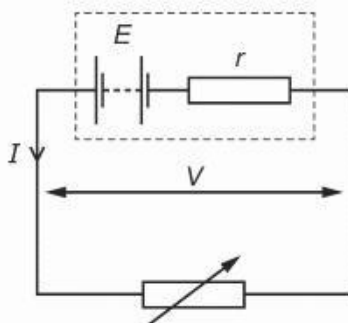


Which statement about the circuit is **not** correct?

- A Electromotive force is the energy transferred per unit charge.
 B Energy is transferred from chemical potential energy in the cell to other forms when the switch is closed.
 C The electromotive force of the cell is greater than the terminal potential difference when the switch is closed.
 D When the switch is open, the voltmeter measures the electromotive force of the cell.

60 - (9702/12_Winter_2019_Q35) - D.c. Circuits

A battery has an electromotive force (e.m.f.) E and internal resistance r . The battery delivers a current I to a variable resistor and the potential difference (p.d.) across its terminals is V .



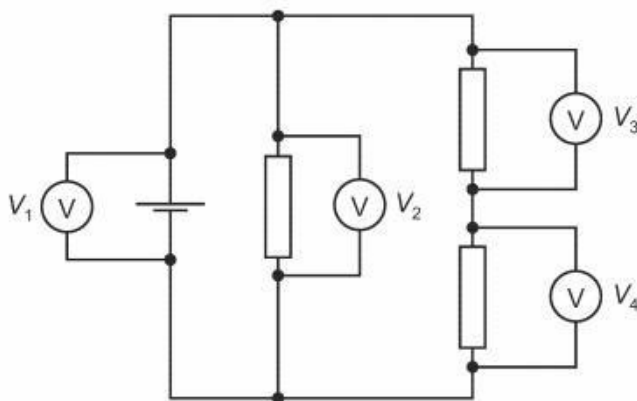
The variable resistor is adjusted so that I increases.

Why does V decrease?

- A The e.m.f. E decreases.
- B The internal resistance r increases.
- C The p.d. across r increases.
- D The resistance of the variable resistor increases.

61 - (9702/11_Winter_2019_Q36) - D.c. Circuits

The diagram shows a circuit containing four voltmeters. The readings on the voltmeters are V_1 , V_2 , V_3 and V_4 . All the readings are positive.

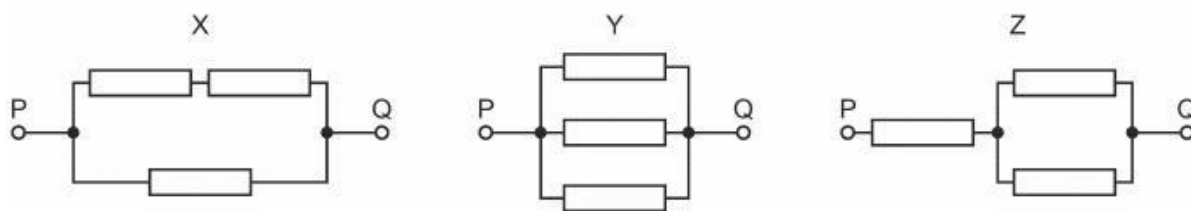


Which equation relating the voltmeter readings is correct?

- A $V_1 = V_2 + V_4$
- B $V_1 = V_2 + V_3 + V_4$
- C $V_2 + V_3 = V_4$
- D $V_3 + V_4 - V_2 = 0$

62 - (9702/12_Winter_2019_Q36) - D.c. Circuits

Three identical resistors are connected between terminals P and Q in different networks X, Y and Z as shown.

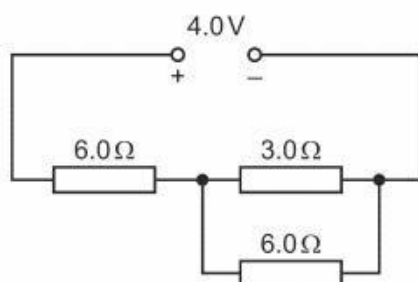


What is the order of increasing combined resistance between P and Q (lowest first)?

- A $X \rightarrow Y \rightarrow Z$
- B $X \rightarrow Z \rightarrow Y$
- C $Y \rightarrow X \rightarrow Z$
- D $Y \rightarrow Z \rightarrow X$

63 - (9702/11_Winter_2019_Q37) - D.c. Circuits

A network consists of a $3.0\ \Omega$ resistor and two $6.0\ \Omega$ resistors, as shown.



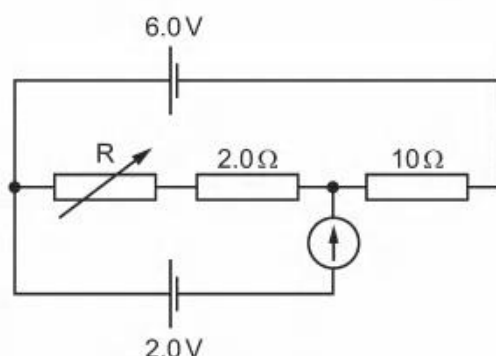
The potential difference (p.d.) across the network is 4.0 V .

What is the current through the $3.0\ \Omega$ resistor?

- A 0.17 A
- B 0.25 A
- C 0.33 A
- D 1.3 A

64 - (9702/12_Winter_2019_Q37) - D.c. Circuits

The diagram shows a variable resistor R and two fixed resistors connected in series in a circuit to act as a potential divider.



The cell of electromotive force (e.m.f.) 6.0V has negligible internal resistance. A cell of e.m.f. 2.0V and a galvanometer are connected into the potential divider. The resistance of R is varied until the galvanometer reads zero.

What is the resistance of resistor R ?

- A** 3.0Ω **B** 5.0Ω **C** 8.0Ω **D** 18Ω

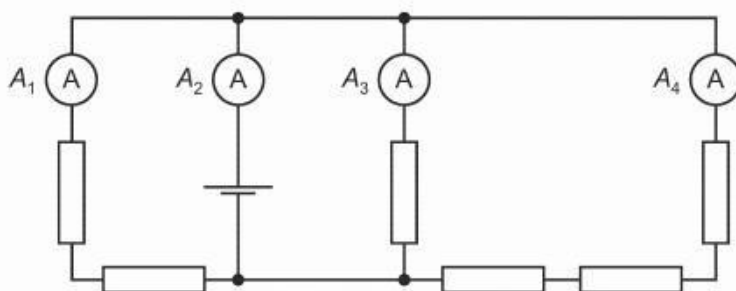
65 - (9702/13_Winter_2019_Q37) - D.c. Circuits

Which row correctly describes Kirchhoff's laws?

	Kirchhoff's first law	physics principle applied for first law	Kirchhoff's second law	physics principle applied for second law
A	The sum of the currents entering a junction equals the sum of the currents leaving the junction.	conservation of charge	The sum of the e.m.f.s around any closed loop in a circuit equals the sum of the p.d.s around the same loop.	conservation of energy
B	The sum of the currents entering a junction equals the sum of the currents leaving the junction.	conservation of energy	The sum of the e.m.f.s around any closed loop in a circuit equals the sum of the p.d.s around the same loop.	conservation of charge
C	The sum of the e.m.f.s around any closed loop in a circuit equals the sum of the p.d.s around the same loop.	conservation of energy	The sum of the currents entering a junction equals the sum of the currents leaving the junction.	conservation of charge
D	The sum of the e.m.f.s around any closed loop in a circuit equals the sum of the p.d.s around the same loop.	conservation of charge	The sum of the currents entering a junction equals the sum of the currents leaving the junction.	conservation of energy

66 - (9702/11_Winter_2019_Q38) - D.c. Circuits

In the circuit shown, all the resistors are identical and all the ammeters have negligible resistance.



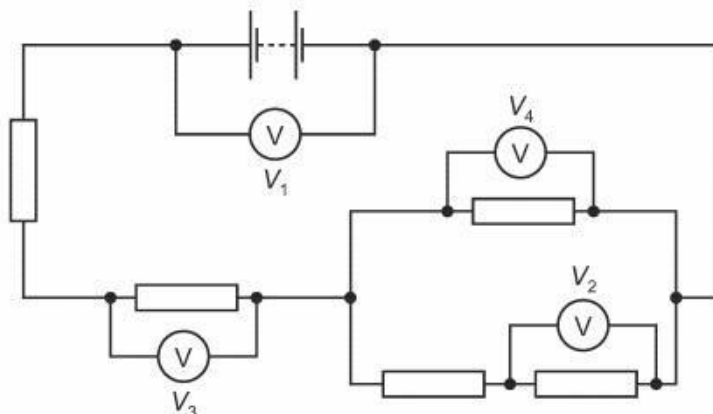
The reading A_1 is 0.6 A .

What are the readings on the other ammeters?

	A_2/A	A_3/A	A_4/A
A	1.0	0.3	0.1
B	1.4	0.6	0.2
C	1.8	0.9	0.3
D	2.2	1.2	0.4

67 - (9702/13_Winter_2019_Q38) - D.c. Circuits

In the circuit shown, all the resistors are identical.



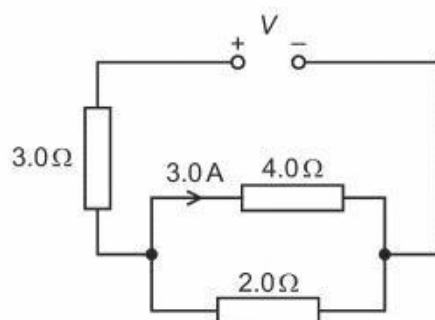
The reading V_1 is 8.0 V and the reading V_2 is 1.0 V .

What are the readings on the other voltmeters?

	V_3/V	V_4/V
A	1.5	1.0
B	3.0	2.0
C	4.5	3.0
D	6.0	4.0

68 – (9702/13_Summer_2020_Q35) – D.c. Circuits

A power supply of electromotive force (e.m.f.) V and negligible internal resistance is connected in the circuit shown. There is a current of 3.0 A in the $4.0\ \Omega$ resistor.



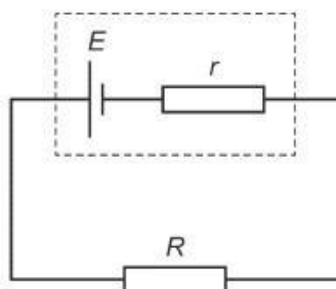
What is the value of V ?

- A** 15 V **B** 29 V **C** 39 V **D** 51 V

69 – (9702/11_Summer_2020_Q36) – D.c. Circuits

A cell of electromotive force (e.m.f.) E and internal resistance r is connected to a resistor of resistance R .

A maximum power P can be dissipated by the resistor without overheating.

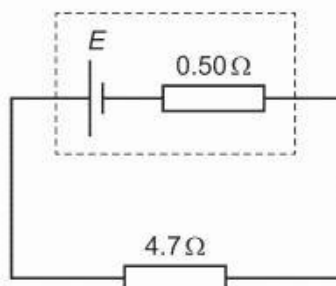


What is the maximum value of E if the resistor does not overheat?

- A** $R\sqrt{\frac{P}{(R-r)}}$ **B** $R\sqrt{\frac{P}{(R+r)}}$ **C** $(R-r)\sqrt{\frac{P}{R}}$ **D** $(R+r)\sqrt{\frac{P}{R}}$

70 - (9702/12_Summer_2020_Q36) - D.c. Circuits

A cell of electromotive force (e.m.f.) E and internal resistance $0.50\ \Omega$ is connected to a resistor of resistance $4.7\ \Omega$.



The maximum power that can be dissipated by the resistor without overheating is $0.50\ \text{W}$.

What is the maximum value of E for the resistor **not** to overheat?

- A** 1.4V **B** 1.5V **C** 1.7V **D** 2.9V

71 - (9702/12_Summer_2020_Q37) - D.c. Circuits

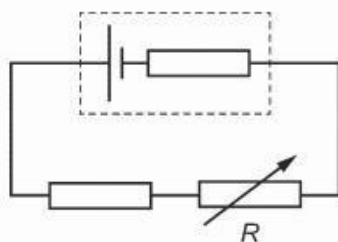
Kirchhoff's first and second laws link to the conservation of physical quantities.

Which quantities do they link to?

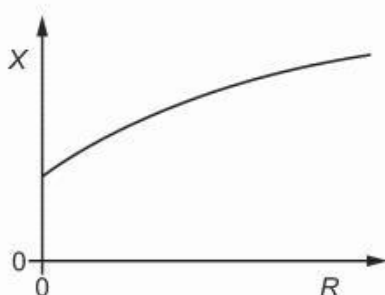
	first law	second law
A	charge	energy
B	charge	momentum
C	energy	charge
D	energy	momentum

72 - (9702/13_Summer_2020_Q37) - D.c. Circuits

A fixed resistor and a variable resistor are connected in series with a cell that has an internal resistance, as shown.



The graph shows the variation of a quantity X with the resistance R of the variable resistor as R is increased from zero to its maximum value.

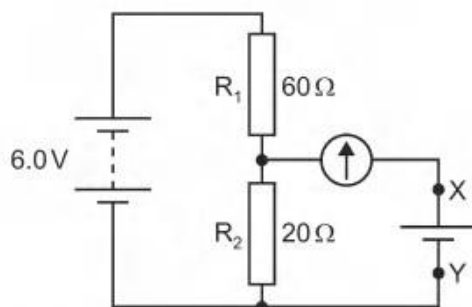


What could X represent?

- A** the current in the circuit
- B** the electromotive force of the cell
- C** the potential difference across the internal resistance
- D** the terminal potential difference across the cell

73 - (9702/11_Summer_2020_Q38) - D.c. Circuits

In the circuit shown, a battery of negligible internal resistance is connected in series with a pair of fixed resistors R_1 and R_2 .



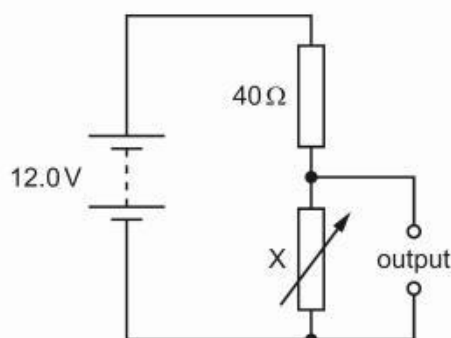
The circuit is to be used to test whether the electromotive force (e.m.f.) of a particular cell is 1.5 V. The cell is connected between terminals X and Y in parallel with R_2 and in series with a galvanometer.

Which statement about the test is correct?

- A Any non-zero reading on the galvanometer means the cell has an e.m.f. of 1.5 V.
- B The battery does not need to have an e.m.f. of 6.0 V.
- C The cell may be connected either way round between X and Y.
- D The galvanometer does not need a scale calibrated in amperes.

74 - (9702/12_Summer_2020_Q38) - D.c. Circuits

In the circuit shown, X is a variable resistor whose resistance can be changed from 5.0Ω to 500Ω . The electromotive force (e.m.f.) of the battery is 12.0 V. It has negligible internal resistance.

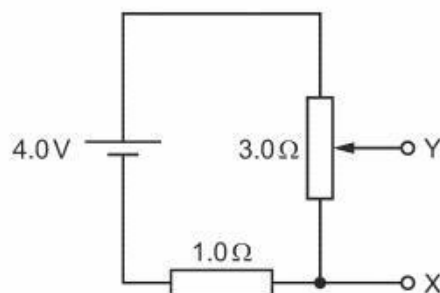


What is the maximum range of values of potential difference across the output?

- A 1.3 V to 11.1 V
- B 1.3 V to 12.0 V
- C 1.5 V to 11.1 V
- D 1.5 V to 12.0 V

75 - (9702/13_Summer_2020_Q38) - D.c. Circuits

A cell of electromotive force (e.m.f.) 4.0 V and negligible internal resistance is connected to a fixed resistor of resistance $1.0\ \Omega$ and a potentiometer of maximum resistance $3.0\ \Omega$, as shown.



Which range of potential differences can be obtained between the terminals X and Y?

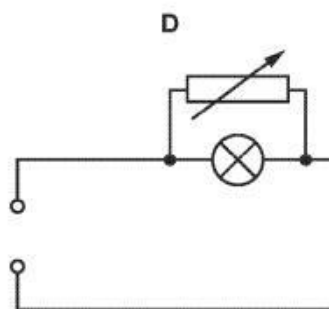
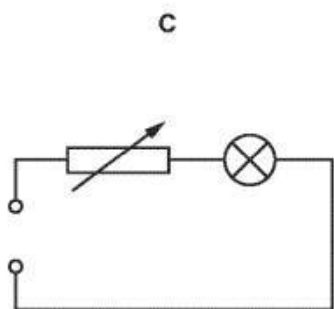
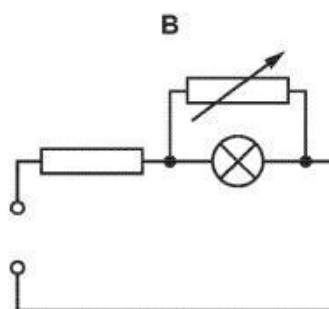
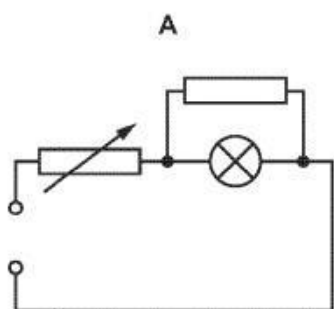
- A 0 V to 3.0 V
- B 0 V to 4.0 V
- C 1.0 V to 3.0 V
- D 1.0 V to 4.0 V

76 - (9702/11_Winter_2020_Q35) - D.c. Circuits

In the circuits shown, the power supply has an electromotive force (e.m.f.) greater than the normal operating voltage of the lamp. The internal resistance of the power supply is negligible.

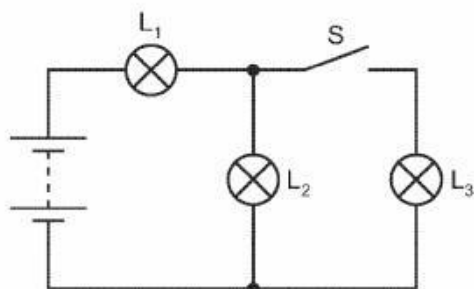
The resistance of the variable resistor is adjusted from zero to its maximum value.

In which circuit could the voltage across the lamp change from zero to its normal operating voltage and **not** exceed its normal operating voltage?



77 - (9702/11_Winter_2020_Q36) - D.c. Circuits

Three identical lamps L_1 , L_2 and L_3 are connected to a battery with negligible internal resistance, as shown.

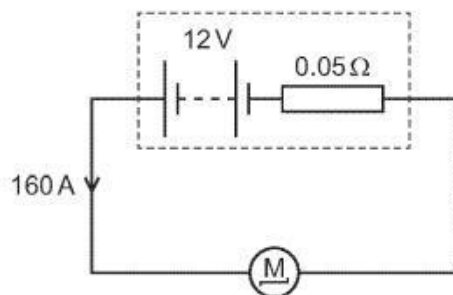


What happens to the brightness of lamps L_1 and L_2 when the switch S is closed?

	lamp L_1	lamp L_2
A	brighter	brighter
B	brighter	dimmer
C	dimmer	brighter
D	dimmer	dimmer

78 - (9702/12_Winter_2020_Q36) - D.c. Circuits

A car battery has an electromotive force (e.m.f.) of 12 V and an internal resistance of $0.05\ \Omega$. The battery is connected to the starter motor of a car. The current in the motor is 160 A.



What is the terminal p.d. across the battery?

- A 0 V B 4 V C 8 V D 12 V

79 - (9702/13_Winter_2020_Q36) - D.c. Circuits

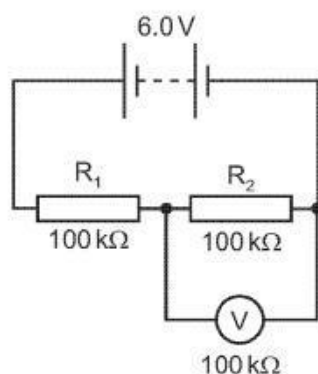
A cell is connected to a fixed resistor. Over a long period of time, the internal resistance of the cell increases.

What is the effect of the increase in internal resistance on the electromotive force (e.m.f.) of the cell and on the power dissipated by the fixed resistor?

	e.m.f.	power dissipated
A	decreases	decreases
B	decreases	no change
C	no change	decreases
D	no change	no change

80 - (9702/11_Winter_2020_Q37) - D.c. Circuits

In the circuit shown, the 6.0 V battery has negligible internal resistance. Resistors R_1 and R_2 and the voltmeter each have a resistance of $100\text{ k}\Omega$.

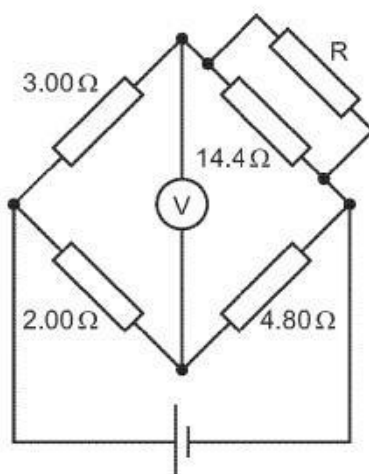


What is the current in the resistor R_2 ?

- A $20\text{ }\mu\text{A}$ B $30\text{ }\mu\text{A}$ C $40\text{ }\mu\text{A}$ D $60\text{ }\mu\text{A}$

81 - (9702/12_Winter_2020_Q37) - D.c. Circuits

A cell of negligible internal resistance is connected to a network of resistors and a voltmeter, as shown.



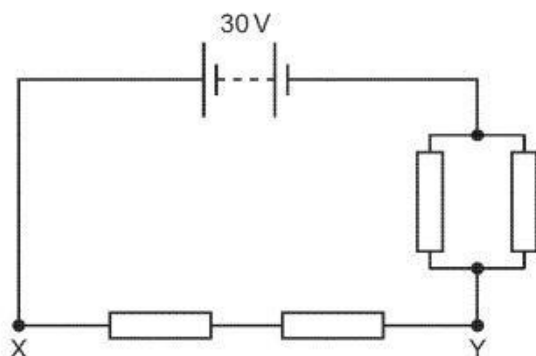
The reading on the voltmeter is zero.

What is the resistance of resistor R?

- A $1.20\ \Omega$ B $1.80\ \Omega$ C $7.20\ \Omega$ D $14.4\ \Omega$

82 - (9702/13_Winter_2020_Q37) - D.c. Circuits

Four identical resistors are connected in a circuit, as shown.



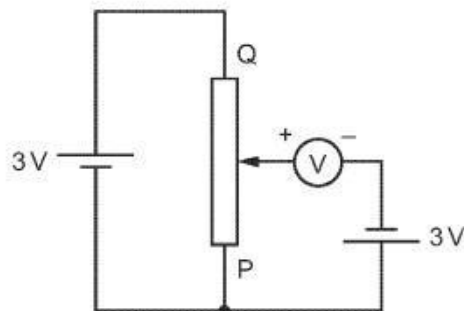
The battery has negligible internal resistance and an e.m.f. of 30 V.

What is the potential difference between the two points X and Y?

- A 6.0 V B 15 V C 20 V D 24 V

83 - (9702/12_Winter_2020_Q38) - D.c. Circuits

A voltmeter is connected into a circuit with the polarity shown in the diagram.



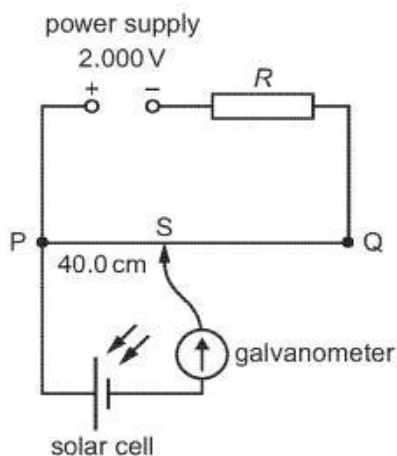
The sliding contact is moved to end P of the potentiometer and then to end Q.

What are the two readings of the voltmeter?

	sliding contact at end P	sliding contact at end Q
A	0 V	3 V
B	0 V	6 V
C	3 V	3 V
D	3 V	6 V

84 - (9702/13_Winter_2020_Q38) - D.c. Circuits

A power supply and a solar cell are compared using the potentiometer circuit shown.



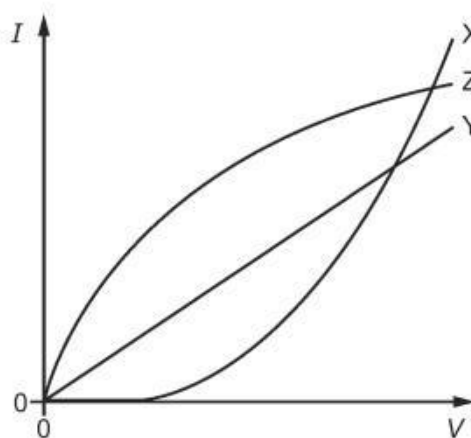
The potentiometer wire PQ is 100.0 cm long and has a resistance of $5.00\ \Omega$. The power supply has an e.m.f. of 2.000 V and the solar cell has an e.m.f. of 5.00 mV.

Which resistance R must be used so that the galvanometer reads zero when $PS = 40.0\text{ cm}$?

- A $395\ \Omega$ B $405\ \Omega$ C $795\ \Omega$ D $805\ \Omega$

85 – (9702/12_Summer_2021_Q34) – D.c. Circuits

The graph shows the variation with potential difference V of the current I in components X, Y and Z.



Which row correctly identifies the components?

	metallic conductor at constant temperature	semiconductor diode	filament lamp
A	X	Z	Y
B	Y	X	Z
C	Y	Z	X
D	Z	Y	X

86 – (9702/11_Summer_2021_Q35) – D.c. Circuits

A cell is described as having an electromotive force (e.m.f.) of 6 V.

What does this mean?

- A 1 coulomb of charge always dissipates 6 J of energy in the internal resistance of the cell.
- B 1 electron gains 6 J of energy when passing through the cell.
- C There is a potential difference of 6 V applied across any external circuit connected to the cell.
- D When 1 coulomb of charge passes through the cell, 6 J of chemical energy is transformed.

87 – (9702/12_Summer_2021_Q35) – D.c. Circuits

A wire of resistance $9.55\ \Omega$ has a diameter of 0.280 mm.

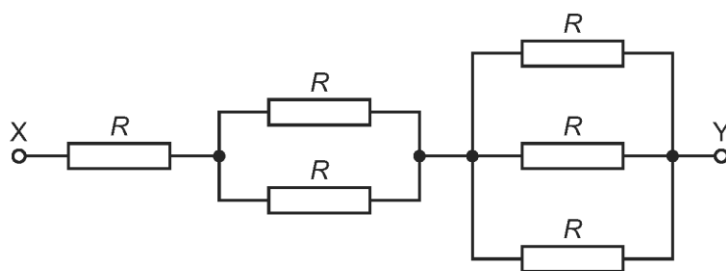
It is made of metal of resistivity $4.90 \times 10^{-7}\ \Omega\text{m}$.

What is the length of the wire?

- A 1.20 m
- B 4.80 m
- C 19.0 m
- D 76.0 m

88 - (9702/11_Summer_2021_Q36) - D.c. Circuits

The diagram shows a network of resistors. Each resistor has resistance R .

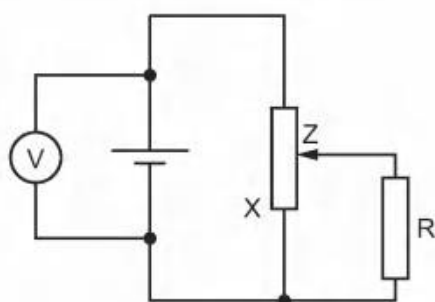


What is the total resistance of the network between points X and Y?

- A $\frac{R}{6}$ B $\frac{6R}{11}$ C $\frac{11R}{6}$ D $6R$

89 - (9702/12_Summer_2021_Q36) - D.c. Circuits

A cell of constant electromotive force (e.m.f.) but with internal resistance is connected to a fixed resistor R using a potentiometer. A voltmeter measures the potential difference (p.d.) between the terminals of the cell.

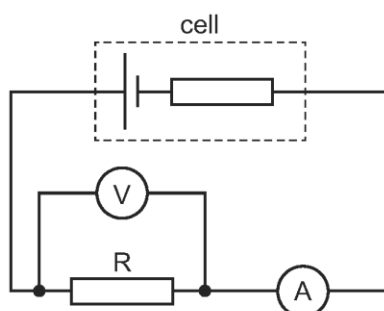


Which statement explains the change to the reading of the voltmeter as contact Z is moved towards end X of the potentiometer?

- A The voltmeter reading decreases because the current through the cell decreases.
B The voltmeter reading decreases because the current through the cell increases.
C The voltmeter reading increases because the current through the cell decreases.
D The voltmeter reading increases because the current through the cell increases.

90 - (9702/13_Summer_2021_Q36) - D.c. Circuits

The circuit shown includes a cell of constant internal resistance and an external resistor R.



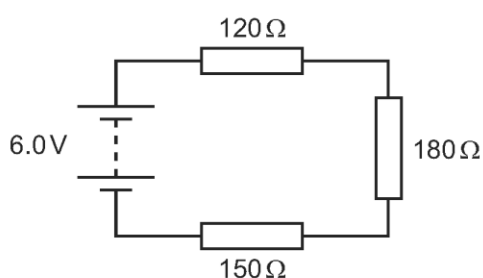
A student records the ammeter and voltmeter readings. She then connects a second identical external resistor in parallel with the first external resistor.

What happens to the ammeter reading and to the voltmeter reading?

	ammeter reading	voltmeter reading
A	decreases	decreases
B	decreases	stays the same
C	increases	decreases
D	increases	stays the same

91 - (9702/11_Summer_2021_Q37) - D.c. Circuits

Three resistors are connected in series with a battery, as shown. The battery has negligible internal resistance.



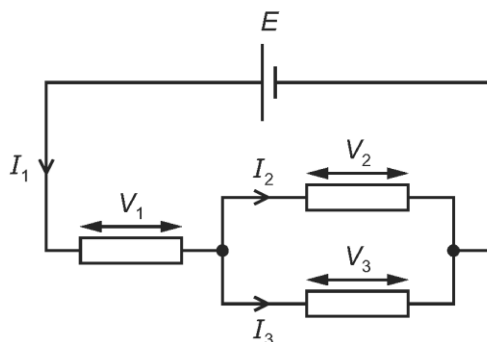
What is the potential difference across the 180Ω resistor?

- A 1.6V B 2.4V C 3.6V D 4.0V

92 - (9702/12_Summer_2021_Q37) - D.c. Circuits

A cell of electromotive force (e.m.f.) E and negligible internal resistance is connected to a circuit.

The circuit has currents I_1 , I_2 and I_3 , and potential differences V_1 , V_2 and V_3 , as shown.

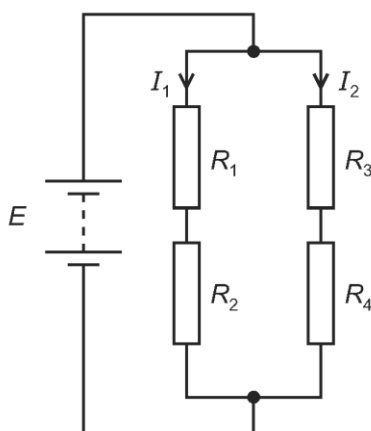


Which equation represents a statement of Kirchhoff's first law?

- A** $I_1 = I_2 + I_3$ **B** $I_1 = I_2 = I_3$ **C** $E = V_1 + V_2$ **D** $V_1 = V_2 = V_3$

93 - (9702/13_Summer_2021_Q37) - D.c. Circuits

A battery of electromotive force (e.m.f.) E and negligible internal resistance is connected to four resistors of resistances R_1 , R_2 , R_3 and R_4 .



The currents I_1 and I_2 in the resistors are as shown.

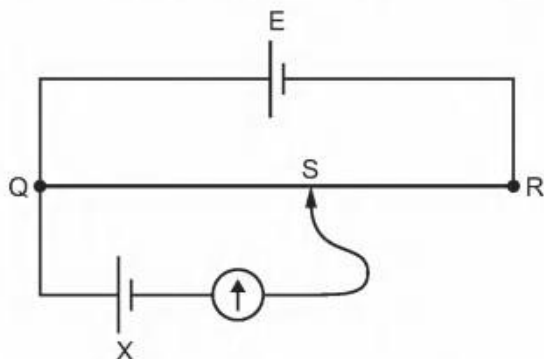
Which equation is correct?

- A** $0 = I_1(R_1 + R_2) + I_2(R_3 + R_4)$
B $0 = I_1(R_1 + R_2) - I_2(R_3 + R_4)$
C $E = I_1(R_1 + R_2) + I_2(R_3 + R_4)$
D $E = I_1(R_1 + R_2) - I_2(R_3 + R_4)$

94 - (9702/11_Summer_2021_Q38) - D.c. Circuits

A potentiometer circuit is used to determine the unknown electromotive force (e.m.f.) of a cell X.

In the circuit shown, E is a cell with an e.m.f. that is known accurately. QR is the potentiometer wire, which has a movable contact S. Contact S is connected to a galvanometer and to cell X.

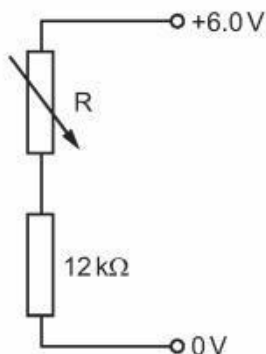


What is **not** a necessary requirement to determine the e.m.f. of X from the circuit?

- A The e.m.f. of cell X must be lower than the e.m.f. of cell E.
- B The internal resistance of cell X must be known.
- C The lengths QS and QR must be determined accurately.
- D The resistance of the wire QR must be proportional to its length.

95 - (9702/12_Summer_2021_Q38) - D.c. Circuits

Two resistors are connected in series with a 6.0 V power supply, as shown.



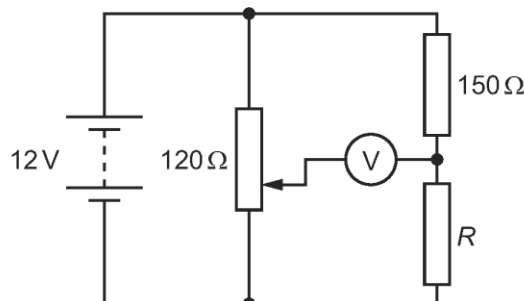
What is the resistance of the variable resistor R to give a potential difference of 1.0 V across the 12 kΩ resistor?

- A 2.0 kΩ
- B 10 kΩ
- C 60 kΩ
- D 72 kΩ

96 - (9702/13_Summer_2021_Q38) - D.c. Circuits

In the circuit shown, a potentiometer of total resistance $120\ \Omega$ is connected in parallel with a resistor of resistance $150\ \Omega$ and a resistor of resistance R .

The battery has electromotive force (e.m.f.) $12\ \text{V}$ and negligible internal resistance.



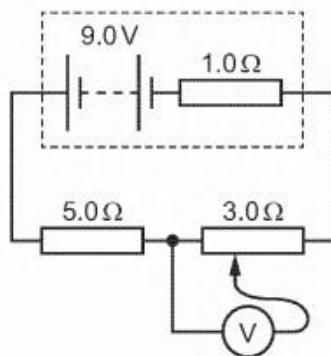
The voltmeter reads $0\ \text{V}$ when the slider of the potentiometer is $\frac{1}{4}$ of the way from its lower end, as shown.

What is resistance R ?

- A $30\ \Omega$ B $38\ \Omega$ C $50\ \Omega$ D $450\ \Omega$

97 - (9702/12_Winter_2021_Q38) - D.c. Circuits

A battery of electromotive force (e.m.f.) $9.0\ \text{V}$ and internal resistance $1.0\ \Omega$ is connected to a fixed resistor of resistance $5.0\ \Omega$ and a potentiometer of maximum resistance $3.0\ \Omega$, as shown.



The sliding contact of the potentiometer is moved over its full range of movement.

What is the maximum value of the potential difference that is measured by the voltmeter?

- A $3.0\ \text{V}$ B $3.4\ \text{V}$ C $4.5\ \text{V}$ D $5.4\ \text{V}$

98 – (9702/12_Summer_2022_Q35) – D.c. Circuits

A cell with constant electromotive force (e.m.f.) is connected across a fixed resistor. Over time, the internal resistance of the cell increases.

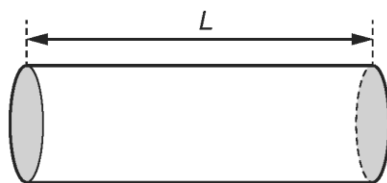
Which change occurs as the internal resistance of the cell increases?

- A a decrease in the charge of each charge carrier
- B a decrease in the potential difference measured across the cell
- C an increase in the energy dissipated per unit time in the fixed resistor
- D an increase in the number of charge carriers leaving the cell per unit time

99 – (9702/13_Summer_2022_Q35) – D.c. Circuits

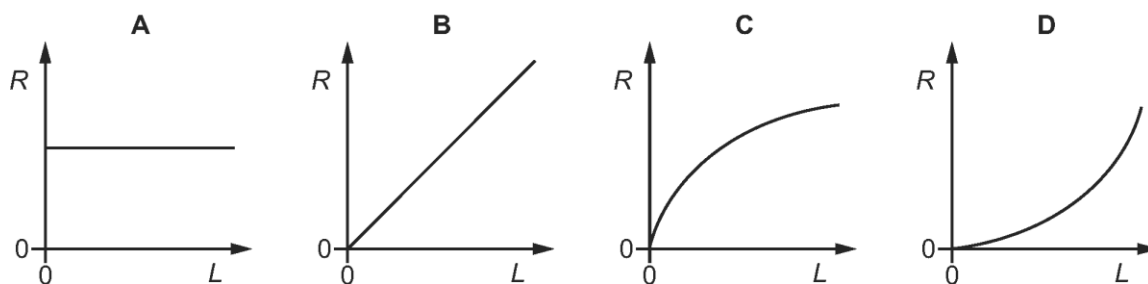
A piece of conducting putty (modelling clay) of constant resistivity is formed into a cylindrical shape.

The resistance R between its flat ends (shaded) is measured.



The same volume of putty is re-formed into cylinders of different lengths L , and the resistance R between the flat ends is measured for each value of L .

Which graph best shows the variation of R with L ?



100 – (9702/11_Summer_2022_Q36) – D.c. Circuits

The sum of the currents entering a junction in an electrical circuit is always equal to the sum of the currents leaving the junction.

Why is this?

- A It is a consequence of the conservation of charge.
- B It is a consequence of the conservation of electromotive force.
- C It is a consequence of the conservation of energy.
- D It is a consequence of the conservation of potential difference.

101 - (9702/13_Summer_2022_Q36) - D.c. Circuits

The diagram shows the symbol for a component that may be used in an electrical circuit.



Which component is represented by this circuit symbol?

- A buzzer
- B electric bell
- C loudspeaker
- D microphone

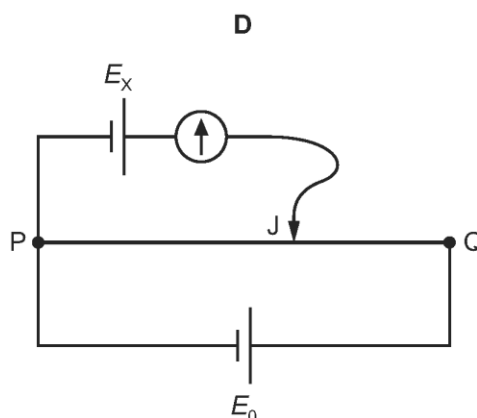
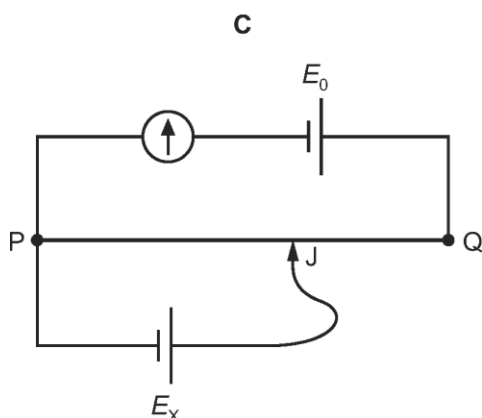
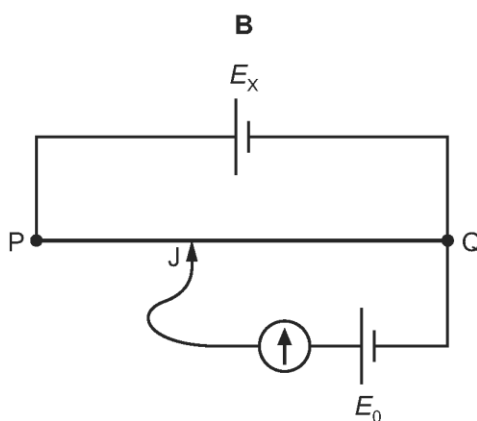
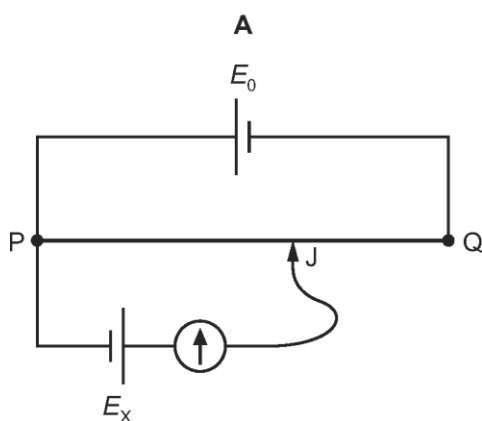
102 - (9702/12_Summer_2022_Q37) - D.c. Circuits

A potentiometer circuit is used to determine the electromotive force (e.m.f.) E_x of a cell. The circuit includes a second cell of known e.m.f. E_0 and negligible internal resistance, and a uniform resistance wire PQ of known length.

E_x is less than E_0 .

The movable connection J can be positioned anywhere along the length of the resistance wire.

Which circuit is suitable for determining E_x ?



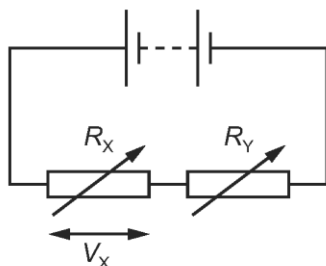
103 - (9702/13_Summer_2022_Q37) - D.c. Circuits

Which row correctly describes Kirchhoff's laws?

	Kirchhoff's first law	physics principle applied for first law	Kirchhoff's second law	physics principle applied for second law
A	The sum of the currents entering a junction equals the sum of the currents leaving the junction.	conservation of charge	The sum of the e.m.f.s around any closed loop in a circuit equals the sum of the p.d.s around the same loop.	conservation of energy
B	The sum of the currents entering a junction equals the sum of the currents leaving the junction.	conservation of energy	The sum of the e.m.f.s around any closed loop in a circuit equals the sum of the p.d.s around the same loop.	conservation of charge
C	The sum of the e.m.f.s around any closed loop in a circuit equals the sum of the p.d.s around the same loop.	conservation of energy	The sum of the currents entering a junction equals the sum of the currents leaving the junction.	conservation of charge
D	The sum of the e.m.f.s around any closed loop in a circuit equals the sum of the p.d.s around the same loop.	conservation of charge	The sum of the currents entering a junction equals the sum of the currents leaving the junction.	conservation of energy

104 - (9702/13_Summer_2022_Q38) - D.c. Circuits

A potential divider circuit is formed by connecting a battery of negligible internal resistance in series with two variable resistors, as shown.



The variable resistors have resistances R_X and R_Y .

V_X is the potential difference (p.d.) across the variable resistor with resistance R_X .

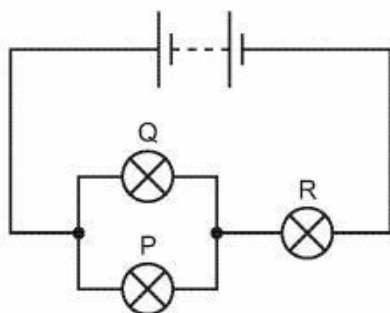
R_X and R_Y are both changed at the same time.

Which combination of changes **must** cause V_X to increase?

	R_X	R_Y
A	larger	larger
B	larger	smaller
C	smaller	larger
D	smaller	smaller

105 - (9702/11_Winter_2022_Q34) - *D.c. Circuits*

Three identical filament lamps, P, Q and R, are connected to a battery of negligible internal resistance, as shown.



The filament wire in lamp Q breaks so that it no longer conducts.

What are the changes in the brightness of lamps P and R?

	lamp P	lamp R
A	brighter	brighter
B	brighter	dimmer
C	dimmer	brighter
D	dimmer	dimmer

106 - (9702/12_Winter_2022_Q34) - *D.c. Circuits*

A metal wire has resistance R .

The wire is stretched so that its diameter decreases to 94.0% of the original diameter.

The volume of the wire is unchanged.

What is the resistance of the stretched wire?

- A $1.06R$ B $1.13R$ C $1.20R$ D $1.28R$

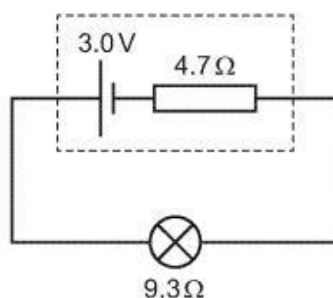
107 - (9702/11_Winter_2022_Q35) - *D.c. Circuits*

Which ratio has the same units as electromotive force (e.m.f.)?

- A charge per unit energy transferred
 B charge per unit time
 C energy transferred per unit charge
 D energy transferred per unit time

108 - (9702/12_Winter_2022_Q35) - D.c. Circuits

The diagram shows a cell of electromotive force (e.m.f.) 3.0 V and internal resistance $4.7\ \Omega$ connected across a lamp. The lamp has a resistance of $9.3\ \Omega$.



What is the power dissipated by the internal resistance of the cell?

- A 0.22 W B 0.43 W C 0.64 W D 1.0 W

109 - (9702/13_Winter_2022_Q35) - D.c. Circuits

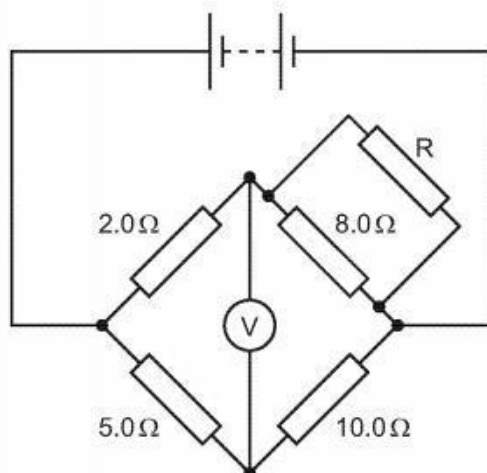
Each of Kirchhoff's laws is linked to the conservation of a physical quantity.

Which conserved physical quantities are used in the derivation of Kirchhoff's first law and of Kirchhoff's second law?

	Kirchhoff's first law	Kirchhoff's second law
A	energy	charge
B	energy	momentum
C	charge	energy
D	momentum	energy

110 - (9702/11_Winter_2022_Q36) - D.c. Circuits

A circuit consists of a battery, a voltmeter and five fixed resistors, as shown.



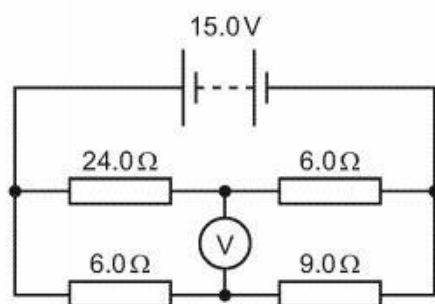
The voltmeter reading is zero.

What is the resistance of resistor R?

- A $1.1\ \Omega$ B $2.1\ \Omega$ C $4.0\ \Omega$ D $8.0\ \Omega$

111 - (9702/12_Winter_2022_Q36) - D.c. Circuits

A circuit consists of a battery, a high-resistance voltmeter and four fixed resistors, as shown. The battery has an electromotive force (e.m.f.) of 15.0 V and negligible internal resistance.

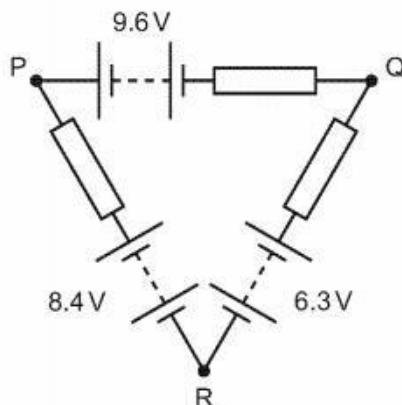


What is the reading on the voltmeter?

- A 3.0 V B 6.0 V C 9.0 V D 12.0 V

112 – (9702/13_Winter_2022_Q36) – D.c. Circuits

Three batteries and three identical resistors are connected in a circuit PQR, as shown.



The batteries have negligible internal resistance.

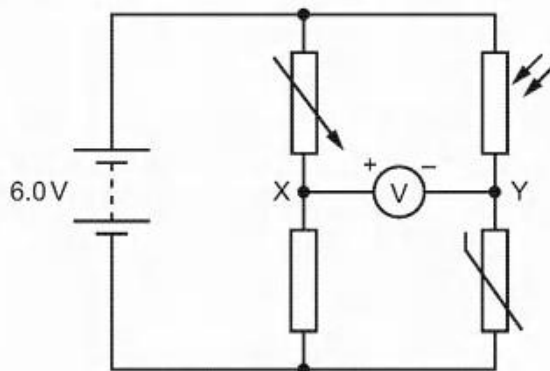
What is the potential difference between points P and Q?

- A 1.5 V B 2.1 V C 7.1 V D 12.1 V

113 – (9702/11_Winter_2022_Q37) – D.c. Circuits

A battery of electromotive force (e.m.f.) 6.0 V and negligible internal resistance is connected to a voltmeter and four other components, as shown.

The voltmeter is connected between points X and Y. The positive terminal of the voltmeter is connected to X and the negative terminal of the voltmeter is connected to Y.



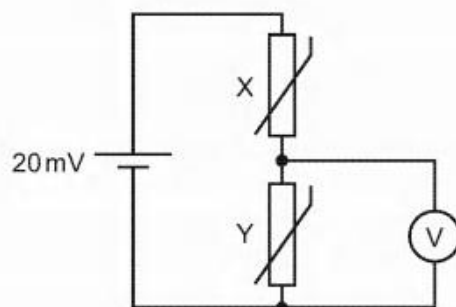
Initially, the resistance of each of the four components is $1.0\text{ k}\Omega$.

Which change, on its own, will cause the voltmeter to show a positive reading?

- A Decrease the temperature of the thermistor.
B Increase the resistance of the variable resistor.
C Reduce the intensity of light incident on the light-dependent resistor (LDR).
D Replace the fixed resistor with a $500\text{ }\Omega$ resistor.

114 - (9702/12_Winter_2022_Q37) - D.c. Circuits

A potential divider circuit is designed to detect the difference in temperature between two different places.



The cell has electromotive force (e.m.f.) 20 mV and negligible internal resistance.

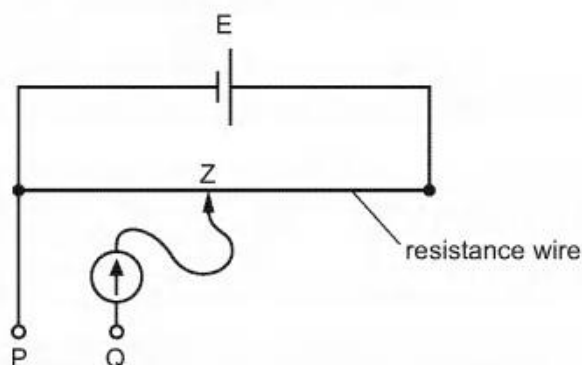
Initially, thermistors X and Y are at the same temperature and have the same resistance. The voltmeter reads 10 mV. X is then placed in a cold environment and its resistance doubles. Y is placed in a warm environment and its resistance halves.

What is the new reading on the voltmeter?

- A 4 mV B 5 mV C 15 mV D 16 mV

115 - (9702/13_Winter_2022_Q37) - D.c. Circuits

A cell E, of electromotive force (e.m.f.) 2 V and negligible internal resistance, is connected to a uniform resistance wire of resistance $10\ \Omega$ and length 1.0 m.



Z is a connection that may be made at any position along the resistance wire. A galvanometer is connected between Z and a point Q.

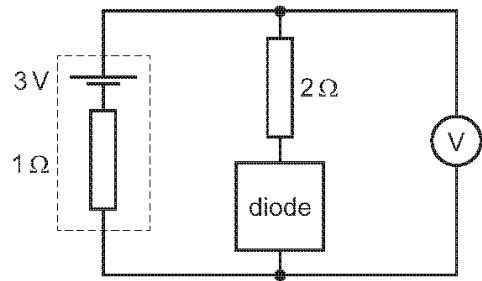
A new source of e.m.f. of approximately 8 mV is connected between points P and Q. The e.m.f. of the new source is determined by changing the position of Z until the reading on the galvanometer is zero.

Which change to the circuit allows a much more precise value for the e.m.f. of the new source to be obtained?

- A Add a resistor of resistance $0.1\ \Omega$ in series with cell E.
- B Add a resistor of resistance $1000\ \Omega$ in series with cell E.
- C Add a resistor of resistance $10\ \Omega$ in series with the new source.
- D Add a resistor of resistance $800\ \Omega$ in series with the new source.

1 - (9702/13_Winter_2017_Q35) - D.c. Circuits, Electronics

An ideal diode has zero resistance when forward biased and infinite resistance when reverse biased. The diode is connected in series with a $2\,\Omega$ resistor across the terminals of a source having electromotive force (e.m.f.) $3\,\text{V}$ and internal resistance $1\,\Omega$, as shown.



A high-resistance voltmeter is connected across the diode and resistor.

Which row gives the readings of the voltmeter for the two ways of connecting the diode?

	forward biased	reverse biased
A	1 V	3 V
B	2 V	0 V
C	2 V	3 V
D	3 V	0 V

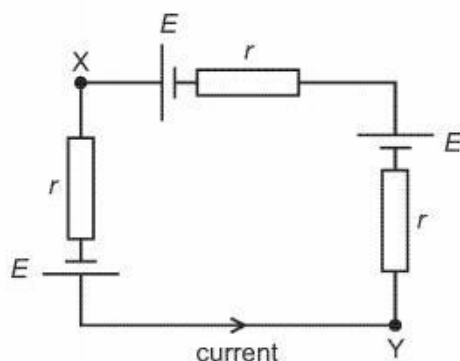
2 - (9702/11_Winter_2021_Q36) - Electronics

What is the circuit symbol for an oscilloscope?



3 - (9702/11_Winter_2021_Q37) - Electronics

Three identical cells, each of electromotive force (e.m.f.) E and internal resistance r , are connected as shown.

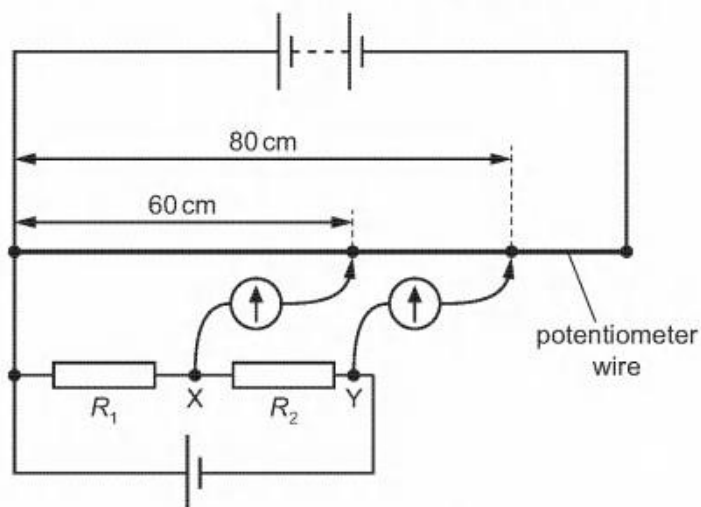


What is the potential difference between points X and Y?

- A 0 B E C $2E$ D $3E$

4 - (9702/11_Winter_2021_Q38) - Electronics

Potential differences across two resistors of resistances R_1 and R_2 are compared using a potentiometer wire (uniform resistance wire) in the electrical circuit shown.



One terminal of a galvanometer is connected to point X. The galvanometer reads zero when its other terminal is connected to a point that is a distance of 60 cm from one end of the potentiometer wire.

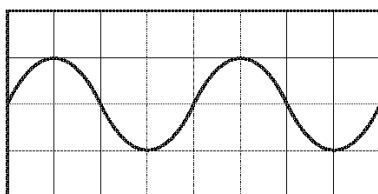
One terminal of a second galvanometer is connected to point Y. This galvanometer reads zero when its other terminal is connected to a point that is a distance of 80 cm from the same end of the potentiometer wire.

What is the ratio $\frac{R_2}{R_1}$?

- A $\frac{1}{3}$ B $\frac{3}{4}$ C $\frac{3}{1}$ D $\frac{4}{3}$

1 - (9702/13_Winter_2017_Q24) - *Alternating Currents*

An electrical signal is displayed on a cathode-ray oscilloscope (c.r.o.).



The time-base setting is 50 ms div^{-1} .

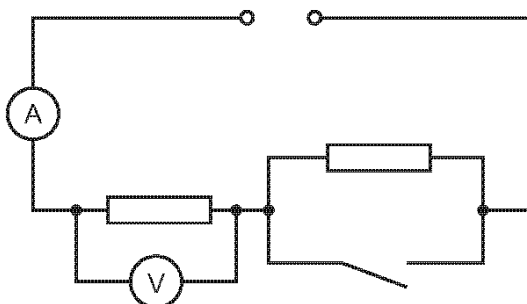
The Y-gain setting is 2 V div^{-1} .

What is the amplitude of the signal?

- A** 2 V **B** 4 V **C** 5 V **D** 10 V

2 - (9702/11_Winter_2017_Q36) - *Current Of Electricity, Alternating Currents*

In the circuit shown, the ammeter reading is I and the voltmeter reading is V .



When the switch is closed, which row describes what happens to I and to V ?

	I	V
A	decreases	decreases
B	increases	increases
C	increases	stays the same
D	stays the same	increases

1 - (9702/11_Summer_2023_Q38) - Quantum Physics

A proton has mass m_p and charge $+e$.

What are the mass and charge of an antiproton?

	mass	charge
A	$-m_p$	$+e$
B	$-m_p$	$-e$
C	m_p	$+e$
D	m_p	$-e$

2 - (9702/12_Summer_2023_Q40) - Quantum Physics

A π^+ meson has a charge of $+e$, where e is the elementary charge. It consists of an up quark and one other quark.

What could be the other quark in the π^+ meson?

- A anti-down
- B anti-up
- C bottom
- D charm

1 - (9702/13_Summer_2017_Q37) - Particle & Nuclear Physics

A nucleus of uranium-238, ${}^{238}_{92}\text{U}$, decays in a series of steps to form a nucleus of lead-206, ${}^{206}_{82}\text{Pb}$, as shown.



An α -particle or a β^- particle is emitted during each step.

What is the total number of β^- particles that are emitted?

- A** 6 **B** 8 **C** 10 **D** 16

2 - (9702/11_Summer_2017_Q38) - Particle & Nuclear Physics

The table lists the nucleon number and the proton number of various nuclei. The nuclei are represented by the letters L to T.

nucleus	nucleon number	proton number
L	227	89
M	226	89
N	225	89
O	227	90
P	226	90
Q	225	90
R	227	91
S	226	91
T	225	91

Which row in the following table correctly shows three nuclei of the same element, and three nuclei that have the same number of neutrons?

	same element	same number of neutrons
A	L M N	R P N
B	M P S	R S T
C	O P Q	M P S
D	R P N	O P Q

3 - (9702/12_Summer_2017_Q38) - Particle & Nuclear Physics

In a television programme to illustrate scientific models, a presenter fires a gun many times at a bale of hay. Two small cannon balls are embedded within the hay some distance apart from each other.

The hay bale measures approximately $2\text{ m} \times 2\text{ m} \times 2\text{ m}$ and the cannon balls are made of iron, approximately spherical, and about 5 cm in diameter.

What might the presenter be illustrating?

- A α -particle scattering
- B β^- decay
- C conservation of momentum
- D double-slit interference

4 - (9702/13_Summer_2017_Q38) - Particle & Nuclear Physics

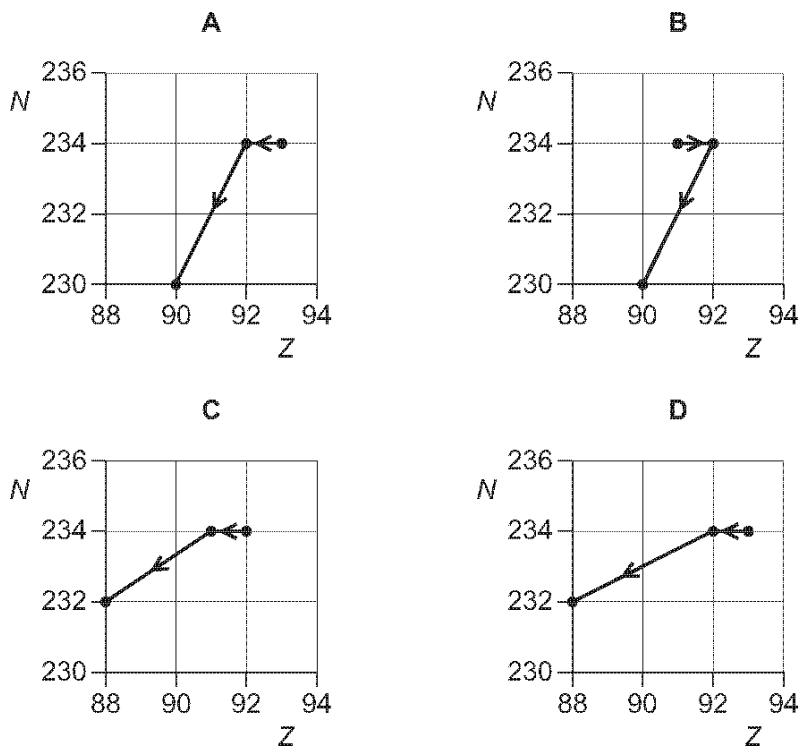
Which statement about α -particles is correct?

- A α -particles emitted from a single radioactive isotope have a continuous distribution of energies.
- B α -particles have less ionising power than β -particles.
- C The charge of an α -particle is $+1.60 \times 10^{-19}\text{ C}$.
- D The speeds of α -particles can be as high as $1.5 \times 10^7\text{ m s}^{-1}$.

5 - (9702/11_Summer_2017_Q39) - Particle & Nuclear Physics

A radioactive nucleus is formed by β^- decay. This nucleus then decays by α -emission.

Which graph of nucleon number N plotted against proton number Z shows the β^- decay followed by the α -emission?



6 - (9702/12_Summer_2017_Q39) - Particle & Nuclear Physics

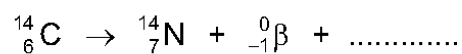
A certain nuclide, uranium-235, has nucleon number 235, proton number 92 and neutron number 143. Data on four other nuclides are given below.

Which nuclide is an isotope of uranium-235?

	nucleon number	proton number	neutron number
A	235	91	144
B	236	92	144
C	237	94	143
D	238	95	143

7 - (9702/13_Summer_2017_Q39) - Particle & Nuclear Physics

The nuclear equation shown has a term missing.



What is represented by the missing term?

- A** an antineutrino
- B** an electron
- C** a neutrino
- D** a positron

8 - (9702/11_Summer_2017_Q40) - Particle & Nuclear Physics

What are the structures of the proton and of the neutron in terms of quarks?

	proton		neutron	
	up quark	down quark	up quark	down quark
A	1	1	2	2
B	1	2	2	1
C	2	1	1	2
D	2	2	1	1

9 - (9702/12_Summer_2017_Q40) - Particle & Nuclear Physics

During β^- decay, which change takes place to the quark composition of the nucleus that emits the β^- particle, and which other particle is emitted?

	quark change	other particle emitted
A	down to up	antineutrino
B	down to up	neutrino
C	up to down	antineutrino
D	up to down	neutrino

10 - (9702/13_Summer_2017_Q40) - Particle & Nuclear Physics

Which particle is a fundamental particle?

- A electron
- B hadron
- C neutron
- D proton

11 - (9702/11_Winter_2017_Q39) - Particle & Nuclear Physics

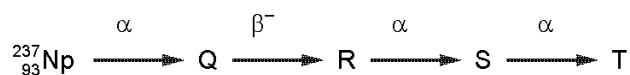
An astatine nucleus has a nucleon number of 218 and a proton number of 85. It decays to form a polonium nucleus, emitting a β^- particle and an α -particle in the process.

What are the nucleon number and the proton number of this polonium nucleus?

	nucleon number	proton number
A	214	83
B	214	84
C	215	83
D	216	82

12 - (9702/12_Winter_2017_Q39) - Particle & Nuclear Physics

The diagram shows a sequence of radioactive decays involving three α -particles and a β^- particle.



What is nuclide T?

- A ${}_{88}^{225}\text{Ra}$ B ${}_{88}^{231}\text{Ra}$ C ${}_{90}^{225}\text{Th}$ D ${}_{90}^{229}\text{Th}$

13 - (9702/13_Winter_2017_Q39) - Particle & Nuclear Physics

Each option shows the number of neutrons, protons and electrons in two atoms, some of which are ionised.

Which pair of atoms in the table are isotopes of the same element?

	neutron	proton	electron
A	20 20	17 19	20 20
B	28 28	23 24	23 24
C	34 36	29 29	29 28
D	40 42	32 31	32 32

14 - (9702/11_Winter_2017_Q40) - Particle & Nuclear Physics

What is the quark composition of a hydrogen-3 nucleus, ${}^3_1\text{H}$?

	number of quarks	
	up	down
A	4	5
B	5	4
C	5	7
D	7	5

15 - (9702/12_Winter_2017_Q40) - Particle & Nuclear Physics

Which combination of up (u) and down (d) quarks forms a neutron?

- A u u u B u u d C u d d D d d d

16 - (9702/13_Winter_2017_Q40) - Particle & Nuclear Physics

Which combination of up (u) and down (d) quarks forms a proton?

- A u u u B u u d C u d d D d d d

17 - (9702/11_Summer_2018_Q38) - Particle & Nuclear Physics

Which elementary particle is a lepton?

- A proton
B neutron
C electron
D quark

18 - (9702/12_Summer_2018_Q38) - Particle & Nuclear Physics

In the α -particle scattering experiment, a beam of α -particles is aimed at a thin gold foil. Most of the α -particles go straight through or are deflected by a small angle. A very small proportion are deflected through more than 90° , effectively rebounding towards the source of the α -particles.

Which conclusion about the structure of atoms **cannot** be drawn from this experiment alone?

- A Most of the atom is empty space.
B Most of the mass of an atom is concentrated in the nucleus.
C The nucleus contains both protons and neutrons.
D The nucleus is charged.

19 - (9702/11_Summer_2018_Q39) - Particle & Nuclear Physics

How many down quarks are in a nucleus of hydrogen-3, ${}^3_1\text{H}$?

- A 2 B 3 C 4 D 5

20 - (9702/12_Summer_2018_Q39) - Particle & Nuclear Physics

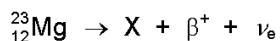
Radon-211, ${}^{211}_{86}\text{Rn}$, francium-210, ${}^{210}_{87}\text{Fr}$, and radium-212, ${}^{212}_{88}\text{Ra}$, are three nuclides.

How many neutrons does each nuclide have in its nucleus?

	radon-211	francium-210	radium-212
A	86	87	88
B	125	123	124
C	211	210	212
D	297	297	300

21 - (9702/13_Summer_2018_Q39) - Particle & Nuclear Physics

A nucleus of magnesium-23 undergoes β^+ decay, as represented by the nuclear equation shown.



What is nucleus X?

- A ${}^{22}_{11}\text{Na}$ B ${}^{22}_{13}\text{Al}$ C ${}^{23}_{11}\text{Na}$ D ${}^{23}_{13}\text{Al}$

22 - (9702/11_Summer_2018_Q40) - Particle & Nuclear Physics

What is the correct equation for β^+ decay?

- A neutron $\rightarrow$ proton + electron + electron antineutrino
B neutron $\rightarrow$ proton + electron + electron neutrino
C proton $\rightarrow$ neutron + positron + electron antineutrino
D proton $\rightarrow$ neutron + positron + electron neutrino

23 - (9702/12_Summer_2018_Q40) - Particle & Nuclear Physics

A neutron is composed of one up (u) quark and two down (d) quarks. When the neutron decays to a proton, there is β -emission.

What is the change in the quark structure of the neutron due to the β -emission?

(The symbol for a neutrino is ν_e and for an antineutrino is $\bar{\nu}_e$.)

A $d \rightarrow u + \beta^- + \nu_e$

B $d \rightarrow u + \beta^- + \bar{\nu}_e$

C $u \rightarrow d + \beta^+ + \nu_e$

D $u \rightarrow d + \beta^+ + \bar{\nu}_e$

24 - (9702/13_Summer_2018_Q40) - Particle & Nuclear Physics

Which list contains only leptons?

A electron, neutrino, positron

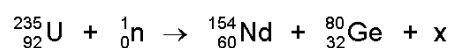
B electron, neutrino, proton

C electron, proton, neutron

D neutrino, neutron, positron

25 - (9702/13_Winter_2018_Q38) - Particle & Nuclear Physics

A neutron collides with a nucleus of uranium-235. One possible nuclear reaction that results is represented by the equation



where x represents one or more particles.

What does x represent?

A one neutron

B two electrons

C two neutrons

D two protons

26 - (9702/11_Winter_2018_Q39) - Particle & Nuclear Physics

A nucleus emits a β^- particle.

What is the change to the proton number and to the nucleon number of the nucleus?

	proton number	nucleon number
A	−1	+1
B	0	−1
C	+1	−1
D	+1	0

27 - (9702/12_Winter_2018_Q39) - Particle & Nuclear Physics

A proton in a nucleus undergoes β^+ decay. One of the products is a neutron.

What are the other products?

- A** an electron and a neutrino
- B** an electron and an antineutrino
- C** a positron and a neutrino
- D** a positron and an antineutrino

28 - (9702/13_Winter_2018_Q39) - Particle & Nuclear Physics

A nucleus Q has the notation ${}^y_x\text{Q}$.

Which of the following is an isotope of Q?

- A** ${}^{y-1}_x\text{Q}$ **B** ${}^y_{x-1}\text{Q}$ **C** ${}^y_{x+1}\text{Q}$ **D** ${}^{y-1}_{x+1}\text{Q}$

29 - (9702/11_Winter_2018_Q40) - Particle & Nuclear Physics

How many up quarks and how many down quarks are in a nucleus of the nuclide ${}^{37}_{17}\text{Cl}$?

	up quarks	down quarks
A	51	60
B	54	57
C	57	54
D	60	51

30 - (9702/12_Winter_2018_Q40) - Particle & Nuclear Physics

A certain type of hadron has zero charge. It is composed of a down quark, a strange quark and one other quark.

What could be the other quark?

- A up
- B down
- C strange
- D anti-strange

31 - (9702/13_Winter_2018_Q40) - Particle & Nuclear Physics

In β^- decay, a neutron inside a nucleus changes to a proton.

Which statement describes the quark composition of the nucleus during the decay?

- A The number of down quarks decreases by one.
- B The number of down quarks increases by one.
- C The number of down quarks stays the same.
- D The number of up quarks stays the same.

32 - (9702/12_Summer_2019_Q38) - Particle & Nuclear Physics

A nucleus of francium-221 ($^{221}_{87}\text{Fr}$) decays into a nucleus of bismuth-209 ($^{209}_{83}\text{Bi}$) in several steps.

Which particles could be emitted?

- A 2 α -particles and 4 β^- particles
- B 2 α -particles and 4 β^+ particles
- C 3 α -particles and 2 β^- particles
- D 3 α -particles and 2 β^+ particles

33 - (9702/11_Summer_2019_Q39) - Particle & Nuclear Physics

Which statement about the alpha-particle scattering experiment provides evidence for the existence of the nucleus?

- A A tiny proportion of the alpha-particles are deflected through large angles.
- B Slower alpha-particles are deflected through larger angles.
- C The kinetic energies of the deflected alpha-particles are unchanged.
- D The number of alpha-particles deflected depends on the thickness of the foil.

34 - (9702/12_Summer_2019_Q39) - Particle & Nuclear Physics

Which equation describes the changes to the quark composition of a nucleus and the lepton emission during the process of β^+ decay?

- A down $\rightarrow$ up + positron + electron neutrino
- B down $\rightarrow$ up + positron + electron antineutrino
- C up $\rightarrow$ down + positron + electron neutrino
- D up $\rightarrow$ down + positron + electron antineutrino

35 - (9702/13_Summer_2019_Q39) - Particle & Nuclear Physics

What is a correct estimate of the order of magnitude of the diameter of a typical atomic nucleus?

- A 10^{-14} m B 10^{-18} m C 10^{-22} m D 10^{-26} m

36 - (9702/11_Summer_2019_Q40) - Particle & Nuclear Physics

Some particles are a combination of three quarks.

Which combination of quarks would **not** result in a particle with a charge of either $+1.6 \times 10^{-19}$ C or zero?

- A up, down, down
- B up, strange, strange
- C up, up, down
- D up, up, up

37 - (9702/12_Summer_2019_Q40) - Particle & Nuclear Physics

There are protons, neutrons and electrons in the simple model of an atom.

To which class (group), hadron or lepton, do these particles belong?

	hadron	lepton
A	electron	proton and neutron
B	neutron	proton and electron
C	proton and electron	neutron
D	proton and neutron	electron

38 - (9702/13_Summer_2019_Q40) - Particle & Nuclear Physics

Which statement describes β^- decay in terms of a simple quark model?

- A A down quark changes to an up quark, and an electron and an electron antineutrino are emitted.
- B A down quark changes to an up quark, and a positron and an electron neutrino are emitted.
- C An up quark changes to a down quark, and an electron and an electron antineutrino are emitted.
- D An up quark changes to a down quark, and a positron and an electron neutrino are emitted.

39 - (9702/12_Winter_2019_Q38) - Particle & Nuclear Physics

The table gives some data relating to four neutral (uncharged) atoms W, X, Y and Z.

	W	X	Y	Z
nucleon (mass) number	16	17	17	18
total number of particles (protons, neutrons and electrons) in the atom	24	26	25	28

Two of the atoms are isotopes of the same element.

What is the proton number of this element?

- A 7
- B 8
- C 9
- D 10

40 - (9702/11_Winter_2019_Q39) - Particle & Nuclear Physics

An unstable nucleus of an element decays by emitting an α -particle or a β^- particle to become a nucleus of a different element. This nucleus is also unstable and also emits an α -particle or a β^- particle. The process continues until an isotope of the original element is produced.

What is the minimum possible number of these particles emitted?

- A 2
- B 3
- C 4
- D 5

41 - (9702/12_Winter_2019_Q39) - Particle & Nuclear Physics

What is **not** a fundamental particle?

- A electron
- B neutrino
- C neutron
- D positron

42 – (9702/13_Winter_2019_Q39) – Particle & Nuclear Physics

A radioactive nucleus emits an α -particle or a β^- particle, creating a product nucleus.

Which decay could create the product nucleus stated?

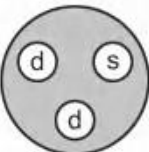
	radioactive nucleus	decay	product nucleus
A	$^{226}_{88}\text{Ra}$	α	$^{224}_{86}\text{Rn}$
B	$^{238}_{92}\text{U}$	α	$^{242}_{94}\text{Pu}$
C	$^{228}_{88}\text{Ra}$	β^-	$^{228}_{87}\text{Fr}$
D	$^{231}_{90}\text{Th}$	β^-	$^{231}_{91}\text{Pa}$

43 – (9702/11_Winter_2019_Q40) – Particle & Nuclear Physics

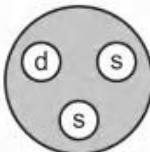
The diagrams show the quark composition of four different hadrons. One of the hadrons is a Σ^+ particle. It has a charge of $+e$, where e is the elementary charge.

Which hadron could be the Σ^+ particle?

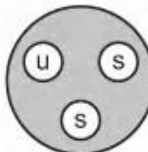
A



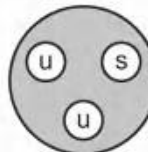
B



C



D



key

u = up quark

d = down quark

s = strange quark

44 – (9702/12_Winter_2019_Q40) – Particle & Nuclear Physics

An unstable nucleus decays and emits a β^- particle.

Which changes, if any, occur to the quark composition of the nucleus?

	quark changes	
	up quarks	down quarks
A	+1	0
B	+1	-1
C	-1	+1
D	0	+1

45 – (9702/13_Winter_2019_Q40) – Particle & Nuclear Physics

Which statement is correct?

- A Electrons and neutrinos are fundamental particles.
- B Electrons and neutrinos are hadrons.
- C Protons and neutrons are leptons.
- D Protons and neutrons are quarks.

46 - (9702/11_Summer_2020_Q39) - Particle & Nuclear Physics

An element has two isotopic forms.

What are the nuclear arrangements of these two isotopes?

- A They have different nucleon numbers and different proton numbers.
- B They have different nucleon numbers but the same proton number.
- C They have the same nucleon number and the same proton number.
- D They have the same nucleon number but different proton numbers.

47 - (9702/12_Summer_2020_Q39) - Particle & Nuclear Physics

An unstable nucleus goes through successive decays to become a final, stable nucleus.

The initial nucleus and the final nucleus are isotopes of each other.

How many α and β^- particles could have been emitted during the decay sequence?

	particle	
	α	β^-
A	1	0
B	1	2
C	2	0
D	2	1

48 - (9702/13_Summer_2020_Q39) - Particle & Nuclear Physics

Radiation from a radioactive source has a range of a few millimetres in air and can be deflected by an electric field.

Which type of radiation is being emitted?

- A α -radiation
- B β^- radiation
- C β^+ radiation
- D γ -rays

49 - (9702/11_Summer_2020_Q40) - Particle & Nuclear Physics

A hadron has a charge $+e$, where e is the elementary charge.

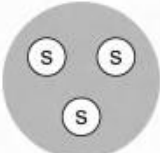
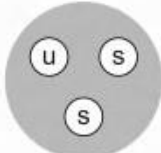
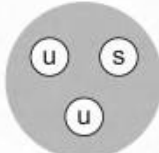
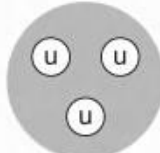
Which combination of up (u) and down (d) quarks could form this hadron?

- A ddd
- B udd
- C uud
- D uuu

50 - (9702/12_Summer_2020_Q40) - Particle & Nuclear Physics

A hadron has a charge of $-e$ and is composed of three quarks.

What could be the quark composition of the hadron?

A  **B**  **C**  **D** 

key
u = up quark
s = strange quark

51 - (9702/13_Summer_2020_Q40) - Particle & Nuclear Physics

Which equation describes the process of β^+ decay?

key:

u = up quark

d = down quark

ν = (electron) neutrino

$\bar{\nu}$ = (electron) antineutrino

A $ddu \rightarrow uud + \beta^+ + \nu$

B $ddu \rightarrow uud + \beta^+ + \bar{\nu}$

C $uud \rightarrow ddu + \beta^+ + \nu$

D $uud \rightarrow ddu + \beta^+ + \bar{\nu}$

52 - (9702/11_Winter_2020_Q38) - Particle & Nuclear Physics

Which statement about two nuclei that are isotopes of the same element is correct?

A The nuclei each have the same acceleration when in the same uniform electric field.

B The nuclei each have the same number of neutrons.

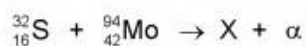
C The nuclei each have the same number of nucleons.

D Uncharged atoms containing the nuclei each have the same number of electrons.

53 - (9702/11_Winter_2020_Q39) - Particle & Nuclear Physics

In a nuclear physics experiment, a nucleus of $^{32}_{16}\text{S}$ collides with a nucleus of $^{94}_{42}\text{Mo}$. The nuclei combine together and immediately emit a single alpha-particle.

The nuclear reaction is shown.



What is nucleus X?

A $^{122}_{56}\text{X}$

B $^{124}_{54}\text{X}$

C $^{126}_{58}\text{X}$

D $^{126}_{59}\text{X}$

54 - (9702/12_Winter_2020_Q39) - Particle & Nuclear Physics

What is a conclusion from the alpha-particle scattering experiment?

- A Protons and electrons have equal but opposite charges.
- B Protons have a much larger mass than electrons.
- C The nucleus contains most of the mass of the atom.
- D The nucleus of an atom contains protons and neutrons.

55 - (9702/13_Winter_2020_Q39) - Particle & Nuclear Physics

The table contains data for four different nuclei P, Q, R and S.

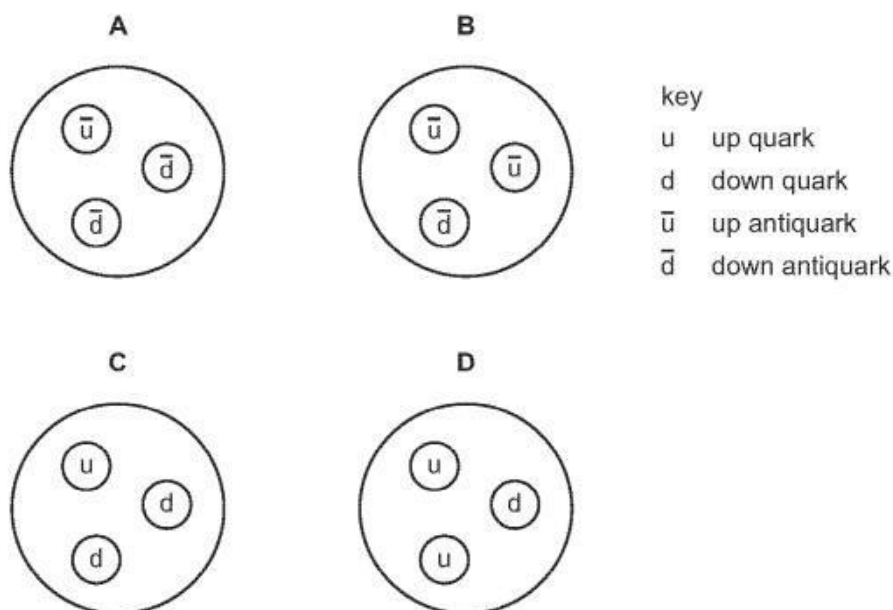
nucleus	number of neutrons	nucleon number
P	5	10
Q	6	10
R	6	14
S	8	16

Which two nuclei are isotopes of the same element?

- A P and Q
- B P and S
- C Q and R
- D R and S

56 - (9702/11_Winter_2020_Q40) - Particle & Nuclear Physics

Which diagram represents the quark composition of an antineutron?



57 - (9702/12_Winter_2020_Q40) - Particle & Nuclear Physics

Which particle is a hadron?

- A electron
- B neutrino
- C positron
- D proton

58 - (9702/13_Winter_2020_Q40) - Particle & Nuclear Physics

Which particle is a fundamental particle?

- A alpha-particle
- B electron
- C neutron
- D proton

59 - (9702/11_Summer_2021_Q39) - Particle & Nuclear Physics

A nucleus of uranium, ${}_{92}^{235}\text{U}$, undergoes a series of decays. During the series of decays, two α -particles and one β^- particle are emitted.

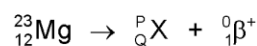
As a result, a nucleus of actinium, Ac, is formed.

What is the correct notation for the nuclide of actinium that is formed?

- A ${}_{87}^{227}\text{Ac}$ B ${}_{89}^{227}\text{Ac}$ C ${}_{87}^{231}\text{Ac}$ D ${}_{89}^{231}\text{Ac}$

60 - (9702/12_Summer_2021_Q39) - Particle & Nuclear Physics

A nucleus of magnesium decays into a nucleus X by emitting a β^+ particle. The decay is represented by the equation shown.



What are the values of P and Q?

	P	Q
A	22	11
B	22	13
C	23	11
D	23	13

61 - (9702/13_Summer_2021_Q39) - Particle & Nuclear Physics

A beam of α -particles is incident on a thin gold foil. One α -particle collides head-on with a gold nucleus and is deflected back along its original path.

Which statement could explain why the recoil speed of the gold nucleus is small compared with the recoil speed of the α -particle?

- A Most α -particles are only slightly deflected as they pass through the gold foil.
B The α -particle and the gold nucleus repel each other.
C The mass of the gold nucleus is much greater than the mass of the α -particle.
D The momentum of the α -particle decreases as it approaches the gold nucleus.

62 - (9702/11_Summer_2021_Q40) - Particle & Nuclear Physics

Which particle is a fundamental particle?

- A electron
B hadron
C neutron
D proton

63 - (9702/13_Summer_2021_Q40) - Particle & Nuclear Physics

A hadron is composed of three quarks. The hadron has a charge.

What is a possible quark composition of the hadron?

- A down, down, up
- B down, up, strange
- C up, strange, strange
- D up, up, strange

64 - (9702/13_Winter_2021_Q38) - Particle & Nuclear Physics

When α -particles are fired at a thin metal foil, most of the particles pass straight through but a few are deflected by a large angle.

Which change would increase the **proportion** of α -particles deflected by a large angle?

- A using α -particles with greater kinetic energy
- B using a double thickness foil
- C using a foil made of a metal with fewer protons in its nuclei
- D using a source emitting more α -particles per unit time

65 - (9702/11_Winter_2021_Q39) - Particle & Nuclear Physics

A uranium-238 nucleus, ${}_{92}^{238}\text{U}$, undergoes a series of nuclear decays to form uranium-234, ${}_{92}^{234}\text{U}$.

Which series of decays could give this result?

- A emission of four β^- particles
- B emission of four γ -rays
- C emission of one α -particle and two β^- particles
- D emission of two α -particles and eight β^- particles

66 - (9702/12_Winter_2021_Q39) - Particle & Nuclear Physics

An unstable nucleus decays by emitting a β^+ particle.

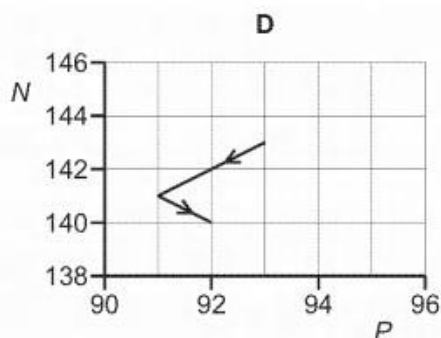
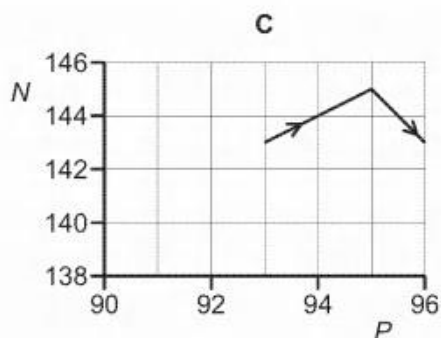
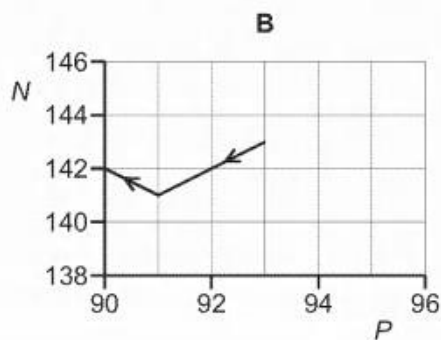
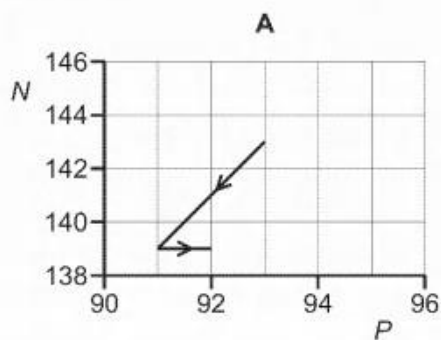
Which statement is correct?

- A An antineutrino is also emitted.
- B A neutron changes into a proton.
- C Mass–energy is conserved.
- D The nucleon number is not conserved.

67 - (9702/13_Winter_2021_Q39) - Particle & Nuclear Physics

A nucleus of neptunium-236 contains 93 protons and 143 neutrons. This nucleus decays with the emission of an α -particle. The nucleus formed then emits a β^- particle.

Which diagram shows the changes in the number P of protons and the number N of neutrons in these nuclei?



68 - (9702/12_Winter_2021_Q40) - Particle & Nuclear Physics

Which statement is **not** correct?

- A** An antineutrino is a fundamental particle.
- B** An electron is made up of a quark and an antiquark.
- C** A neutrino is a lepton.
- D** A neutron is composed of three quarks.

69 - (9702/13_Winter_2021_Q40) - Particle & Nuclear Physics

Which combination of quarks could **not** be the quark composition of the hadron shown?

p = proton

n = neutron

 Σ^- = sigma particle of charge $-e$ Σ^+ = sigma particle of charge $+e$

u = up quark

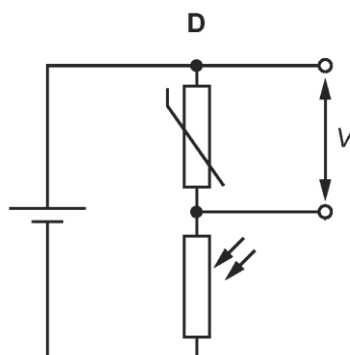
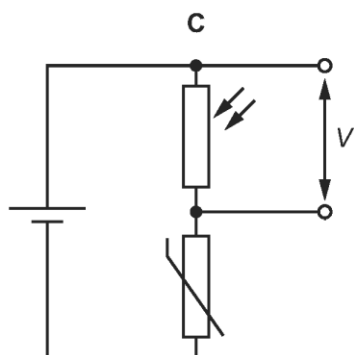
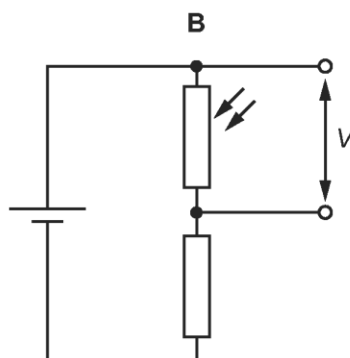
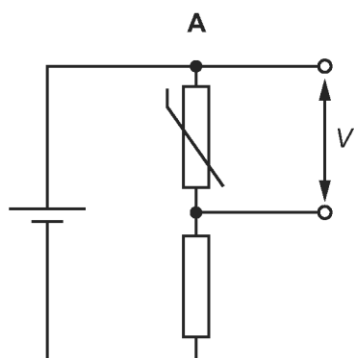
d = down quark

s = strange quark

	hadron	quark composition
A	Σ^-	dds
B	Σ^+	uds
C	p	uud
D	n	udd

70 - (9702/11_Summer_2022_Q37) - Particle & Nuclear Physics

In the circuits shown, the temperature remains constant.

In which circuit does the potential difference (p.d.) V increase with increasing light intensity?

71 - (9702/11_Summer_2022_Q38) - Particle & Nuclear Physics

Carbon-14 decays into nitrogen-14 by emitting a β^- particle.

Which statement explains why the β^- particles are emitted with a range of different kinetic energies?

- A The carbon-14 nuclei have slightly different masses.
- B The emitted β^- particles have a range of different masses.
- C The energy released in the decay process is different for each carbon-14 nucleus that decays.
- D The energy released in the decay process is shared between the nitrogen-14 nucleus, a β^- particle and an antineutrino.

72 - (9702/12_Summer_2022_Q38) - Particle & Nuclear Physics

In an experiment on α -particle scattering, α -particles are directed at a thin gold foil. Most of the α -particles pass straight through the foil or are deflected by a small angle. A small number of α -particles are deflected by a large angle.

Which statement **cannot** be deduced from this experiment?

- A Atoms are mostly empty space.
- B Most of the mass of an atom is concentrated in the nucleus.
- C The nucleus of an atom contains protons.
- D The nucleus of an atom is small compared to the size of an atom.

73 - (9702/11_Summer_2022_Q39) - Particle & Nuclear Physics

A nucleus of a radioactive element emits an α -particle, then a β^- particle and then another β^- particle.

Which statement describes the final element that is produced?

- A It is a different element of higher proton number than the original element.
- B It is a different element of lower nucleon number than the original element.
- C It is an isotope of the original element.
- D It is the same element as the original element but with a different proton number.

74 - (9702/12_Summer_2022_Q39) - Particle & Nuclear Physics

Four nuclei are represented below.



Which statement about these nuclei is correct?

- A An uncharged atom of element Q has 24 orbital electrons.
- B Nuclei G and M are isotopes of the same element.
- C When E absorbs a neutron and then emits an α -particle, E transforms into M.
- D When M emits a β^- particle, M transforms into Q.

75 - (9702/13_Summer_2022_Q39) - Particle & Nuclear Physics

An actinium nucleus has a nucleon number of 227 and a proton number of 89. It decays to form a radium nucleus, emitting a β^- particle and an α -particle in the process.

What are the nucleon number and the proton number of this radium nucleus?

	nucleon number	proton number
A	223	87
B	223	88
C	224	87
D	225	86

76 - (9702/11_Summer_2022_Q40) - Particle & Nuclear Physics

How many hadrons, baryons and mesons are there in a nucleus of ${}^9_4\text{Be}$?

	hadrons	baryons	mesons
A	9	4	5
B	9	5	4
C	9	9	0
D	13	9	0

77 - (9702/12_Summer_2022_Q40) - Particle & Nuclear Physics

A neutron is composed of one up (u) quark and two down (d) quarks. When a neutron decays to a proton, a beta-particle is emitted.

What is the change in the quark structure of the neutron due to the emission of the beta-particle?

(The symbol for a neutrino is ν_e and for an antineutrino is $\bar{\nu}_e$.)

A $d \rightarrow u + \beta^- + \nu_e$

B $d \rightarrow u + \beta^- + \bar{\nu}_e$

C $u \rightarrow d + \beta^+ + \nu_e$

D $u \rightarrow d + \beta^+ + \bar{\nu}_e$

78 - (9702/13_Summer_2022_Q40) - Particle & Nuclear Physics

Which statement is **not** correct?

A A meson consists of three quarks.

B A proton is a baryon.

C A quark is a fundamental particle.

D There are six flavours (types) of quark.

79 - (9702/11_Winter_2022_Q38) - Particle & Nuclear Physics

An α -particle passes close to a gold nucleus and is deflected through an angle greater than 90° .

Which property of the α -particle changes as a result of the deflection?

A charge

B momentum

C nucleon number

D proton number

80 - (9702/12_Winter_2022_Q38) - Particle & Nuclear Physics

In the α -particle scattering experiment, a beam of α -particles is aimed at a thin gold foil. Most of the α -particles go straight through or are deflected by a small angle. A very small proportion are deflected by more than 90° , effectively rebounding towards the source of the α -particles.

Which conclusion about the structure of atoms **cannot** be drawn from this experiment alone?

A Most of the atom is empty space.

B Most of the mass of an atom is concentrated in the nucleus.

C The nucleus contains both protons and neutrons.

D The nucleus is charged.

81 - (9702/13_Winter_2022_Q38) - Particle & Nuclear Physics

Which statement about the alpha-particle scattering experiment provides evidence for the existence of the nucleus?

- A A tiny proportion of the alpha-particles are deflected through large angles.
- B Slower alpha-particles are deflected through larger angles.
- C The kinetic energies of the deflected alpha-particles are unchanged.
- D The number of alpha-particles deflected depends on the thickness of the foil.

82 - (9702/11_Winter_2022_Q39) - Particle & Nuclear Physics

A nucleus of ${}^{238}_{92}\text{U}$ decays in stages by emitting α -particles and β^- particles, eventually forming a nucleus of ${}^{206}_{82}\text{Pb}$.

How many α -particles and how many β^- particles are emitted during the decay chain?

	α -particles	β^- particles
A	8	6
B	8	10
C	16	6
D	16	22

83 - (9702/12_Winter_2022_Q39) - Particle & Nuclear Physics

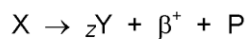
Which two particles have opposite charges?

- A alpha-particle and helium nucleus
- B antiproton and beta-plus particle
- C beta-minus particle and electron
- D positron and proton

84 - (9702/13_Winter_2022_Q39) - Particle & Nuclear Physics

A nucleus X undergoes β^+ decay.

The products are a nucleus Y with proton number Z, a β^+ particle and another particle P.



What is particle P and what is the proton number of nucleus X?

	P	proton number of nucleus X
A	antineutrino	$Z - 1$
B	antineutrino	$Z + 1$
C	neutrino	$Z - 1$
D	neutrino	$Z + 1$

85 - (9702/11_Winter_2022_Q40) - Particle & Nuclear Physics

Which list of particles contains **only** fundamental particles?

- A antineutrino, beta, meson
- B baryon, neutrino, positron
- C electron, neutrino, alpha
- D lepton, quark, positron

86 - (9702/12_Winter_2022_Q40) - Particle & Nuclear Physics

Which particle is a lepton?

- A meson
- B positron
- C proton
- D quark

87 - (9702/13_Winter_2022_Q40) - Particle & Nuclear Physics

A particle consists of two up quarks and a charm quark.

What is the charge of this particle, expressed in terms of the elementary charge e ?

- A $-2e$
- B $-e$
- C $+e$
- D $+2e$

88 - (9702/11_Summer_2023_Q39) - Particle & Nuclear Physics

A uranium nucleus has 92 protons and 143 neutrons.

The nucleus emits a total of 3 α -particles and 4 β^- particles to form nucleus X.

How can nucleus X be represented?

A ${}_{90}^{131}\text{X}$

B ${}_{87}^{219}\text{X}$

C ${}_{82}^{223}\text{X}$

D ${}_{90}^{223}\text{X}$

89 - (9702/11_Summer_2023_Q40) - Particle & Nuclear Physics

Which statement about a proton is correct?

- A A proton is a baryon but not a meson.
- B A proton is a meson but not a hadron.
- C A proton is both a hadron and a meson.
- D A proton is both a meson and a baryon.

90 - (9702/12_Summer_2023_Q38) - Particle & Nuclear Physics

What are isotopes?

- A nuclei of different elements with the same number of neutrons
- B nuclei of different elements with the same number of nucleons
- C nuclei of the same element with different numbers of neutrons
- D nuclei of the same element with different numbers of protons

91 - (9702/12_Summer_2023_Q39) - Particle & Nuclear Physics

A neutron ${}_0^1\text{n}$ is fired at a ${}_{92}^{235}\text{U}$ nucleus. The neutron is absorbed by the nucleus which then splits to form nuclei of ${}_{56}^{141}\text{Ba}$ and ${}_{36}^{92}\text{Kr}$.

What is the number of free neutrons emitted when the ${}_{92}^{235}\text{U}$ nucleus splits?

A 0

B 1

C 2

D 3

92 - (9702/13_Summer_2023_Q38) - Particle & Nuclear Physics

The table contains data for four different nuclei P, Q, R and S.

nucleus	number of neutrons	nucleon number
P	5	10
Q	6	10
R	6	14
S	8	16

Which two nuclei are isotopes of the same element?

- A P and Q B P and S C Q and R D R and S

93 - (9702/13_Summer_2023_Q39) - Particle & Nuclear Physics

Which statement about β^- decay is correct?

- A A neutron changes to a proton in the nucleus and an electron and an antineutrino are emitted.
- B A neutron changes to a proton in the nucleus and an electron and a neutrino are emitted.
- C A proton changes to a neutron in the nucleus and an electron and an antineutrino are emitted.
- D A proton changes to a neutron in the nucleus and an electron and a neutrino are emitted.

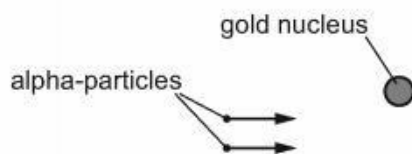
94 - (9702/13_Summer_2023_Q40) - Particle & Nuclear Physics

What is the quark composition of a hydrogen-3 nucleus, ${}^3_1\text{H}$?

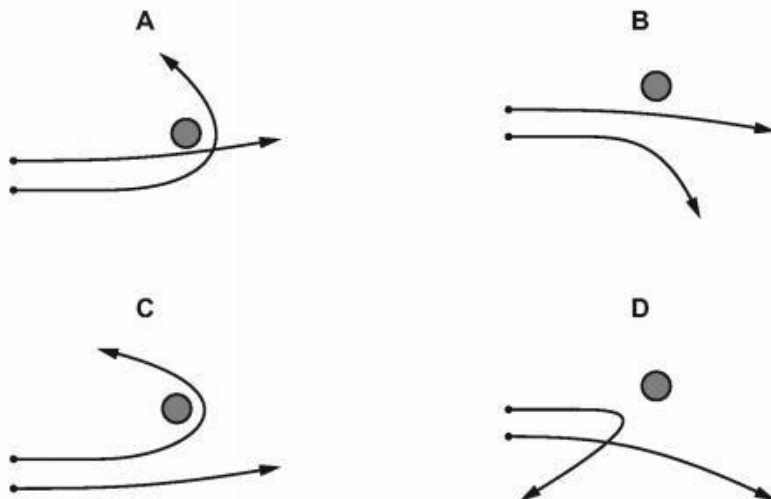
	number of quarks	
	up	down
A	4	5
B	5	4
C	5	7
D	7	5

95 - (9702/11_Winter_2023_Q38) - Particle & Nuclear Physics

Two alpha-particles with the same kinetic energy are moving towards, and are then deflected by, a gold nucleus.



Which diagram could show the paths of the two alpha-particles?



96 - (9702/11_Winter_2023_Q39) - Particle & Nuclear Physics

Which nuclide is formed when $^{10}_6\text{C}$ undergoes β^+ decay?

A $^{11}_6\text{C}$ B ^9_6C C $^{10}_5\text{B}$ D $^{10}_7\text{N}$

97 - (9702/11_Winter_2023_Q40) - Particle & Nuclear Physics

A particular hadron is composed of three quarks and has zero charge.

What is a possible quark composition of the hadron?

A down, down, strange

B up, down, strange

C up, up, down

D up, up, strange

98 - (9702/12_Winter_2023_Q38) - Particle & Nuclear Physics

Two nuclides are different isotopes of the same element.

Which statement about the nuclides is correct?

- A Neutral atoms of the nuclides have the same number of electrons.
- B Nuclei of the nuclides have different numbers of protons.
- C Nuclei of the nuclides have the same number of nucleons.
- D Nuclei of the nuclides have the same number of neutrons.

99 - (9702/12_Winter_2023_Q39) - Particle & Nuclear Physics

The charge-to-mass ratio r of a particle is given by the equation shown.

$$r = \frac{\text{charge on particle}}{\text{mass of particle}}$$

The value of r is determined for an α -particle, a β^+ particle and a proton p.

Which list shows the particles in order of increasing magnitude of r from left to right?

- A $\alpha \rightarrow \beta^+ \rightarrow p$
- B $\alpha \rightarrow p \rightarrow \beta^+$
- C $p \rightarrow \alpha \rightarrow \beta^+$
- D $p \rightarrow \beta^+ \rightarrow \alpha$

100 - (9702/12_Winter_2023_Q40) - Particle & Nuclear Physics

Which combination of up (u) and down (d) quarks forms a neutron?

- A u u u B u u d C u d d D d d d

101 - (9702/13_Winter_2023_Q38) - Particle & Nuclear Physics

The table shows the number of nucleons and the total number of particles (protons, neutrons and electrons) in neutral atoms of four nuclides W, X, Y and Z.

	number of nucleons	total number of particles
W	19	30
X	19	31
Y	21	32
Z	22	31

Which two nuclides are isotopes of each other?

- A W and X B W and Y C X and Z D Y and Z

102 – (9702/13_Winter_2023_Q39) – Particle & Nuclear Physics

When a sample of a radioactive isotope decays by α -particle emission, the α -particles emitted have a single discrete energy.

When a sample of a radioactive isotope decays by β^- particle emission, the β^- particles emitted have a continuous range of energies.

What is the explanation for this?

- A An antineutrino is emitted with a β^- particle but not with an α -particle.
- B An antineutrino is emitted with an α -particle but not with a β^- particle.
- C The α -particles have much more energy than the β^- particles.
- D The β^- particles have much more energy than the α -particles.

103 – (9702/13_Winter_2023_Q40) – Particle & Nuclear Physics

Some particles are a combination of three quarks.

Which combination of quarks does **not** result in a particle with a charge of either $+1.6 \times 10^{-19} \text{ C}$ or zero?

- A up, down, down
- B up, strange, strange
- C up, up, down
- D up, up, up

ANSWERS

A-Level Cambridge	PHYSICS –P1	CH1 - PHYSICAL QUANTITIES & UNITS
1 - (9702/11_Summer_2017_Q1) - <i>Physical Quantities & Units</i> D		
2 - (9702/12_Summer_2017_Q1) - <i>Physical Quantities & Units</i> B		
3 - (9702/13_Summer_2017_Q1) - <i>Physical Quantities & Units</i> B		
4 - (9702/12_Summer_2017_Q2) - <i>Physical Quantities & Units</i> A		
5 - (9702/13_Summer_2017_Q2) - <i>Physical Quantities & Units</i> B		
6 - (9702/11_Summer_2017_Q3) - <i>Physical Quantities & Units</i> A		
7 - (9702/12_Summer_2017_Q3) - <i>Physical Quantities & Units</i> D		
8 - (9702/13_Summer_2017_Q3) - <i>Physical Quantities & Units</i> D		
9 - (9702/12_Summer_2017_Q13) - <i>Physical Quantities & Units, Forces, Density & Pressure</i> D		
10 - (9702/12_Summer_2017_Q20) - <i>Physical Quantities & Units, Deformation Of Solids</i> D		

A-Level Cambridge	PHYSICS –P1	CH1 - PHYSICAL QUANTITIES & UNITS
11 - (9702/11_Winter_2017_Q1) - <i>Physical Quantities & Units</i> C		
12 - (9702/12_Winter_2017_Q1) - <i>Physical Quantities & Units</i> D		
13 - (9702/13_Winter_2017_Q1) - <i>Physical Quantities & Units</i> C		
14 - (9702/11_Summer_2018_Q1) - <i>Physical Quantities & Units, Deformation Of Solids</i> A		
15 - (9702/12_Summer_2018_Q1) - <i>Physical Quantities & Units</i> C		
16 - (9702/13_Summer_2018_Q1) - <i>Physical Quantities & Units</i> B		
17 - (9702/11_Summer_2018_Q2) - <i>Physical Quantities & Units</i> C		
18 - (9702/12_Summer_2018_Q2) - <i>Physical Quantities & Units</i> B		
19 - (9702/13_Summer_2018_Q2) - <i>Physical Quantities & Units</i> B		

A-Level Cambridge	PHYSICS –P1	CH1 - PHYSICAL QUANTITIES & UNITS
20 - (9702/12_Winter_2018_Q1) - <i>Physical Quantities & Units, Measurement Techniques</i> A		
21 - (9702/11_Winter_2018_Q2) - <i>Physical Quantities & Units</i> D		
22 - (9702/12_Winter_2018_Q2) - <i>Physical Quantities & Units</i> B		
23 - (9702/13_Winter_2018_Q2) - <i>Physical Quantities & Units</i> C		
24 - (9702/12_Winter_2018_Q3) - <i>Physical Quantities & Units</i> B		
25 - (9702/13_Winter_2018_Q3) - <i>Physical Quantities & Units</i> C		
26 - (9702/12_Winter_2018_Q4) - <i>Physical Quantities & Units, Measurement Techniques</i> A		
27 - (9702/11_Summer_2019_Q1) - <i>Physical Quantities & Units</i> A		
28 - (9702/12_Summer_2019_Q1) - <i>Physical Quantities & Units</i> B		

A-Level Cambridge	PHYSICS – P1	CH1 - PHYSICAL QUANTITIES & UNITS
29 - (9702/13_Summer_2019_Q1) - <i>Physical Quantities & Units</i> C		
30 - (9702/11_Summer_2019_Q2) - <i>Physical Quantities & Units</i> C		
31 - (9702/12_Summer_2019_Q2) - <i>Physical Quantities & Units</i> D		
32 - (9702/13_Summer_2019_Q2) - <i>Physical Quantities & Units</i> D		
33 - (9702/12_Summer_2019_Q3) - <i>Physical Quantities & Units</i> A		
34 - (9702/11_Winter_2019_Q1) - <i>Physical Quantities & Units</i> D		
35 - (9702/12_Winter_2019_Q1) - <i>Physical Quantities & Units</i> D		
36 - (9702/13_Winter_2019_Q1) - <i>Physical Quantities & Units</i> C		
37 - (9702/12_Winter_2019_Q2) - <i>Physical Quantities & Units</i> A		

A-Level Cambridge	PHYSICS –P1	CH1 - PHYSICAL QUANTITIES & UNITS
38 - (9702/13_Winter_2019_Q2) - <i>Physical Quantities & Units</i> D		
39 - (9702/11_Winter_2019_Q3) - <i>Physical Quantities & Units</i> A		
40 - (9702/12_Winter_2019_Q3) - <i>Physical Quantities & Units</i> B		
41 - (9702/13_Winter_2019_Q3) - <i>Physical Quantities & Units</i> C		
42 - (9702/11_Summer_2020_Q1) - <i>Physical Quantities & Units</i> C		
43 - (9702/12_Summer_2020_Q1) - <i>Physical Quantities & Units</i> D		
44 - (9702/13_Summer_2020_Q1) - <i>Physical Quantities & Units</i> C		
45 - (9702/11_Summer_2020_Q2) - <i>Physical Quantities & Units</i> B		
46 - (9702/11_Summer_2020_Q3) - <i>Physical Quantities & Units</i> B		

47 - (9702/13_Summer_2020_Q3) - *Physical Quantities & Units*

A

48 - (9702/11_Winter_2020_Q1) - *Physical Quantities & Units*

C

49 - (9702/12_Winter_2020_Q1) - *Physical Quantities & Units*

B

50 - (9702/13_Winter_2020_Q1) - *Physical Quantities & Units*

B

51 - (9702/11_Winter_2020_Q2) - *Physical Quantities & Units*

B

52 - (9702/12_Winter_2020_Q2) - *Physical Quantities & Units*

C

53 - (9702/13_Winter_2020_Q2) - *Physical Quantities & Units*

A

54 - (9702/12_Summer_2021_Q1) - *Physical Quantities & Units*

D

55 - (9702/13_Summer_2021_Q2) - *Physical Quantities & Units*

C

A-Level Cambridge	PHYSICS –P1	CH1 - PHYSICAL QUANTITIES & UNITS
56 - (9702/11_Winter_2021_Q1) - <i>Physical Quantities & Units</i> B		
57 - (9702/12_Winter_2021_Q1) - <i>Physical Quantities & Units</i> C		
58 - (9702/13_Winter_2021_Q1) - <i>Physical Quantities & Units</i> C		
59 - (9702/11_Winter_2021_Q2) - <i>Physical Quantities & Units</i> B		
60 - (9702/12_Winter_2021_Q2) - <i>Physical Quantities & Units</i> A		
61 - (9702/13_Winter_2021_Q2) - <i>Physical Quantities & Units</i> D		
62 - (9702/12_Winter_2021_Q3) - <i>Physical Quantities & Units</i> D		
63 - (9702/13_Winter_2021_Q3) - <i>Physical Quantities & Units</i> C		
64 - (9702/11_Summer_2022_Q1) - <i>Physical Quantities & Units</i> D		

A-Level Cambridge	PHYSICS –P1	CH1 - PHYSICAL QUANTITIES & UNITS
65 - (9702/12_Summer_2022_Q1) - <i>Physical Quantities & Units</i>		C
66 - (9702/13_Summer_2022_Q1) - <i>Physical Quantities & Units</i>		D
67 - (9702/11_Summer_2022_Q2) - <i>Physical Quantities & Units</i>		B
68 - (9702/12_Summer_2022_Q2) - <i>Physical Quantities & Units</i>		B
69 - (9702/13_Summer_2022_Q2) - <i>Physical Quantities & Units</i>		D
70 - (9702/11_Winter_2022_Q1) - <i>Physical Quantities & Units</i>		C
71 - (9702/12_Winter_2022_Q1) - <i>Physical Quantities & Units</i>		D
72 - (9702/13_Winter_2022_Q1) - <i>Physical Quantities & Units</i>		B
73 - (9702/11_Winter_2022_Q2) - <i>Physical Quantities & Units</i>		D

A-Level Cambridge	PHYSICS –P1	CH1 - PHYSICAL QUANTITIES & UNITS
74 - (9702/12_Winter_2022_Q2) - <i>Physical Quantities & Units</i>		C
75 - (9702/13_Winter_2022_Q2) - <i>Physical Quantities & Units</i>		B
76 - (9702/11_Summer_2023_Q1) - <i>Physical Quantities & Units</i>		C
77 - (9702/12_Summer_2023_Q1) - <i>Physical Quantities & Units</i>		B
78 - (9702/12_Summer_2023_Q2) - <i>Physical Quantities & Units</i>		D
79 - (9702/13_Summer_2023_Q1) - <i>Physical Quantities & Units</i>		C
80 - (9702/13_Summer_2023_Q2) - <i>Physical Quantities & Units</i>		A
81 - (9702/11_Winter_2023_Q1) - <i>Physical Quantities & Units</i>		C
82 - (9702/11_Winter_2023_Q2) - <i>Physical Quantities & Units</i>		A

83 - (9702/12_Winter_2023_Q1) - *Physical Quantities & Units*

B

84 - (9702/12_Winter_2023_Q2) - *Physical Quantities & Units*

D

85 - (9702/13_Winter_2023_Q1) - *Physical Quantities & Units*

B

86 - (9702/13_Winter_2023_Q2) - *Physical Quantities & Units*

A

A-Level Cambridge	PHYSICS – P1	CH2 - MEASUREMENT TECHNIQUES
1 - (9702/12_Summer_2017_Q4) - <i>Measurement Techniques</i> C		
2 - (9702/13_Summer_2017_Q4) - <i>Measurement Techniques</i> C		
3 - (9702/12_Summer_2017_Q5) - <i>Measurement Techniques</i> B		
4 - (9702/11_Summer_2017_Q9) - <i>Measurement Techniques</i> D		
5 - (9702/13_Summer_2017_Q23) - <i>Measurement Techniques, Waves</i> C		
6 - (9702/11_Summer_2017_Q24) - <i>Measurement Techniques, Waves</i> B		
7 - (9702/12_Winter_2017_Q4) - <i>Measurement Techniques</i> D		
8 - (9702/13_Winter_2017_Q4) - <i>Measurement Techniques</i> B		
9 - (9702/11_Winter_2017_Q5) - <i>Measurement Techniques, Superposition</i> D		
10 - (9702/13_Winter_2017_Q5) - <i>Measurement Techniques</i> B		

A-Level Cambridge	PHYSICS – P1	CH2 - MEASUREMENT TECHNIQUES
11 - (9702/12_Summer_2018_Q3) - <i>Measurement Techniques</i> D		
12 - (9702/11_Summer_2018_Q4) - <i>Measurement Techniques</i> A		
13 - (9702/12_Summer_2018_Q4) - <i>Measurement Techniques</i> D		
14 - (9702/13_Summer_2018_Q4) - <i>Measurement Techniques</i> A		
15 - (9702/11_Summer_2018_Q5) - <i>Measurement Techniques</i> C		
16 - (9702/13_Summer_2018_Q5) - <i>Measurement Techniques</i> D		
17 - (9702/11_Winter_2018_Q1) - <i>Measurement Techniques</i> D		
18 - (9702/12_Winter_2018_Q1) - <i>Physical Quantities & Units, Measurement Techniques</i> A		
19 - (9702/13_Winter_2018_Q1) - <i>Measurement Techniques</i> C		

A-Level Cambridge	PHYSICS – P1	CH2 - MEASUREMENT TECHNIQUES
20 - (9702/11_Winter_2018_Q4) - <i>Measurement Techniques</i> B		
21 - (9702/12_Winter_2018_Q4) - <i>Physical Quantities & Units, Measurement Techniques</i> A		
22 - (9702/13_Winter_2018_Q4) - <i>Measurement Techniques</i> B		
23 - (9702/11_Winter_2018_Q5) - <i>Measurement Techniques</i> C		
24 - (9702/12_Winter_2018_Q5) - <i>Measurement Techniques</i> A		
25 - (9702/13_Winter_2018_Q5) - <i>Measurement Techniques</i> B		
26 - (9702/11_Summer_2019_Q3) - <i>Measurement Techniques</i> B		
27 - (9702/13_Summer_2019_Q4) - <i>Measurement Techniques, Work, Energy & Power</i> B		
28 - (9702/11_Summer_2019_Q5) - <i>Measurement Techniques</i> B		

A-Level Cambridge	PHYSICS – P1	CH2 - MEASUREMENT TECHNIQUES
29 - (9702/12_Summer_2019_Q5) - <i>Measurement Techniques</i> D		
30 - (9702/13_Summer_2019_Q5) - <i>Measurement Techniques</i> A		
31 - (9702/12_Summer_2019_Q6) - <i>Measurement Techniques</i> C		
32 - (9702/13_Summer_2019_Q6) - <i>Measurement Techniques</i> C		
33 - (9702/12_Summer_2019_Q7) - <i>Measurement Techniques</i> D		
34 - (9702/11_Winter_2019_Q4) - <i>Measurement Techniques</i> C		
35 - (9702/12_Winter_2019_Q4) - <i>Measurement Techniques</i> C		
36 - (9702/13_Winter_2019_Q4) - <i>Measurement Techniques</i> B		
37 - (9702/12_Winter_2019_Q5) - <i>Measurement Techniques</i> B		

A-Level Cambridge	PHYSICS – P1	CH2 - MEASUREMENT TECHNIQUES
38 - (9702/13_Winter_2019_Q5) - <i>Measurement Techniques</i> C		
39 - (9702/12_Summer_2020_Q2) - <i>Measurement Techniques</i> C		
40 - (9702/12_Summer_2020_Q3) - <i>Measurement Techniques</i> B		
41 - (9702/12_Summer_2020_Q4) - <i>Measurement Techniques</i> D		
42 - (9702/13_Summer_2020_Q4) - <i>Measurement Techniques</i> A		
43 - (9702/11_Summer_2020_Q5) - <i>Measurement Techniques</i> D		
44 - (9702/13_Summer_2020_Q5) - <i>Measurement Techniques</i> D		
45 - (9702/11_Winter_2020_Q3) - <i>Measurement Techniques</i> A		
46 - (9702/12_Winter_2020_Q3) - <i>Measurement Techniques</i> A		

A-Level Cambridge	PHYSICS – P1	CH2 - MEASUREMENT TECHNIQUES
47 - (9702/13_Winter_2020_Q3) - <i>Measurement Techniques</i> B		
48 - (9702/11_Winter_2020_Q4) - <i>Measurement Techniques</i> D		
49 - (9702/12_Winter_2020_Q4) - <i>Measurement Techniques</i> D		
50 - (9702/13_Winter_2020_Q4) - <i>Measurement Techniques</i> A		
51 - (9702/11_Winter_2020_Q5) - <i>Measurement Techniques</i> D		
52 - (9702/12_Winter_2020_Q5) - <i>Measurement Techniques</i> B		
53 - (9702/13_Winter_2020_Q5) - <i>Measurement Techniques</i> C		
54 - (9702/12_Summer_2021_Q4) - <i>Measurement Techniques</i> D		
55 - (9702/13_Summer_2021_Q4) - <i>Measurement Techniques</i> B		

A-Level Cambridge	PHYSICS – P1	CH2 - MEASUREMENT TECHNIQUES
56 - (9702/11_Summer_2021_Q5) - <i>Measurement Techniques</i> D		
57 - (9702/12_Summer_2021_Q5) - <i>Measurement Techniques</i> D		
58 - (9702/13_Summer_2021_Q5) - <i>Measurement Techniques</i> B		
59 - (9702/11_Winter_2021_Q4) - <i>Measurement Techniques</i> A		
60 - (9702/12_Winter_2021_Q4) - <i>Measurement Techniques</i> A		
61 - (9702/13_Winter_2021_Q4) - <i>Measurement Techniques</i> B		
62 - (9702/11_Winter_2021_Q5) - <i>Measurement Techniques</i> B		
63 - (9702/12_Winter_2021_Q5) - <i>Measurement Techniques</i> D		
64 - (9702/13_Winter_2021_Q5) - <i>Measurement Techniques</i> D		

A-Level Cambridge	PHYSICS – P1	CH2 - MEASUREMENT TECHNIQUES
65 - (9702/11_Summer_2022_Q3) - <i>Measurement Techniques</i> A		
66 - (9702/12_Summer_2022_Q3) - <i>Measurement Techniques</i> C		
67 - (9702/13_Summer_2022_Q3) - <i>Measurement Techniques</i> B		
68 - (9702/13_Summer_2022_Q4) - <i>Measurement Techniques</i> C		
69 - (9702/11_Winter_2022_Q3) - <i>Measurement Techniques</i> C		
70 - (9702/12_Winter_2022_Q3) - <i>Measurement Techniques</i> D		
71 - (9702/13_Winter_2022_Q3) - <i>Measurement Techniques</i> C		
72 - (9702/11_Winter_2022_Q4) - <i>Measurement Techniques</i> A		
73 - (9702/12_Winter_2022_Q4) - <i>Measurement Techniques</i> C		

A-Level Cambridge	PHYSICS – P1	CH2 - MEASUREMENT TECHNIQUES
74 - (9702/13_Winter_2022_Q4) - <i>Measurement Techniques</i> D		
75 - (9702/11_Summer_2023_Q2) - <i>Measurement Techniques</i> B		
76 - (9702/11_Summer_2023_Q3) - <i>Measurement Techniques</i> D		
77 - (9702/12_Summer_2023_Q3) - <i>Measurement Techniques</i> D		
78 - (9702/13_Summer_2023_Q3) - <i>Measurement Techniques</i> D		
79 - (9702/11_Winter_2023_Q3) - <i>Measurement Techniques</i> D		
80 - (9702/12_Winter_2023_Q3) - <i>Measurement Techniques</i> D		
81 - (9702/13_Winter_2023_Q3) - <i>Measurement Techniques</i> C		

A-Level Cambridge	PHYSICS – P1	CH3 - KINEMATICS
1 - (9702/11_Summer_2017_Q2) - <i>Kinematics</i> D		
2 - (9702/11_Summer_2017_Q4) - <i>Kinematics</i> D		
3 - (9702/13_Summer_2017_Q5) - <i>Kinematics</i> B		
4 - (9702/11_Summer_2017_Q6) - <i>Kinematics</i> B		
5 - (9702/12_Summer_2017_Q6) - <i>Kinematics</i> A		
6 - (9702/13_Summer_2017_Q6) - <i>Kinematics</i> A		
7 - (9702/13_Summer_2017_Q7) - <i>Kinematics</i> D		
8 - (9702/11_Summer_2017_Q8) - <i>Kinematics, Dynamics</i> C		
9 - (9702/13_Summer_2017_Q8) - <i>Kinematics, Dynamics</i> C		
10 - (9702/12_Winter_2017_Q2) - <i>Kinematics, Forces, Density & Pressure</i> A		

11 - (9702/11_Winter_2017_Q6) - *Kinematics*

C

12 - (9702/12_Winter_2017_Q6) - *Kinematics*

B

13 - (9702/13_Winter_2017_Q6) - *Kinematics*

D

14 - (9702/11_Winter_2017_Q7) - *Kinematics*

B

15 - (9702/12_Winter_2017_Q7) - *Kinematics*

B

16 - (9702/13_Winter_2017_Q7) - *Kinematics*

C

17 - (9702/12_Winter_2017_Q8) - *Kinematics*

D

18 - (9702/13_Winter_2017_Q11) - *Kinematics, Dynamics*

B

19 - (9702/12_Winter_2017_Q16) - *Kinematics*

A

20 - (9702/11_Winter_2017_Q18) - *Kinematics*

B

21 - (9702/12_Summer_2018_Q5) - *Kinematics*

A

22 - (9702/11_Summer_2018_Q6) - *Kinematics*

A

23 - (9702/12_Summer_2018_Q6) - *Kinematics*

C

24 - (9702/13_Summer_2018_Q6) - *Kinematics*

B

25 - (9702/11_Summer_2018_Q7) - *Kinematics*

B

26 - (9702/12_Summer_2018_Q7) - *Kinematics*

C

27 - (9702/11_Summer_2018_Q8) - *Kinematics, Work, Energy & Power*

A

28 - (9702/13_Summer_2018_Q8) - *Kinematics*

B

29 - (9702/11_Summer_2018_Q9) - *Kinematics*

B

30 - (9702/12_Summer_2018_Q9) - *Kinematics, Work, Energy & Power*

C

31 - (9702/13_Summer_2018_Q9) - *Kinematics*

C

32 - (9702/11_Summer_2018_Q16) - *Kinematics, Work, Energy & Power*

B

33 - (9702/11_Winter_2018_Q3) - *Kinematics*

B

34 - (9702/11_Winter_2018_Q6) - *Kinematics*

D

35 - (9702/12_Winter_2018_Q6) - *Kinematics*

C

36 - (9702/13_Winter_2018_Q6) - *Kinematics*

A

37 - (9702/13_Winter_2018_Q7) - *Kinematics*

B

38 - (9702/11_Winter_2018_Q8) - *Kinematics*

C

39 - (9702/13_Winter_2018_Q8) - *Kinematics*

A

40 - (9702/11_Summer_2019_Q6) - *Kinematics*

B

41 - (9702/11_Summer_2019_Q7) - *Kinematics*

D

42 - (9702/13_Summer_2019_Q7) - *Kinematics*

B

43 - (9702/12_Summer_2019_Q8) - *Kinematics*

B

44 - (9702/13_Summer_2019_Q8) - *Kinematics*

C

45 - (9702/11_Summer_2019_Q10) - *Kinematics*

C

46 - (9702/11_Summer_2019_Q11) - *Kinematics*

D

47 - (9702/11_Winter_2019_Q2) - *Kinematics*

A

48 - (9702/11_Winter_2019_Q5) - *Kinematics*

D

49 - (9702/11_Winter_2019_Q6) - *Kinematics*

C

50 - (9702/12_Winter_2019_Q6) - *Kinematics*

B

51 - (9702/13_Winter_2019_Q6) - *Kinematics*

B

52 - (9702/12_Winter_2019_Q8) - *Kinematics*

D

53 - (9702/11_Winter_2019_Q9) - *Kinematics*

D

54 - (9702/12_Summer_2020_Q5) - *Kinematics*

B

55 - (9702/11_Summer_2020_Q6) - *Kinematics*

D

56 - (9702/12_Summer_2020_Q6) - *Kinematics*

B

57 - (9702/13_Summer_2020_Q6) - *Kinematics*

A

58 - (9702/11_Summer_2020_Q7) - *Kinematics*

A

59 - (9702/13_Summer_2020_Q7) - *Kinematics*

C

60 - (9702/11_Winter_2020_Q6) - *Kinematics*

D

61 - (9702/12_Winter_2020_Q6) - *Kinematics*

A

62 - (9702/13_Winter_2020_Q6) - *Kinematics*

A

63 - (9702/11_Winter_2020_Q7) - *Kinematics*

B

64 - (9702/12_Winter_2020_Q7) - *Kinematics*

A

65 - (9702/13_Winter_2020_Q7) - *Kinematics*

C

66 - (9702/11_Winter_2020_Q8) - *Kinematics*

C

67 - (9702/11_Winter_2020_Q9) - *Kinematics*

B

68 - (9702/11_Summer_2021_Q6) - *Kinematics*

C

69 - (9702/12_Summer_2021_Q6) - *Kinematics*

D

70 - (9702/13_Summer_2021_Q6) - *Kinematics*

D

71 - (9702/11_Summer_2021_Q7) - *Kinematics*

C

72 - (9702/12_Summer_2021_Q7) - *Kinematics*

B

73 - (9702/13_Summer_2021_Q7) - *Kinematics*

C

74 - (9702/13_Summer_2021_Q8) - *Kinematics*

C

75 - (9702/13_Summer_2021_Q9) - *Kinematics*

D

76 - (9702/11_Winter_2021_Q3) - *Kinematics*

A

77 - (9702/11_Winter_2021_Q6) - *Kinematics*

B

78 - (9702/12_Winter_2021_Q6) - *Kinematics*

C

79 - (9702/13_Winter_2021_Q6) - *Kinematics*

B

80 - (9702/11_Winter_2021_Q7) - *Kinematics*

D

81 - (9702/12_Winter_2021_Q7) - *Kinematics*

B

82 - (9702/13_Winter_2021_Q7) - *Kinematics*

D

83 - (9702/12_Winter_2021_Q8) - *Kinematics*

A

84 - (9702/12_Winter_2021_Q9) - *Kinematics*

B

85 - (9702/13_Winter_2021_Q9) - *Kinematics*

A

86 - (9702/12_Winter_2021_Q10) - *Kinematics*

D

87 - (9702/13_Winter_2021_Q10) - *Kinematics*

A

88 - (9702/11_Summer_2022_Q4) - *Kinematics*

C

89 - (9702/12_Summer_2022_Q4) - *Kinematics*

B

90 - (9702/11_Summer_2022_Q5) - *Kinematics*

C

91 - (9702/12_Summer_2022_Q5) - *Kinematics*

A

92 - (9702/13_Summer_2022_Q5) - *Kinematics*

A

93 - (9702/11_Summer_2022_Q6) - *Kinematics*

C

94 - (9702/12_Summer_2022_Q6) - *Kinematics*

D

95 - (9702/13_Summer_2022_Q6) - *Kinematics*

C

96 - (9702/11_Summer_2022_Q7) - *Kinematics*

D

97 - (9702/12_Summer_2022_Q7) - *Kinematics*

C

98 - (9702/13_Summer_2022_Q7) - *Kinematics*

D

99 - (9702/12_Summer_2022_Q8) - *Kinematics*

A

100 - (9702/13_Summer_2022_Q8) - *Kinematics*

C

101 - (9702/12_Summer_2022_Q9) - *Kinematics*

B

102 - (9702/13_Summer_2022_Q9) - *Kinematics*

D

103 - (9702/12_Summer_2022_Q10) - *Kinematics*

B

104 - (9702/13_Summer_2022_Q10) - *Kinematics*

B

105 - (9702/13_Summer_2022_Q11) - *Kinematics*

A

106 - (9702/11_Winter_2022_Q5) - *Kinematics*

D

107 - (9702/12_Winter_2022_Q5) - *Kinematics*

A

108 - (9702/13_Winter_2022_Q5) - *Kinematics*

A

109 - (9702/11_Winter_2022_Q6) - *Kinematics*

B

110 - (9702/12_Winter_2022_Q6) - *Kinematics*

A

111 - (9702/13_Winter_2022_Q6) - *Kinematics*

B

112 - (9702/12_Winter_2022_Q7) - *Kinematics*

D

113 - (9702/13_Winter_2022_Q7) - *Kinematics*

D

114 - (9702/13_Winter_2022_Q8) - *Kinematics*

D

115 - (9702/11_Summer_2023_Q4) - *Kinematics*

B

116 - (9702/11_Summer_2023_Q5) - *Kinematics*

C

117 - (9702/11_Summer_2023_Q6) - *Kinematics*

C

118 - (9702/12_Summer_2023_Q4) - *Kinematics*

C

119 - (9702/12_Summer_2023_Q5) - *Kinematics*

B

120 - (9702/12_Summer_2023_Q6) - *Kinematics*

A

121 - (9702/13_Summer_2023_Q4) - *Kinematics*

A

122 - (9702/13_Summer_2023_Q5) - *Kinematics*

C

123 - (9702/13_Summer_2023_Q6) - *Kinematics*

D

124 - (9702/11_Winter_2023_Q4) - *Kinematics*

C

125 - (9702/11_Winter_2023_Q5) - *Kinematics*

B

126 - (9702/11_Winter_2023_Q6) - *Kinematics*

A

127 - (9702/12_Winter_2023_Q4) - *Kinematics*

A

128 - (9702/12_Winter_2023_Q5) - *Kinematics*

D

129 - (9702/12_Winter_2023_Q6) - *Kinematics*

B

130 - (9702/13_Winter_2023_Q4) - *Kinematics*

A

131 - (9702/13_Winter_2023_Q5) - *Kinematics*

D

132 - (9702/13_Winter_2023_Q6) - *Kinematics*

C

A-Level Cambridge	PHYSICS – P1	CH4 - DYNAMICS
1 - (9702/11_Summer_2017_Q5) - <i>Dynamics</i> C		
2 - (9702/11_Summer_2017_Q7) - <i>Dynamics</i> B		
3 - (9702/12_Summer_2017_Q7) - <i>Dynamics</i> C		
4 - (9702/11_Summer_2017_Q8) - <i>Kinematics, Dynamics</i> C		
5 - (9702/12_Summer_2017_Q8) - <i>Dynamics</i> B		
6 - (9702/13_Summer_2017_Q8) - <i>Kinematics, Dynamics</i> C		
7 - (9702/13_Summer_2017_Q9) - <i>Dynamics</i> D		
8 - (9702/11_Summer_2017_Q10) - <i>Dynamics</i> A		
9 - (9702/13_Summer_2017_Q10) - <i>Dynamics</i> A		
10 - (9702/12_Summer_2017_Q14) - <i>Dynamics, Work, Energy & Power</i> C		

11 - (9702/13_Summer_2017_Q16) - *Dynamics*

C

12 - (9702/11_Winter_2017_Q8) - *Dynamics, Forces, Density & Pressure*

B

13 - (9702/13_Winter_2017_Q8) - *Dynamics*

D

14 - (9702/11_Winter_2017_Q9) - *Dynamics*

B

15 - (9702/12_Winter_2017_Q9) - *Dynamics*

C

16 - (9702/13_Winter_2017_Q9) - *Dynamics*

B

17 - (9702/11_Winter_2017_Q10) - *Dynamics*

D

18 - (9702/12_Winter_2017_Q10) - *Dynamics*

B

19 - (9702/13_Winter_2017_Q10) - *Dynamics*

A

20 - (9702/11_Winter_2017_Q11) - *Dynamics*

D

21 - (9702/13_Winter_2017_Q11) - *Kinematics, Dynamics*

B

22 - (9702/13_Winter_2017_Q13) - *Dynamics, Forces, Density & Pressure*

C

23 - (9702/12_Winter_2017_Q17) - *Dynamics*

D

24 - (9702/13_Winter_2017_Q19) - *Dynamics, Motion In A Circle*

A

25 - (9702/11_Summer_2018_Q3) - *Dynamics*

C

26 - (9702/13_Summer_2018_Q3) - *Dynamics*

A

27 - (9702/13_Summer_2018_Q7) - *Dynamics*

C

28 - (9702/12_Summer_2018_Q8) - *Dynamics*

D

29 - (9702/12_Summer_2018_Q11) - *Dynamics*

C

30 - (9702/12_Summer_2018_Q15) - *Dynamics, Forces, Density & Pressure*

D

31 - (9702/12_Summer_2018_Q17) - *Dynamics*

C

32 - (9702/11_Winter_2018_Q7) - *Dynamics*

A

33 - (9702/12_Winter_2018_Q7) - *Dynamics*

B

34 - (9702/12_Winter_2018_Q8) - *Dynamics*

B

35 - (9702/12_Winter_2018_Q9) - *Dynamics*

B

36 - (9702/13_Winter_2018_Q9) - *Dynamics*

A

37 - (9702/12_Winter_2018_Q10) - *Dynamics*

D

38 - (9702/13_Winter_2018_Q10) - *Dynamics*

C

39 - (9702/12_Winter_2018_Q11) - *Dynamics, Electric Fields*

D

40 - (9702/13_Winter_2018_Q11) - *Dynamics, Forces, Density & Pressure*

A

41 - (9702/13_Summer_2019_Q3) - *Dynamics*

C

42 - (9702/11_Summer_2019_Q9) - *Dynamics*

B

43 - (9702/12_Summer_2019_Q9) - *Dynamics*

C

44 - (9702/13_Summer_2019_Q9) - *Dynamics*

C

45 - (9702/12_Summer_2019_Q10) - *Dynamics*

A

46 - (9702/12_Summer_2019_Q11) - *Dynamics*

D

47 - (9702/12_Summer_2019_Q14) - *Dynamics*

D

48 - (9702/13_Summer_2019_Q17) - *Dynamics, Work, Energy & Power*

A

49 - (9702/11_Winter_2019_Q7) - *Dynamics*

A

50 - (9702/12_Winter_2019_Q7) - *Dynamics*

D

51 - (9702/13_Winter_2019_Q7) - *Dynamics*

A

52 - (9702/11_Winter_2019_Q8) - *Dynamics*

C

53 - (9702/13_Winter_2019_Q8) - *Dynamics*

D

54 - (9702/12_Winter_2019_Q9) - *Dynamics*

A

55 - (9702/13_Winter_2019_Q9) - *Dynamics*

B

56 - (9702/11_Winter_2019_Q10) - *Dynamics*

C

57 - (9702/12_Winter_2019_Q10) - *Dynamics, Electric Fields*

A

58 - (9702/11_Winter_2019_Q13) - *Dynamics, Forces, Density & Pressure*

C

59 - (9702/12_Summer_2020_Q7) - *Dynamics*

B

60 - (9702/11_Summer_2020_Q8) - *Dynamics*

A

61 - (9702/12_Summer_2020_Q8) - *Dynamics*

C

62 - (9702/13_Summer_2020_Q8) - *Dynamics*

D

63 - (9702/11_Summer_2020_Q9) - *Dynamics*

C

64 - (9702/12_Summer_2020_Q9) - *Dynamics*

D

65 - (9702/13_Summer_2020_Q9) - *Dynamics*

B

66 - (9702/11_Summer_2020_Q10) - *Dynamics*

D

67 - (9702/12_Summer_2020_Q10) - *Dynamics*

B

68 - (9702/13_Summer_2020_Q10) - *Dynamics*

C

69 - (9702/11_Summer_2020_Q11) - *Dynamics*

D

70 - (9702/12_Winter_2020_Q8) - *Dynamics*

D

71 - (9702/13_Winter_2020_Q8) - *Dynamics*

B

72 - (9702/12_Winter_2020_Q9) - *Dynamics*

B

73 - (9702/13_Winter_2020_Q9) - *Dynamics*

D

74 - (9702/11_Winter_2020_Q10) - *Dynamics*

B

75 - (9702/12_Winter_2020_Q10) - *Dynamics*

C

76 - (9702/13_Winter_2020_Q10) - *Dynamics*

D

77 - (9702/12_Winter_2020_Q11) - *Dynamics*

C

78 - (9702/11_Summer_2021_Q1) - *Dynamics, Forces, Density & Pressure*

A

79 - (9702/11_Summer_2021_Q3) - *Dynamics*

C

80 - (9702/12_Summer_2021_Q3) - *Dynamics*

D

81 - (9702/13_Summer_2021_Q3) - *Dynamics*

A

82 - (9702/11_Summer_2021_Q8) - *Dynamics*

D

83 - (9702/12_Summer_2021_Q8) - *Dynamics*

C

84 - (9702/11_Summer_2021_Q9) - *Dynamics*

A

85 - (9702/12_Summer_2021_Q9) - *Dynamics*

B

86 - (9702/11_Summer_2021_Q10) - *Dynamics*

C

87 - (9702/12_Summer_2021_Q10) - *Dynamics*

D

88 - (9702/13_Summer_2021_Q10) - *Dynamics*

B

89 - (9702/13_Summer_2021_Q11) - *Dynamics*

A

90 - (9702/11_Winter_2021_Q8) - *Dynamics*

C

91 - (9702/13_Winter_2021_Q8) - *Dynamics*

A

92 - (9702/11_Winter_2021_Q9) - *Dynamics*

B

93 - (9702/11_Winter_2021_Q11) - *Dynamics*

C

94 - (9702/12_Winter_2021_Q11) - *Dynamics*

B

95 - (9702/11_Winter_2021_Q12) - *Dynamics*

A

96 - (9702/12_Winter_2021_Q12) - *Dynamics*

C

97 - (9702/11_Winter_2021_Q13) - *Dynamics*

D

98 - (9702/12_Winter_2021_Q13) - *Dynamics*

C

99 - (9702/13_Winter_2021_Q13) - *Dynamics*

A

100 - (9702/11_Winter_2021_Q14) - *Dynamics*

D

101 - (9702/12_Winter_2021_Q14) - *Dynamics*

D

102 - (9702/13_Winter_2021_Q14) - *Dynamics*

C

103 - (9702/12_Winter_2021_Q15) - *Dynamics*

C

104 - (9702/11_Summer_2022_Q11) - *Dynamics*

C

105 - (9702/12_Summer_2022_Q11) - *Dynamics*

C

106 - (9702/11_Summer_2022_Q12) - *Dynamics*

B

107 - (9702/12_Summer_2022_Q12) - *Dynamics*

D

108 - (9702/13_Summer_2022_Q12) - *Dynamics*

C

109 - (9702/11_Summer_2022_Q13) - *Dynamics*

A

110 - (9702/12_Summer_2022_Q13) - *Dynamics*

C

111 - (9702/13_Summer_2022_Q13) - *Dynamics*

D

112 - (9702/11_Summer_2022_Q14) - *Dynamics*

B

113 - (9702/13_Summer_2022_Q14) - *Dynamics*

B

114 - (9702/13_Summer_2022_Q15) - *Dynamics*

A

115 - (9702/11_Winter_2022_Q7) - *Dynamics*

C

116 - (9702/11_Winter_2022_Q8) - *Dynamics*

A

117 - (9702/12_Winter_2022_Q8) - *Dynamics*

C

118 - (9702/11_Winter_2022_Q9) - *Dynamics*

A

119 - (9702/12_Winter_2022_Q9) - *Dynamics*

B

120 - (9702/13_Winter_2022_Q9) - *Dynamics*

A

121 - (9702/11_Winter_2022_Q10) - *Dynamics*

D

122 - (9702/12_Winter_2022_Q10) - *Dynamics*

C

123 - (9702/13_Winter_2022_Q10) - *Dynamics*

B

124 - (9702/12_Winter_2022_Q11) - *Dynamics*

D

125 - (9702/13_Winter_2022_Q11) - *Dynamics*

D

126 - (9702/12_Winter_2022_Q12) - *Dynamics*

D

127 - (9702/13_Winter_2022_Q12) - *Dynamics*

D

A-Level Cambridge	PHYSICS – P1	CH4 - DYNAMICS
128 - (9702/12_Winter_2022_Q13) - <i>Dynamics</i> B		
129 - (9702/13_Winter_2022_Q13) - <i>Dynamics</i> B		
130 - (9702/12_Winter_2022_Q14) - <i>Dynamics</i> A		
131 - (9702/11_Summer_2023_Q7) - <i>Dynamics</i> C		
132 - (9702/11_Summer_2023_Q8) - <i>Dynamics</i> A		
133 - (9702/11_Summer_2023_Q10) - <i>Dynamics</i> D		
134 - (9702/11_Summer_2023_Q11) - <i>Dynamics</i> D		
135 - (9702/11_Summer_2023_Q12) - <i>Dynamics</i> A		
136 - (9702/11_Summer_2023_Q13) - <i>Dynamics</i> C		

137 - (9702/11_Summer_2023_Q18) - *Dynamics*

A

138 - (9702/11_Summer_2023_Q19) - *Dynamics*

A

139 - (9702/12_Summer_2023_Q7) - *Dynamics*

C

140 - (9702/12_Summer_2023_Q8) - *Dynamics*

B

141 - (9702/12_Summer_2023_Q9) - *Dynamics*

D

142 - (9702/12_Summer_2023_Q10) - *Dynamics*

A

143 - (9702/12_Summer_2023_Q11) - *Dynamics*

B

144 - (9702/12_Summer_2023_Q12) - *Dynamics*

C

145 - (9702/13_Summer_2023_Q7) - *Dynamics*

B

146 - (9702/13_Summer_2023_Q8) - *Dynamics*

B

147 - (9702/13_Summer_2023_Q9) - *Dynamics*

D

148 - (9702/13_Summer_2023_Q10) - *Dynamics*

C

149 - (9702/13_Summer_2023_Q11) - *Dynamics*

B

150 - (9702/13_Summer_2023_Q12) - *Dynamics*

C

151 - (9702/11_Winter_2023_Q7) - *Dynamics*

D

152 - (9702/11_Winter_2023_Q8) - *Dynamics*

B

153 - (9702/11_Winter_2023_Q9) - *Dynamics*

B

154 - (9702/11_Winter_2023_Q10) - *Dynamics*

B

155 - (9702/11_Winter_2023_Q11) - *Dynamics*

C

156 - (9702/11_Winter_2023_Q12) - *Dynamics*

A

157 - (9702/11_Winter_2023_Q13) - *Dynamics*

D

158 - (9702/12_Winter_2023_Q7) - *Dynamics*

A

159 - (9702/12_Winter_2023_Q8) - *Dynamics*

C

160 - (9702/12_Winter_2023_Q9) - *Dynamics*

B

161 - (9702/12_Winter_2023_Q10) - *Dynamics*

C

162 - (9702/12_Winter_2023_Q11) - *Dynamics*

A

163 - (9702/12_Winter_2023_Q12) - *Dynamics*

C

164 - (9702/12_Winter_2023_Q13) - *Dynamics*

B

165 - (9702/13_Winter_2023_Q7) - *Dynamics*

B

166 - (9702/13_Winter_2023_Q8) - *Dynamics*

D

167 - (9702/13_Winter_2023_Q9) - *Dynamics*

A

168 - (9702/13_Winter_2023_Q10) - *Dynamics*

C

169 - (9702/13_Winter_2023_Q11) - *Dynamics*

C

170 - (9702/13_Winter_2023_Q12) - *Dynamics*

B

1 - (9702/12_Summer_2017_Q9) - *Forces, Density & Pressure*

C

2 - (9702/12_Summer_2017_Q10) - *Forces, Density & Pressure*

A

3 - (9702/12_Summer_2017_Q11) - *Forces, Density & Pressure*

C

4 - (9702/13_Summer_2017_Q11) - *Forces, Density & Pressure*

D

5 - (9702/11_Summer_2017_Q12) - *Forces, Density & Pressure*

D

6 - (9702/12_Summer_2017_Q12) - *Forces, Density & Pressure*

D

7 - (9702/13_Summer_2017_Q12) - *Forces, Density & Pressure*

A

8 - (9702/11_Summer_2017_Q13) - *Forces, Density & Pressure*

C

9 - (9702/12_Summer_2017_Q13) - *Physical Quantities & Units, Forces, Density & Pressure*

D

10 - (9702/13_Summer_2017_Q13) - *Forces, Density & Pressure*

A

11 - (9702/11_Summer_2017_Q14) - *Forces, Density & Pressure*

A

12 - (9702/12_Summer_2017_Q16) - *Forces, Density & Pressure, Work, Energy & Power*

C

13 - (9702/11_Winter_2017_Q2) - *Forces, Density & Pressure*

B

14 - (9702/12_Winter_2017_Q2) - *Kinematics, Forces, Density & Pressure*

A

15 - (9702/13_Winter_2017_Q3) - *Forces, Density & Pressure*

A

16 - (9702/11_Winter_2017_Q8) - *Dynamics, Forces, Density & Pressure*

B

17 - (9702/12_Winter_2017_Q11) - *Forces, Density & Pressure*

D

18 - (9702/11_Winter_2017_Q12) - *Forces, Density & Pressure*

A

19 - (9702/12_Winter_2017_Q12) - *Forces, Density & Pressure*

B

20 - (9702/13_Winter_2017_Q12) - *Forces, Density & Pressure*

B

21 - (9702/11_Winter_2017_Q13) - *Forces, Density & Pressure*

A

22 - (9702/12_Winter_2017_Q13) - *Forces, Density & Pressure*

D

23 - (9702/13_Winter_2017_Q13) - *Dynamics, Forces, Density & Pressure*

C

24 - (9702/11_Winter_2017_Q14) - *Forces, Density & Pressure*

B

25 - (9702/12_Winter_2017_Q14) - *Forces, Density & Pressure*

A

26 - (9702/13_Winter_2017_Q14) - *Forces, Density & Pressure*

A

27 - (9702/11_Winter_2017_Q15) - *Forces, Density & Pressure*

B

28 - (9702/12_Winter_2017_Q15) - *Forces, Density & Pressure*

B

29 - (9702/11_Winter_2017_Q17) - *Forces, Density & Pressure, Work, Energy & Power*

A

30 - (9702/13_Winter_2017_Q17) - *Forces, Density & Pressure*

C

31 - (9702/11_Summer_2018_Q10) - *Forces, Density & Pressure*

A

32 - (9702/12_Summer_2018_Q10) - *Forces, Density & Pressure*

D

33 - (9702/13_Summer_2018_Q10) - *Forces, Density & Pressure*

A

34 - (9702/11_Summer_2018_Q11) - *Forces, Density & Pressure*

D

35 - (9702/13_Summer_2018_Q11) - *Forces, Density & Pressure*

D

36 - (9702/11_Summer_2018_Q12) - *Forces, Density & Pressure*

D

37 - (9702/12_Summer_2018_Q12) - *Forces, Density & Pressure*

B

38 - (9702/13_Summer_2018_Q12) - *Forces, Density & Pressure*

D

39 - (9702/11_Summer_2018_Q13) - *Forces, Density & Pressure*

C

40 - (9702/12_Summer_2018_Q13) - *Forces, Density & Pressure*

A

41 - (9702/13_Summer_2018_Q13) - *Forces, Density & Pressure*

B

42 - (9702/12_Summer_2018_Q14) - *Forces, Density & Pressure*

C

43 - (9702/13_Summer_2018_Q14) - *Forces, Density & Pressure*

A

44 - (9702/12_Summer_2018_Q15) - *Dynamics, Forces, Density & Pressure*

D

45 - (9702/11_Winter_2018_Q11) - *Forces, Density & Pressure*

C

46 - (9702/13_Winter_2018_Q11) - *Dynamics, Forces, Density & Pressure*

A

47 - (9702/11_Winter_2018_Q12) - *Forces, Density & Pressure*

A

48 - (9702/12_Winter_2018_Q12) - *Forces, Density & Pressure*

C

49 - (9702/13_Winter_2018_Q12) - *Forces, Density & Pressure*

B

50 - (9702/11_Winter_2018_Q13) - *Forces, Density & Pressure*

C

51 - (9702/12_Winter_2018_Q13) - *Forces, Density & Pressure*

A

52 - (9702/13_Winter_2018_Q13) - *Forces, Density & Pressure*

D

53 - (9702/12_Winter_2018_Q14) - *Forces, Density & Pressure*

C

54 - (9702/13_Winter_2018_Q14) - *Forces, Density & Pressure*

D

55 - (9702/12_Summer_2019_Q4) - *Forces, Density & Pressure*

C

56 - (9702/13_Summer_2019_Q11) - *Forces, Density & Pressure*

A

57 - (9702/11_Summer_2019_Q12) - *Forces, Density & Pressure*

A

58 - (9702/12_Summer_2019_Q12) - *Forces, Density & Pressure*

D

59 - (9702/13_Summer_2019_Q12) - *Forces, Density & Pressure*

C

60 - (9702/11_Summer_2019_Q13) - *Forces, Density & Pressure*

C

61 - (9702/13_Summer_2019_Q13) - *Forces, Density & Pressure*

A

62 - (9702/11_Summer_2019_Q14) - *Forces, Density & Pressure*

C

63 - (9702/13_Summer_2019_Q14) - *Forces, Density & Pressure*

D

64 - (9702/11_Summer_2019_Q15) - *Forces, Density & Pressure*

D

65 - (9702/12_Summer_2019_Q15) - *Forces, Density & Pressure*

D

66 - (9702/11_Summer_2019_Q16) - *Forces, Density & Pressure*

A

67 - (9702/12_Summer_2019_Q21) - *Forces, Density & Pressure*

C

68 - (9702/13_Winter_2019_Q10) - *Forces, Density & Pressure*

B

69 - (9702/11_Winter_2019_Q11) - *Forces, Density & Pressure*

D

70 - (9702/12_Winter_2019_Q11) - *Forces, Density & Pressure*

A

71 - (9702/13_Winter_2019_Q11) - *Forces, Density & Pressure*

A

72 - (9702/11_Winter_2019_Q12) - *Forces, Density & Pressure*

A

73 - (9702/12_Winter_2019_Q12) - *Forces, Density & Pressure*

D

74 - (9702/13_Winter_2019_Q12) - *Forces, Density & Pressure*

A

75 - (9702/11_Winter_2019_Q13) - *Dynamics, Forces, Density & Pressure*

C

76 - (9702/12_Winter_2019_Q13) - *Forces, Density & Pressure*

B

77 - (9702/13_Winter_2019_Q13) - *Forces, Density & Pressure*

B

78 - (9702/11_Winter_2019_Q14) - *Forces, Density & Pressure*

A

79 - (9702/13_Summer_2020_Q2) - *Forces, Density & Pressure*

C

80 - (9702/12_Summer_2020_Q11) - *Forces, Density & Pressure*

B

81 - (9702/13_Summer_2020_Q11) - *Forces, Density & Pressure*

B

82 - (9702/11_Summer_2020_Q12) - *Forces, Density & Pressure*

A

83 - (9702/12_Summer_2020_Q12) - *Forces, Density & Pressure*

A

84 - (9702/13_Summer_2020_Q12) - *Forces, Density & Pressure*

B

85 - (9702/11_Summer_2020_Q13) - *Forces, Density & Pressure*

C

86 - (9702/12_Summer_2020_Q13) - *Forces, Density & Pressure*

B

87 - (9702/13_Summer_2020_Q13) - *Forces, Density & Pressure*

A

88 - (9702/11_Summer_2020_Q14) - *Forces, Density & Pressure*

D

89 - (9702/13_Summer_2020_Q14) - *Forces, Density & Pressure*

D

90 - (9702/11_Summer_2020_Q15) - *Forces, Density & Pressure*

B

91 - (9702/13_Summer_2020_Q15) - *Forces, Density & Pressure*

B

92 - (9702/13_Winter_2020_Q11) - *Forces, Density & Pressure*

A

93 - (9702/11_Winter_2020_Q12) - *Forces, Density & Pressure*

B

94 - (9702/12_Winter_2020_Q12) - *Forces, Density & Pressure*

A

95 - (9702/13_Winter_2020_Q12) - *Forces, Density & Pressure*

B

96 - (9702/11_Winter_2020_Q13) - *Forces, Density & Pressure*

D

97 - (9702/12_Winter_2020_Q13) - *Forces, Density & Pressure*

A

98 - (9702/13_Winter_2020_Q13) - *Forces, Density & Pressure*

B

99 - (9702/11_Winter_2020_Q14) - *Forces, Density & Pressure*

D

100 - (9702/12_Winter_2020_Q14) - *Forces, Density & Pressure*

C

101 - (9702/13_Winter_2020_Q14) - *Forces, Density & Pressure*

D

102 - (9702/12_Winter_2020_Q15) - *Forces, Density & Pressure*

B

103 - (9702/13_Winter_2020_Q15) - *Forces, Density & Pressure*

D

104 - (9702/11_Summer_2021_Q1) - *Dynamics, Forces, Density & Pressure*

A

105 - (9702/12_Summer_2021_Q2) - *Forces, Density & Pressure*

B

106 - (9702/11_Summer_2021_Q12) - *Forces, Density & Pressure*

D

107 - (9702/12_Summer_2021_Q12) - *Forces, Density & Pressure*

C

108 - (9702/13_Summer_2021_Q12) - *Forces, Density & Pressure*

B

109 - (9702/11_Summer_2021_Q13) - *Forces, Density & Pressure*

C

110 - (9702/12_Summer_2021_Q13) - *Forces, Density & Pressure*

B

111 - (9702/13_Summer_2021_Q13) - *Forces, Density & Pressure*

A

112 - (9702/11_Summer_2021_Q14) - *Forces, Density & Pressure*

D

113 - (9702/12_Summer_2021_Q14) - *Forces, Density & Pressure*

C

114 - (9702/13_Summer_2021_Q14) - *Forces, Density & Pressure*

A

115 - (9702/13_Summer_2021_Q15) - *Forces, Density & Pressure*

B

116 - (9702/11_Winter_2021_Q10) - *Forces, Density & Pressure*

D

117 - (9702/13_Winter_2021_Q11) - *Forces, Density & Pressure*

B

118 - (9702/13_Winter_2021_Q12) - *Forces, Density & Pressure*

A

119 - (9702/13_Winter_2021_Q15) - *Forces, Density & Pressure*

C

120 - (9702/11_Summer_2022_Q8) - *Forces, Density & Pressure*

D

121 - (9702/11_Summer_2022_Q9) - *Forces, Density & Pressure*

B

122 - (9702/11_Summer_2022_Q10) - *Forces, Density & Pressure*

D

123 - (9702/12_Summer_2022_Q14) - *Forces, Density & Pressure*

B

124 - (9702/11_Summer_2022_Q15) - *Forces, Density & Pressure*

A

125 - (9702/12_Summer_2022_Q15) - *Forces, Density & Pressure*

C

126 - (9702/13_Summer_2022_Q16) - *Forces, Density & Pressure*

A

127 - (9702/11_Summer_2022_Q19) - *Forces, Density & Pressure*

A

128 - (9702/11_Summer_2022_Q20) - *Forces, Density & Pressure*

D

129 - (9702/11_Winter_2022_Q11) - *Forces, Density & Pressure*

B

130 - (9702/11_Winter_2022_Q12) - *Forces, Density & Pressure*

A

131 - (9702/11_Winter_2022_Q13) - *Forces, Density & Pressure*

C

132 - (9702/11_Winter_2022_Q14) - *Forces, Density & Pressure*

D

133 - (9702/13_Winter_2022_Q14) - *Forces, Density & Pressure*

C

134 - (9702/11_Winter_2022_Q15) - *Forces, Density & Pressure*

C

135 - (9702/12_Winter_2022_Q15) - *Forces, Density & Pressure*

C

136 - (9702/13_Winter_2022_Q15) - *Forces, Density & Pressure*

B

137 - (9702/12_Winter_2022_Q16) - *Forces, Density & Pressure*

A

138 - (9702/11_Summer_2023_Q9) - *Forces, Density & Pressure*

A

139 - (9702/11_Summer_2023_Q14) - *Forces, Density & Pressure*

A

140 - (9702/11_Summer_2023_Q15) - *Forces, Density & Pressure*

C

141 - (9702/12_Summer_2023_Q13) - *Forces, Density & Pressure*

A

142 - (9702/12_Summer_2023_Q14) - *Forces, Density & Pressure*

A

143 - (9702/12_Summer_2023_Q18) - *Forces, Density & Pressure*

D

144 - (9702/12_Summer_2023_Q19) - *Forces, Density & Pressure*

B

145 - (9702/13_Summer_2023_Q13) - *Forces, Density & Pressure*

D

146 - (9702/13_Summer_2023_Q18) - *Forces, Density & Pressure*

B

147 - (9702/13_Summer_2023_Q19) - *Forces, Density & Pressure*

B

148 - (9702/11_Winter_2023_Q14) - *Forces, Density & Pressure*

D

149 - (9702/11_Winter_2023_Q18) - *Forces, Density & Pressure*

C

150 - (9702/12_Winter_2023_Q14) - *Forces, Density & Pressure*

C

151 - (9702/13_Winter_2023_Q13) - *Forces, Density & Pressure*

B

152 - (9702/13_Winter_2023_Q14) - *Forces, Density & Pressure*

A

153 - (9702/13_Winter_2023_Q15) - *Forces, Density & Pressure*

D

A-Level Cambridge	PHYSICS – P1	CH6 - WORK, ENERGY & POWER
1 - (9702/12_Summer_2017_Q14) - <i>Dynamics, Work, Energy & Power</i> C		
2 - (9702/13_Summer_2017_Q14) - <i>Work, Energy & Power</i> A		
3 - (9702/11_Summer_2017_Q15) - <i>Work, Energy & Power</i> A		
4 - (9702/12_Summer_2017_Q15) - <i>Work, Energy & Power</i> B		
5 - (9702/13_Summer_2017_Q15) - <i>Work, Energy & Power</i> D		
6 - (9702/11_Summer_2017_Q16) - <i>Work, Energy & Power</i> C		
7 - (9702/12_Summer_2017_Q16) - <i>Forces, Density & Pressure, Work, Energy & Power</i> C		
8 - (9702/11_Summer_2017_Q17) - <i>Work, Energy & Power</i> C		
9 - (9702/12_Summer_2017_Q17) - <i>Work, Energy & Power</i> C		
10 - (9702/13_Summer_2017_Q17) - <i>Work, Energy & Power</i> B		

11 - (9702/11_Summer_2017_Q18) - *Work, Energy & Power*

D

12 - (9702/12_Summer_2017_Q18) - *Work, Energy & Power*

A

13 - (9702/11_Summer_2017_Q19) - *Work, Energy & Power*

A

14 - (9702/13_Winter_2017_Q2) - *Work, Energy & Power*

C

15 - (9702/11_Winter_2017_Q3) - *Work, Energy & Power*

B

16 - (9702/13_Winter_2017_Q15) - *Work, Energy & Power*

A

17 - (9702/11_Winter_2017_Q16) - *Work, Energy & Power*

D

18 - (9702/13_Winter_2017_Q16) - *Work, Energy & Power*

D

19 - (9702/11_Winter_2017_Q17) - *Forces, Density & Pressure, Work, Energy & Power*

A

A-Level Cambridge	PHYSICS – P1	CH6 - WORK, ENERGY & POWER
20 - (9702/12_Winter_2017_Q18) - <i>Work, Energy & Power</i> A		
21 - (9702/13_Winter_2017_Q18) - <i>Work, Energy & Power</i> D		
22 - (9702/11_Winter_2017_Q19) - <i>Work, Energy & Power</i> B		
23 - (9702/12_Winter_2017_Q19) - <i>Work, Energy & Power, Current Of Electricity</i> B		
24 - (9702/11_Summer_2018_Q8) - <i>Kinematics, Work, Energy & Power</i> A		
25 - (9702/12_Summer_2018_Q9) - <i>Kinematics, Work, Energy & Power</i> C		
26 - (9702/11_Summer_2018_Q14) - <i>Work, Energy & Power</i> C		
27 - (9702/11_Summer_2018_Q15) - <i>Work, Energy & Power</i> D		
28 - (9702/13_Summer_2018_Q15) - <i>Work, Energy & Power</i> D		

A-Level Cambridge	PHYSICS – P1	CH6 - WORK, ENERGY & POWER
29 - (9702/11_Summer_2018_Q16) - <i>Kinematics, Work, Energy & Power</i> B		
30 - (9702/12_Summer_2018_Q16) - <i>Work, Energy & Power, Current Of Electricity</i> B		
31 - (9702/13_Summer_2018_Q16) - <i>Work, Energy & Power</i> B		
32 - (9702/11_Summer_2018_Q17) - <i>Work, Energy & Power</i> C		
33 - (9702/13_Summer_2018_Q17) - <i>Work, Energy & Power</i> B		
34 - (9702/12_Summer_2018_Q18) - <i>Work, Energy & Power</i> C		
35 - (9702/12_Summer_2018_Q19) - <i>Work, Energy & Power</i> B		
36 - (9702/11_Winter_2018_Q14) - <i>Work, Energy & Power</i> A		
37 - (9702/11_Winter_2018_Q15) - <i>Work, Energy & Power</i> B		

A-Level Cambridge	PHYSICS – P1	CH6 - WORK, ENERGY & POWER
38 - (9702/12_Winter_2018_Q15) - <i>Work, Energy & Power</i> D		
39 - (9702/13_Winter_2018_Q15) - <i>Work, Energy & Power</i> D		
40 - (9702/12_Winter_2018_Q16) - <i>Work, Energy & Power</i> A		
41 - (9702/13_Winter_2018_Q16) - <i>Work, Energy & Power</i> B		
42 - (9702/11_Winter_2018_Q17) - <i>Work, Energy & Power</i> C		
43 - (9702/12_Winter_2018_Q17) - <i>Work, Energy & Power</i> A		
44 - (9702/13_Winter_2018_Q17) - <i>Work, Energy & Power</i> C		
45 - (9702/12_Winter_2018_Q18) - <i>Work, Energy & Power</i> B		
46 - (9702/13_Winter_2018_Q18) - <i>Work, Energy & Power</i> C		

47 - (9702/12_Winter_2018_Q19) - *Work, Energy & Power*

A

48 - (9702/13_Summer_2019_Q4) - *Measurement Techniques, Work, Energy & Power*

B

49 - (9702/12_Summer_2019_Q13) - *Electric Fields, Work, Energy & Power*

C

50 - (9702/13_Summer_2019_Q15) - *Work, Energy & Power*

D

51 - (9702/12_Summer_2019_Q16) - *Work, Energy & Power*

B

52 - (9702/13_Summer_2019_Q16) - *Work, Energy & Power*

C

53 - (9702/11_Summer_2019_Q17) - *Work, Energy & Power*

C

54 - (9702/12_Summer_2019_Q17) - *Work, Energy & Power*

D

55 - (9702/13_Summer_2019_Q17) - *Dynamics, Work, Energy & Power*

A

56 - (9702/11_Summer_2019_Q18) - *Work, Energy & Power*

B

57 - (9702/12_Summer_2019_Q18) - *Work, Energy & Power*

A

58 - (9702/13_Summer_2019_Q18) - *Work, Energy & Power*

B

59 - (9702/11_Summer_2019_Q19) - *Work, Energy & Power*

C

60 - (9702/12_Summer_2019_Q19) - *Work, Energy & Power*

C

61 - (9702/12_Winter_2019_Q14) - *Work, Energy & Power*

A

62 - (9702/13_Winter_2019_Q14) - *Work, Energy & Power*

A

63 - (9702/11_Winter_2019_Q15) - *Work, Energy & Power*

D

64 - (9702/12_Winter_2019_Q15) - *Work, Energy & Power*

C

A-Level Cambridge	PHYSICS – P1	CH6 - WORK, ENERGY & POWER
65 - (9702/13_Winter_2019_Q15) - <i>Work, Energy & Power</i> A		
66 - (9702/11_Winter_2019_Q16) - <i>Work, Energy & Power</i> C		
67 - (9702/12_Winter_2019_Q16) - <i>Work, Energy & Power</i> D		
68 - (9702/13_Winter_2019_Q16) - <i>Work, Energy & Power</i> B		
69 - (9702/11_Winter_2019_Q17) - <i>Work, Energy & Power</i> C		
70 - (9702/12_Winter_2019_Q17) - <i>Work, Energy & Power</i> B		
71 - (9702/13_Winter_2019_Q17) - <i>Work, Energy & Power</i> A		
72 - (9702/11_Winter_2019_Q18) - <i>Work, Energy & Power</i> B		
73 - (9702/13_Winter_2019_Q18) - <i>Work, Energy & Power</i> B		

A-Level Cambridge	PHYSICS – P1	CH6 - WORK, ENERGY & POWER
74 - (9702/12_Summer_2020_Q14) - <i>Work, Energy & Power</i> C		
75 - (9702/12_Summer_2020_Q15) - <i>Work, Energy & Power</i> C		
76 - (9702/11_Summer_2020_Q16) - <i>Work, Energy & Power</i> C		
77 - (9702/13_Summer_2020_Q16) - <i>Work, Energy & Power</i> D		
78 - (9702/11_Summer_2020_Q17) - <i>Work, Energy & Power</i> B		
79 - (9702/12_Summer_2020_Q17) - <i>Work, Energy & Power</i> C		
80 - (9702/13_Summer_2020_Q17) - <i>Work, Energy & Power</i> D		
81 - (9702/11_Summer_2020_Q18) - <i>Work, Energy & Power</i> C		
82 - (9702/13_Summer_2020_Q18) - <i>Work, Energy & Power</i> C		

A-Level Cambridge	PHYSICS – P1	CH6 - WORK, ENERGY & POWER
83 - (9702/11_Summer_2020_Q19) - <i>Work, Energy & Power</i> D		
84 - (9702/13_Summer_2020_Q19) - <i>Work, Energy & Power</i> C		
85 - (9702/11_Winter_2020_Q15) - <i>Work, Energy & Power</i> B		
86 - (9702/11_Winter_2020_Q16) - <i>Work, Energy & Power</i> C		
87 - (9702/12_Winter_2020_Q16) - <i>Work, Energy & Power</i> A		
88 - (9702/13_Winter_2020_Q16) - <i>Work, Energy & Power</i> B		
89 - (9702/11_Winter_2020_Q17) - <i>Work, Energy & Power</i> A		
90 - (9702/12_Winter_2020_Q17) - <i>Work, Energy & Power</i> D		
91 - (9702/13_Winter_2020_Q17) - <i>Work, Energy & Power</i> C		

A-Level Cambridge	PHYSICS – P1	CH6 - WORK, ENERGY & POWER
92 - (9702/11_Winter_2020_Q18) - <i>Work, Energy & Power</i> B		
93 - (9702/12_Winter_2020_Q18) - <i>Work, Energy & Power</i> C		
94 - (9702/13_Winter_2020_Q18) - <i>Work, Energy & Power</i> A		
95 - (9702/12_Winter_2020_Q19) - <i>Work, Energy & Power</i> A		
96 - (9702/13_Winter_2020_Q19) - <i>Work, Energy & Power</i> B		
97 - (9702/13_Summer_2021_Q1) - <i>Work, Energy & Power</i> C		
98 - (9702/11_Summer_2021_Q15) - <i>Work, Energy & Power</i> A		
99 - (9702/12_Summer_2021_Q15) - <i>Work, Energy & Power</i> A		
100 - (9702/11_Summer_2021_Q16) - <i>Work, Energy & Power</i> D		

101 - (9702/12_Summer_2021_Q16) - *Work, Energy & Power*

A

102 - (9702/13_Summer_2021_Q16) - *Work, Energy & Power*

D

103 - (9702/11_Summer_2021_Q17) - *Work, Energy & Power*

A

104 - (9702/12_Summer_2021_Q17) - *Work, Energy & Power*

D

105 - (9702/13_Summer_2021_Q17) - *Work, Energy & Power*

C

106 - (9702/11_Summer_2021_Q18) - *Work, Energy & Power*

B

107 - (9702/12_Summer_2021_Q18) - *Work, Energy & Power*

D

108 - (9702/13_Summer_2021_Q18) - *Work, Energy & Power*

B

109 - (9702/13_Summer_2021_Q19) - *Work, Energy & Power*

D

110 - (9702/11_Winter_2021_Q15) - *Work, Energy & Power*

D

111 - (9702/11_Winter_2021_Q16) - *Work, Energy & Power*

C

112 - (9702/12_Winter_2021_Q16) - *Work, Energy & Power*

B

113 - (9702/13_Winter_2021_Q16) - *Work, Energy & Power*

B

114 - (9702/11_Winter_2021_Q17) - *Work, Energy & Power*

B

115 - (9702/12_Winter_2021_Q17) - *Work, Energy & Power*

C

116 - (9702/13_Winter_2021_Q17) - *Work, Energy & Power*

C

117 - (9702/11_Winter_2021_Q18) - *Work, Energy & Power*

A

118 - (9702/12_Winter_2021_Q18) - *Work, Energy & Power*

A

119 - (9702/13_Winter_2021_Q18) - *Work, Energy & Power*

C

120 - (9702/11_Winter_2021_Q19) - *Work, Energy & Power*

C

121 - (9702/12_Winter_2021_Q19) - *Work, Energy & Power*

A

122 - (9702/13_Winter_2021_Q19) - *Work, Energy & Power*

B

123 - (9702/11_Winter_2021_Q20) - *Work, Energy & Power*

A

124 - (9702/12_Winter_2021_Q20) - *Work, Energy & Power*

B

125 - (9702/13_Winter_2021_Q20) - *Work, Energy & Power*

C

126 - (9702/12_Winter_2021_Q21) - *Work, Energy & Power*

A

127 - (9702/13_Winter_2021_Q21) - *Work, Energy & Power*

D

A-Level Cambridge	PHYSICS – P1	CH6 - WORK, ENERGY & POWER
128 - (9702/12_Winter_2021_Q22) - <i>Work, Energy & Power</i> D		
129 - (9702/11_Summer_2022_Q16) - <i>Work, Energy & Power</i> A		
130 - (9702/12_Summer_2022_Q16) - <i>Work, Energy & Power</i> B		
131 - (9702/11_Summer_2022_Q17) - <i>Work, Energy & Power</i> C		
132 - (9702/12_Summer_2022_Q17) - <i>Work, Energy & Power</i> A		
133 - (9702/13_Summer_2022_Q17) - <i>Work, Energy & Power</i> C		
134 - (9702/11_Summer_2022_Q18) - <i>Work, Energy & Power</i> A		
135 - (9702/12_Summer_2022_Q18) - <i>Work, Energy & Power</i> C		
136 - (9702/13_Summer_2022_Q18) - <i>Work, Energy & Power</i> C		

137 - (9702/13_Summer_2022_Q19) - *Work, Energy & Power*

B

138 - (9702/13_Winter_2022_Q16) - *Work, Energy & Power*

B

139 - (9702/11_Winter_2022_Q17) - *Work, Energy & Power*

C

140 - (9702/12_Winter_2022_Q17) - *Work, Energy & Power*

C

141 - (9702/13_Winter_2022_Q17) - *Work, Energy & Power*

C

142 - (9702/11_Winter_2022_Q18) - *Work, Energy & Power*

C

143 - (9702/12_Winter_2022_Q18) - *Work, Energy & Power*

B

144 - (9702/13_Winter_2022_Q18) - *Work, Energy & Power*

B

145 - (9702/12_Winter_2022_Q19) - *Work, Energy & Power*

C

146 - (9702/11_Summer_2023_Q16) - *Work, Energy & Power*

B

147 - (9702/11_Summer_2023_Q17) - *Work, Energy & Power*

B

148 - (9702/12_Summer_2023_Q15) - *Work, Energy & Power*

D

149 - (9702/12_Summer_2023_Q16) - *Work, Energy & Power*

A

150 - (9702/12_Summer_2023_Q17) - *Work, Energy & Power*

B

151 - (9702/13_Summer_2023_Q14) - *Work, Energy & Power*

A

152 - (9702/13_Summer_2023_Q15) - *Work, Energy & Power*

C

153 - (9702/13_Summer_2023_Q16) - *Work, Energy & Power*

C

154 - (9702/13_Summer_2023_Q17) - *Work, Energy & Power*

D

155 - (9702/11_Winter_2023_Q15) - *Work, Energy & Power*

D

156 - (9702/11_Winter_2023_Q16) - *Work, Energy & Power*

A

157 - (9702/11_Winter_2023_Q17) - *Work, Energy & Power*

A

158 - (9702/12_Winter_2023_Q15) - *Work, Energy & Power*

A

159 - (9702/12_Winter_2023_Q16) - *Work, Energy & Power*

C

160 - (9702/12_Winter_2023_Q17) - *Work, Energy & Power*

D

161 - (9702/12_Winter_2023_Q18) - *Work, Energy & Power*

B

162 - (9702/13_Winter_2023_Q16) - *Work, Energy & Power*

B

163 - (9702/13_Winter_2023_Q17) - *Work, Energy & Power*

B

1 - (9702/13_Winter_2017_Q19) - *Dynamics, Motion In A Circle*

A

A-Level Cambridge	PHYSICS – P1	CH9 - DEFORMATION OF SOLIDS
1 - (9702/13_Summer_2017_Q18) - <i>Deformation Of Solids</i> D		
2 - (9702/12_Summer_2017_Q19) - <i>Deformation Of Solids</i> A		
3 - (9702/13_Summer_2017_Q19) - <i>Deformation Of Solids</i> B		
4 - (9702/11_Summer_2017_Q20) - <i>Deformation Of Solids</i> D		
5 - (9702/12_Summer_2017_Q20) - <i>Physical Quantities & Units, Deformation Of Solids</i> D		
6 - (9702/13_Summer_2017_Q20) - <i>Deformation Of Solids</i> A		
7 - (9702/11_Summer_2017_Q21) - <i>Deformation Of Solids</i> A		
8 - (9702/12_Summer_2017_Q21) - <i>Deformation Of Solids</i> B		
9 - (9702/11_Winter_2017_Q20) - <i>Deformation Of Solids</i> A		
10 - (9702/12_Winter_2017_Q20) - <i>Deformation Of Solids</i> D		

A-Level Cambridge	PHYSICS – P1	CH9 - DEFORMATION OF SOLIDS
11 - (9702/13_Winter_2017_Q20) - <i>Deformation Of Solids</i> D		
12 - (9702/11_Winter_2017_Q21) - <i>Deformation Of Solids</i> D		
13 - (9702/12_Winter_2017_Q21) - <i>Deformation Of Solids</i> A		
14 - (9702/13_Winter_2017_Q21) - <i>Deformation Of Solids</i> A		
15 - (9702/11_Summer_2018_Q1) - <i>Physical Quantities & Units, Deformation Of Solids</i> A		
16 - (9702/11_Summer_2018_Q18) - <i>Deformation Of Solids</i> B		
17 - (9702/13_Summer_2018_Q18) - <i>Deformation Of Solids</i> D		
18 - (9702/11_Summer_2018_Q19) - <i>Deformation Of Solids</i> B		
19 - (9702/13_Summer_2018_Q19) - <i>Deformation Of Solids</i> C		

A-Level Cambridge	PHYSICS – P1	CH9 - DEFORMATION OF SOLIDS
20 - (9702/12_Summer_2018_Q20) - <i>Deformation Of Solids</i> D		
21 - (9702/12_Summer_2018_Q21) - <i>Deformation Of Solids</i> D		
22 - (9702/11_Winter_2018_Q9) - <i>Deformation Of Solids</i> D		
23 - (9702/11_Winter_2018_Q16) - <i>Deformation Of Solids</i> B		
24 - (9702/11_Winter_2018_Q18) - <i>Deformation Of Solids</i> B		
25 - (9702/11_Winter_2018_Q19) - <i>Deformation Of Solids</i> B		
26 - (9702/13_Winter_2018_Q19) - <i>Deformation Of Solids</i> D		
27 - (9702/11_Winter_2018_Q20) - <i>Deformation Of Solids</i> C		
28 - (9702/12_Winter_2018_Q20) - <i>Deformation Of Solids</i> D		

A-Level Cambridge	PHYSICS – P1	CH9 - DEFORMATION OF SOLIDS
29 - (9702/13_Winter_2018_Q20) - <i>Deformation Of Solids</i> B		
30 - (9702/12_Winter_2018_Q21) - <i>Deformation Of Solids</i> D		
31 - (9702/13_Summer_2019_Q19) - <i>Deformation Of Solids</i> B		
32 - (9702/11_Summer_2019_Q20) - <i>Deformation Of Solids</i> A		
33 - (9702/12_Summer_2019_Q20) - <i>Deformation Of Solids</i> A		
34 - (9702/13_Summer_2019_Q20) - <i>Deformation Of Solids</i> C		
35 - (9702/11_Summer_2019_Q21) - <i>Deformation Of Solids</i> B		
36 - (9702/12_Summer_2019_Q22) - <i>Deformation Of Solids</i> B		
37 - (9702/12_Winter_2019_Q18) - <i>Deformation Of Solids</i> A		

A-Level Cambridge	PHYSICS – P1	CH9 - DEFORMATION OF SOLIDS
38 - (9702/11_Winter_2019_Q19) - <i>Deformation Of Solids</i> D		
39 - (9702/12_Winter_2019_Q19) - <i>Deformation Of Solids</i> B		
40 - (9702/13_Winter_2019_Q19) - <i>Deformation Of Solids</i> D		
41 - (9702/11_Winter_2019_Q20) - <i>Deformation Of Solids</i> D		
42 - (9702/13_Winter_2019_Q20) - <i>Deformation Of Solids</i> C		
43 - (9702/12_Summer_2020_Q16) - <i>Deformation Of Solids</i> D		
44 - (9702/12_Summer_2020_Q18) - <i>Deformation Of Solids</i> C		
45 - (9702/12_Summer_2020_Q19) - <i>Deformation Of Solids</i> B		
46 - (9702/11_Summer_2020_Q20) - <i>Deformation Of Solids</i> B		

A-Level Cambridge	PHYSICS – P1	CH9 - DEFORMATION OF SOLIDS
47 - (9702/12_Summer_2020_Q20) - <i>Deformation Of Solids</i> B		
48 - (9702/13_Summer_2020_Q20) - <i>Deformation Of Solids</i> A		
49 - (9702/11_Summer_2020_Q21) - <i>Deformation Of Solids</i> D		
50 - (9702/13_Summer_2020_Q21) - <i>Deformation Of Solids</i> A		
51 - (9702/11_Winter_2020_Q19) - <i>Deformation Of Solids</i> C		
52 - (9702/11_Winter_2020_Q20) - <i>Deformation Of Solids</i> C		
53 - (9702/12_Winter_2020_Q20) - <i>Deformation Of Solids</i> C		
54 - (9702/13_Winter_2020_Q20) - <i>Deformation Of Solids</i> C		
55 - (9702/12_Winter_2020_Q21) - <i>Deformation Of Solids</i> C		

A-Level Cambridge	PHYSICS – P1	CH9 - DEFORMATION OF SOLIDS
56 - (9702/13_Winter_2020_Q21) - <i>Deformation Of Solids</i> C		
57 - (9702/11_Summer_2021_Q19) - <i>Deformation Of Solids</i> B		
58 - (9702/12_Summer_2021_Q19) - <i>Deformation Of Solids</i> A		
59 - (9702/11_Summer_2021_Q20) - <i>Deformation Of Solids</i> C		
60 - (9702/12_Summer_2021_Q20) - <i>Deformation Of Solids</i> D		
61 - (9702/13_Summer_2021_Q20) - <i>Deformation Of Solids</i> D		
62 - (9702/13_Summer_2021_Q21) - <i>Deformation Of Solids</i> C		
63 - (9702/12_Summer_2022_Q19) - <i>Deformation Of Solids</i> B		
64 - (9702/12_Summer_2022_Q20) - <i>Deformation Of Solids</i> A		

A-Level Cambridge	PHYSICS – P1	CH9 - DEFORMATION OF SOLIDS
65 - (9702/13_Summer_2022_Q20) - <i>Deformation Of Solids</i> C		
66 - (9702/13_Summer_2022_Q21) - <i>Deformation Of Solids</i> B		
67 - (9702/11_Winter_2022_Q16) - <i>Deformation Of Solids</i> D		
68 - (9702/11_Winter_2022_Q19) - <i>Deformation Of Solids</i> C		
69 - (9702/11_Winter_2022_Q20) - <i>Deformation Of Solids</i> D		
70 - (9702/11_Winter_2023_Q19) - <i>Deformation Of Solids</i> D		
71 - (9702/12_Winter_2023_Q19) - <i>Deformation Of Solids</i> D		
72 - (9702/13_Winter_2023_Q18) - <i>Deformation Of Solids</i> C		
73 - (9702/13_Winter_2023_Q19) - <i>Deformation Of Solids</i> A		

1 - (9702/12_Winter_2022_Q20) - *Ideal Gases*

B

2 - (9702/12_Winter_2022_Q21) - *Ideal Gases*

A

3 - (9702/12_Winter_2022_Q22) - *Ideal Gases*

D

4 - (9702/13_Winter_2022_Q19) - *Ideal Gases*

C

5 - (9702/13_Winter_2022_Q20) - *Ideal Gases*

A

1 - (9702/12_Winter_2017_Q3) - *Thermal Properties Of Materials*

C

1 - (9702/12_Winter_2017_Q22) - *Oscillations*

D

2 - (9702/12_Winter_2021_Q23) - *Oscillations*

D

3 - (9702/12_Winter_2023_Q21) - *Oscillations*

C

1 - (9702/13_Summer_2017_Q21) - *Waves*

B

2 - (9702/11_Summer_2017_Q22) - *Waves*

B

3 - (9702/12_Summer_2017_Q22) - *Waves*

C

4 - (9702/13_Summer_2017_Q22) - *Waves*

A

5 - (9702/11_Summer_2017_Q23) - *Waves*

B

6 - (9702/12_Summer_2017_Q23) - *Waves*

B

7 - (9702/13_Summer_2017_Q23) - *Measurement Techniques, Waves*

C

8 - (9702/11_Summer_2017_Q24) - *Measurement Techniques, Waves*

B

9 - (9702/12_Summer_2017_Q24) - *Waves*

A

10 - (9702/13_Summer_2017_Q24) - *Waves*

D

11 - (9702/11_Summer_2017_Q25) - *Waves*

C

12 - (9702/12_Summer_2017_Q25) - *Waves*

D

13 - (9702/13_Summer_2017_Q25) - *Waves*

D

14 - (9702/11_Summer_2017_Q26) - *Waves*

B

15 - (9702/12_Summer_2017_Q26) - *Waves*

B

16 - (9702/11_Winter_2017_Q4) - *Waves*

C

17 - (9702/12_Winter_2017_Q5) - *Waves*

C

18 - (9702/11_Winter_2017_Q22) - *Waves*

B

19 - (9702/13_Winter_2017_Q22) - *Waves*

C

A-Level Cambridge	PHYSICS – P1	CH14 - WAVES
20 - (9702/11_Winter_2017_Q23) - <i>Waves</i> C		
21 - (9702/12_Winter_2017_Q23) - <i>Waves</i> D		
22 - (9702/13_Winter_2017_Q23) - <i>Waves</i> D		
23 - (9702/11_Winter_2017_Q24) - <i>Waves, Superposition</i> A		
24 - (9702/12_Winter_2017_Q24) - <i>Waves, Superposition</i> B		
25 - (9702/11_Winter_2017_Q25) - <i>Waves, Superposition</i> D		
26 - (9702/12_Winter_2017_Q25) - <i>Waves, Superposition</i> C		
27 - (9702/13_Winter_2017_Q25) - <i>Waves</i> C		
28 - (9702/11_Winter_2017_Q26) - <i>Waves</i> C		

29 - (9702/12_Winter_2017_Q26) - Waves

D

30 - (9702/13_Winter_2017_Q26) - Waves

C

31 - (9702/13_Winter_2017_Q27) - Waves

D

32 - (9702/13_Winter_2017_Q28) - Waves

C

33 - (9702/11_Summer_2018_Q20) - Waves

B

34 - (9702/13_Summer_2018_Q20) - Waves

C

35 - (9702/11_Summer_2018_Q21) - Waves

A

36 - (9702/13_Summer_2018_Q21) - Waves

D

37 - (9702/11_Summer_2018_Q22) - Waves

B

38 - (9702/12_Summer_2018_Q22) - *Waves*

B

39 - (9702/13_Summer_2018_Q22) - *Waves*

B

40 - (9702/11_Summer_2018_Q23) - *Waves*

D

41 - (9702/12_Summer_2018_Q23) - *Waves*

D

42 - (9702/13_Summer_2018_Q23) - *Waves*

D

43 - (9702/11_Summer_2018_Q24) - *Waves*

C

44 - (9702/13_Summer_2018_Q24) - *Waves, Superposition*

B

45 - (9702/12_Summer_2018_Q25) - *Waves*

D

46 - (9702/13_Summer_2018_Q25) - *Waves*

D

47 - (9702/12_Summer_2018_Q26) - *Waves, Superposition*

C

48 - (9702/12_Summer_2018_Q27) - *Waves*

D

49 - (9702/11_Winter_2018_Q21) - *Waves*

D

50 - (9702/13_Winter_2018_Q21) - *Waves*

D

51 - (9702/11_Winter_2018_Q22) - *Waves*

C

52 - (9702/12_Winter_2018_Q22) - *Waves*

D

53 - (9702/13_Winter_2018_Q22) - *Waves*

B

54 - (9702/11_Winter_2018_Q23) - *Waves*

A

55 - (9702/12_Winter_2018_Q23) - *Waves*

B

56 - (9702/13_Winter_2018_Q23) - *Waves*

B

57 - (9702/11_Winter_2018_Q24) - *Waves*

D

58 - (9702/13_Winter_2018_Q24) - *Waves*

D

59 - (9702/11_Winter_2018_Q25) - *Waves*

A

60 - (9702/12_Winter_2018_Q25) - *Waves*

D

61 - (9702/13_Winter_2018_Q25) - *Waves*

B

62 - (9702/12_Winter_2018_Q26) - *Waves*

D

63 - (9702/13_Winter_2018_Q27) - *Waves, Superposition*

C

64 - (9702/12_Winter_2018_Q28) - *Waves, Superposition*

B

65 - (9702/11_Summer_2019_Q4) - *Waves*

D

66 - (9702/13_Summer_2019_Q21) - *Waves*

C

67 - (9702/11_Summer_2019_Q22) - *Waves*

A

68 - (9702/13_Summer_2019_Q22) - *Waves*

C

69 - (9702/11_Summer_2019_Q23) - *Waves*

A

70 - (9702/12_Summer_2019_Q23) - *Waves*

A

71 - (9702/13_Summer_2019_Q23) - *Waves*

B

72 - (9702/12_Summer_2019_Q24) - *Waves*

D

73 - (9702/13_Summer_2019_Q24) - *Waves*

D

74 - (9702/13_Summer_2019_Q25) - *Waves*

A

75 - (9702/11_Summer_2019_Q26) - *Waves*

B

76 - (9702/12_Summer_2019_Q26) - *Waves*

B

77 - (9702/12_Summer_2019_Q27) - *Waves*

D

78 - (9702/13_Summer_2019_Q27) - *Waves*

C

79 - (9702/11_Summer_2019_Q28) - *Waves*

B

80 - (9702/12_Summer_2019_Q28) - *Waves*

C

81 - (9702/12_Summer_2019_Q29) - *Waves*

C

82 - (9702/12_Winter_2019_Q20) - *Waves*

D

83 - (9702/11_Winter_2019_Q21) - Waves

C

84 - (9702/12_Winter_2019_Q21) - Waves

D

85 - (9702/13_Winter_2019_Q21) - Waves

C

86 - (9702/11_Winter_2019_Q22) - Waves

C

87 - (9702/12_Winter_2019_Q22) - Waves

C

88 - (9702/13_Winter_2019_Q22) - Waves

B

89 - (9702/12_Winter_2019_Q23) - Waves

C

90 - (9702/13_Winter_2019_Q23) - Waves

B

91 - (9702/11_Winter_2019_Q24) - Waves

A

92 - (9702/12_Winter_2019_Q24) - Waves

B

93 - (9702/13_Winter_2019_Q24) - Waves

B

94 - (9702/11_Winter_2019_Q25) - Waves

D

95 - (9702/13_Winter_2019_Q25) - Waves

A

96 - (9702/12_Winter_2019_Q26) - Waves

B

97 - (9702/11_Winter_2019_Q27) - Waves

A

98 - (9702/13_Winter_2019_Q27) - Waves

A

99 - (9702/11_Winter_2019_Q29) - Waves

B

100 - (9702/11_Summer_2020_Q4) - Waves

B

101 - (9702/12_Summer_2020_Q21) - Waves

A

102 - (9702/11_Summer_2020_Q22) - Waves

A

103 - (9702/12_Summer_2020_Q22) - Waves

C

104 - (9702/13_Summer_2020_Q22) - Waves

B

105 - (9702/11_Summer_2020_Q23) - Waves

A

106 - (9702/12_Summer_2020_Q23) - Waves

A

107 - (9702/13_Summer_2020_Q23) - Waves

D

108 - (9702/11_Summer_2020_Q25) - Waves

B

109 - (9702/12_Summer_2020_Q25) - Waves

D

110 - (9702/13_Summer_2020_Q25) - *Waves*

D

111 - (9702/11_Summer_2020_Q26) - *Waves*

C

112 - (9702/12_Summer_2020_Q26) - *Waves*

A

113 - (9702/13_Summer_2020_Q26) - *Waves*

A

114 - (9702/11_Summer_2020_Q28) - *Waves*

B

115 - (9702/12_Summer_2020_Q28) - *Waves*

B

116 - (9702/13_Summer_2020_Q28) - *Waves*

A

117 - (9702/11_Winter_2020_Q21) - *Waves*

C

118 - (9702/11_Winter_2020_Q22) - *Waves*

B

119 - (9702/12_Winter_2020_Q22) - *Waves*

D

120 - (9702/13_Winter_2020_Q22) - *Waves*

D

121 - (9702/12_Winter_2020_Q23) - *Waves*

D

122 - (9702/13_Winter_2020_Q23) - *Waves*

B

123 - (9702/11_Winter_2020_Q24) - *Waves*

A

124 - (9702/13_Winter_2020_Q24) - *Waves*

B

125 - (9702/11_Winter_2020_Q25) - *Waves*

C

126 - (9702/12_Winter_2020_Q25) - *Waves*

C

127 - (9702/13_Winter_2020_Q25) - *Waves*

A

128 - (9702/12_Winter_2020_Q26) - *Waves*

A

129 - (9702/13_Winter_2020_Q26) - *Waves*

D

130 - (9702/11_Winter_2020_Q27) - *Waves*

A

131 - (9702/12_Winter_2020_Q28) - *Waves*

B

132 - (9702/13_Winter_2020_Q28) - *Waves*

C

133 - (9702/11_Summer_2021_Q2) - *Waves*

D

134 - (9702/11_Summer_2021_Q4) - *Waves*

B

135 - (9702/11_Summer_2021_Q21) - *Waves*

D

136 - (9702/12_Summer_2021_Q21) - *Waves*

B

137 - (9702/11_Summer_2021_Q22) - Waves

B

138 - (9702/12_Summer_2021_Q22) - Waves

A

139 - (9702/13_Summer_2021_Q22) - Waves

B

140 - (9702/11_Summer_2021_Q23) - Waves

A

141 - (9702/12_Summer_2021_Q23) - Waves

B

142 - (9702/13_Summer_2021_Q23) - Waves

A

143 - (9702/11_Summer_2021_Q24) - Waves

A

144 - (9702/12_Summer_2021_Q24) - Waves

A

145 - (9702/13_Summer_2021_Q24) - Waves

A

146 - (9702/12_Summer_2021_Q25) - *Waves*

B

147 - (9702/13_Summer_2021_Q25) - *Waves*

D

148 - (9702/13_Summer_2021_Q26) - *Waves*

B

149 - (9702/11_Winter_2021_Q21) - *Waves*

D

150 - (9702/11_Winter_2021_Q22) - *Waves*

B

151 - (9702/13_Winter_2021_Q22) - *Waves*

B

152 - (9702/11_Winter_2021_Q23) - *Waves*

D

153 - (9702/13_Winter_2021_Q23) - *Waves*

D

154 - (9702/11_Winter_2021_Q24) - *Waves*

A

155 - (9702/12_Winter_2021_Q24) - *Waves*

D

156 - (9702/13_Winter_2021_Q24) - *Waves*

A

157 - (9702/11_Winter_2021_Q25) - *Waves*

D

158 - (9702/12_Winter_2021_Q25) - *Waves*

C

159 - (9702/13_Winter_2021_Q25) - *Waves*

C

160 - (9702/12_Winter_2021_Q26) - *Waves*

A

161 - (9702/13_Winter_2021_Q26) - *Waves*

B

162 - (9702/12_Winter_2021_Q30) - *Waves*

A

163 - (9702/11_Summer_2022_Q21) - *Waves*

A

164 - (9702/12_Summer_2022_Q21) - Waves

D

165 - (9702/11_Summer_2022_Q22) - Waves

D

166 - (9702/12_Summer_2022_Q22) - Waves

C

167 - (9702/13_Summer_2022_Q22) - Waves

B

168 - (9702/11_Summer_2022_Q23) - Waves

C

169 - (9702/12_Summer_2022_Q23) - Waves

D

170 - (9702/13_Summer_2022_Q23) - Waves

B

171 - (9702/11_Summer_2022_Q24) - Waves

D

172 - (9702/12_Summer_2022_Q24) - Waves

A

A-Level Cambridge	PHYSICS – P1	CH14 - WAVES
173 - (9702/13_Summer_2022_Q24) - Waves D		
174 - (9702/11_Summer_2022_Q25) - Waves A		
175 - (9702/12_Summer_2022_Q25) - Waves A		
176 - (9702/13_Summer_2022_Q25) - Waves A		
177 - (9702/11_Summer_2022_Q26) - Waves B		
178 - (9702/12_Summer_2022_Q26) - Waves B		
179 - (9702/13_Summer_2022_Q26) - Waves A		
180 - (9702/11_Summer_2022_Q27) - Waves B		
181 - (9702/13_Summer_2022_Q27) - Waves B		

182 - (9702/11_Winter_2022_Q21) - *Waves*

A

183 - (9702/13_Winter_2022_Q21) - *Waves*

A

184 - (9702/11_Winter_2022_Q22) - *Waves*

B

185 - (9702/13_Winter_2022_Q22) - *Waves*

C

186 - (9702/11_Winter_2022_Q23) - *Waves*

B

187 - (9702/12_Winter_2022_Q23) - *Waves*

B

188 - (9702/13_Winter_2022_Q23) - *Waves*

B

189 - (9702/11_Winter_2022_Q24) - *Waves*

D

190 - (9702/12_Winter_2022_Q24) - *Waves*

A

191 - (9702/13_Winter_2022_Q24) - *Waves*

A

192 - (9702/11_Winter_2022_Q25) - *Waves*

A

193 - (9702/12_Winter_2022_Q25) - *Waves*

B

194 - (9702/12_Winter_2022_Q26) - *Waves*

D

195 - (9702/12_Winter_2022_Q27) - *Waves*

B

196 - (9702/12_Winter_2022_Q28) - *Waves*

C

197 - (9702/11_Summer_2023_Q20) - *Waves*

D

198 - (9702/11_Summer_2023_Q21) - *Waves*

A

199 - (9702/11_Summer_2023_Q22) - *Waves*

C

A-Level Cambridge	PHYSICS – P1	CH14 - WAVES
200 - (9702/11_Summer_2023_Q23) - Waves C		
201 - (9702/11_Summer_2023_Q24) - Waves C		
202 - (9702/11_Summer_2023_Q27) - Waves C		
203 - (9702/12_Summer_2023_Q20) - Waves B		
204 - (9702/12_Summer_2023_Q21) - Waves B		
205 - (9702/12_Summer_2023_Q22) - Waves C		
206 - (9702/12_Summer_2023_Q23) - Waves D		
207 - (9702/12_Summer_2023_Q24) - Waves B		
208 - (9702/12_Summer_2023_Q27) - Waves B		

209 - (9702/12_Summer_2023_Q28) - Waves

D

210 - (9702/13_Summer_2023_Q20) - Waves

A

211 - (9702/13_Summer_2023_Q21) - Waves

D

212 - (9702/13_Summer_2023_Q22) - Waves

D

213 - (9702/13_Summer_2023_Q23) - Waves

B

214 - (9702/13_Summer_2023_Q24) - Waves

C

215 - (9702/13_Summer_2023_Q27) - Waves

C

216 - (9702/13_Summer_2023_Q28) - Waves

B

217 - (9702/11_Winter_2023_Q20) - Waves

B

218 - (9702/11_Winter_2023_Q21) - *Waves*

B

219 - (9702/11_Winter_2023_Q22) - *Waves*

C

220 - (9702/11_Winter_2023_Q23) - *Waves*

C

221 - (9702/11_Winter_2023_Q27) - *Waves*

C

222 - (9702/12_Winter_2023_Q20) - *Waves*

D

223 - (9702/12_Winter_2023_Q22) - *Waves*

A

224 - (9702/12_Winter_2023_Q23) - *Waves*

C

225 - (9702/13_Winter_2023_Q20) - *Waves*

D

226 - (9702/13_Winter_2023_Q21) - *Waves*

D

227 - (9702/13_Winter_2023_Q22) - *Waves*

A

228 - (9702/13_Winter_2023_Q23) - *Waves*

B

1 - (9702/13_Summer_2017_Q26) - *Superposition*

A

2 - (9702/11_Summer_2017_Q27) - *Superposition*

C

3 - (9702/12_Summer_2017_Q27) - *Superposition*

D

4 - (9702/13_Summer_2017_Q27) - *Superposition*

B

5 - (9702/11_Summer_2017_Q28) - *Superposition*

C

6 - (9702/12_Summer_2017_Q28) - *Superposition*

B

7 - (9702/13_Summer_2017_Q28) - *Superposition*

C

8 - (9702/11_Summer_2017_Q29) - *Superposition*

A

9 - (9702/12_Summer_2017_Q29) - *Superposition*

B

10 - (9702/11_Winter_2017_Q5) - *Measurement Techniques, Superposition*

D

11 - (9702/11_Winter_2017_Q24) - *Waves, Superposition*

A

12 - (9702/12_Winter_2017_Q24) - *Waves, Superposition*

B

13 - (9702/11_Winter_2017_Q25) - *Waves, Superposition*

D

14 - (9702/12_Winter_2017_Q25) - *Waves, Superposition*

C

15 - (9702/11_Winter_2017_Q27) - *Superposition*

A

16 - (9702/12_Winter_2017_Q27) - *Superposition*

D

17 - (9702/11_Winter_2017_Q28) - *Superposition*

C

18 - (9702/12_Winter_2017_Q28) - *Superposition*

C

19 - (9702/11_Winter_2017_Q29) - *Superposition*

D

20 - (9702/12_Winter_2017_Q29) - *Superposition*

C

21 - (9702/13_Winter_2017_Q29) - *Superposition*

B

22 - (9702/11_Winter_2017_Q30) - *Superposition*

C

23 - (9702/12_Winter_2017_Q30) - *Superposition*

D

24 - (9702/13_Winter_2017_Q30) - *Superposition*

C

25 - (9702/12_Summer_2018_Q24) - *Superposition*

A

26 - (9702/13_Summer_2018_Q24) - *Waves, Superposition*

B

27 - (9702/11_Summer_2018_Q25) - *Superposition*

B

28 - (9702/11_Summer_2018_Q26) - *Superposition*

A

29 - (9702/12_Summer_2018_Q26) - *Waves, Superposition*

C

30 - (9702/13_Summer_2018_Q26) - *Superposition*

A

31 - (9702/11_Summer_2018_Q27) - *Superposition*

B

32 - (9702/12_Summer_2018_Q28) - *Superposition*

A

33 - (9702/12_Summer_2018_Q29) - *Superposition*

C

34 - (9702/12_Winter_2018_Q24) - *Superposition*

A

35 - (9702/11_Winter_2018_Q26) - *Superposition*

A

36 - (9702/13_Winter_2018_Q26) - *Superposition*

D

37 - (9702/11_Winter_2018_Q27) - *Superposition*

C

38 - (9702/12_Winter_2018_Q27) - *Superposition*

A

39 - (9702/13_Winter_2018_Q27) - *Waves, Superposition*

C

40 - (9702/11_Winter_2018_Q28) - *Superposition*

C

41 - (9702/12_Winter_2018_Q28) - *Waves, Superposition*

B

42 - (9702/13_Winter_2018_Q28) - *Superposition*

C

43 - (9702/11_Winter_2018_Q29) - *Superposition*

C

44 - (9702/12_Winter_2018_Q29) - *Superposition*

A

45 - (9702/13_Winter_2018_Q29) - *Superposition*

B

46 - (9702/12_Winter_2018_Q30) - *Superposition*

C

47 - (9702/11_Summer_2019_Q24) - *Superposition*

C

48 - (9702/11_Summer_2019_Q25) - *Superposition*

D

49 - (9702/12_Summer_2019_Q25) - *Superposition*

D

50 - (9702/13_Summer_2019_Q26) - *Superposition*

B

51 - (9702/11_Summer_2019_Q27) - *Superposition*

D

52 - (9702/13_Summer_2019_Q28) - *Superposition*

D

53 - (9702/11_Summer_2019_Q29) - *Superposition*

D

54 - (9702/13_Summer_2019_Q29) - *Superposition*

B

55 - (9702/11_Summer_2019_Q30) - *Superposition*

C

56 - (9702/12_Summer_2019_Q30) - *Superposition*

B

57 - (9702/13_Summer_2019_Q30) - *Superposition*

D

58 - (9702/12_Summer_2019_Q31) - *Superposition*

A

59 - (9702/11_Winter_2019_Q23) - *Superposition*

B

60 - (9702/12_Winter_2019_Q25) - *Superposition*

C

61 - (9702/11_Winter_2019_Q26) - *Superposition*

C

62 - (9702/13_Winter_2019_Q26) - *Superposition*

C

63 - (9702/12_Winter_2019_Q27) - *Superposition*

D

64 - (9702/11_Winter_2019_Q28) - *Superposition*

A

65 - (9702/12_Winter_2019_Q28) - *Superposition*

B

66 - (9702/13_Winter_2019_Q28) - *Superposition*

D

67 - (9702/13_Winter_2019_Q29) - *Superposition*

C

68 - (9702/13_Winter_2019_Q30) - *Superposition*

C

69 - (9702/11_Summer_2020_Q24) - *Superposition*

B

70 - (9702/12_Summer_2020_Q24) - *Superposition*

D

71 - (9702/13_Summer_2020_Q24) - *Superposition*

B

72 - (9702/11_Summer_2020_Q27) - *Superposition*

B

73 - (9702/12_Summer_2020_Q27) - *Superposition*

B

74 - (9702/13_Summer_2020_Q27) - *Superposition*

C

75 - (9702/11_Summer_2020_Q29) - *Superposition*

A

76 - (9702/12_Summer_2020_Q29) - *Superposition*

A

77 - (9702/13_Summer_2020_Q29) - *Superposition*

D

78 - (9702/11_Summer_2020_Q30) - *Superposition*

C

79 - (9702/12_Summer_2020_Q30) - *Superposition*

A

80 - (9702/13_Summer_2020_Q30) - *Superposition*

C

81 - (9702/11_Winter_2020_Q23) - *Superposition*

C

82 - (9702/12_Winter_2020_Q24) - *Superposition*

B

83 - (9702/11_Winter_2020_Q26) - *Superposition*

A

84 - (9702/12_Winter_2020_Q27) - *Superposition*

A

85 - (9702/13_Winter_2020_Q27) - *Superposition*

B

86 - (9702/11_Winter_2020_Q28) - *Superposition*

A

87 - (9702/11_Winter_2020_Q29) - *Superposition*

B

88 - (9702/12_Winter_2020_Q29) - *Superposition*

C

89 - (9702/13_Winter_2020_Q29) - *Superposition*

A

90 - (9702/12_Winter_2020_Q30) - *Superposition*

B

91 - (9702/13_Winter_2020_Q30) - *Superposition*

C

92 - (9702/11_Summer_2021_Q25) - *Superposition*

A

93 - (9702/11_Summer_2021_Q26) - *Superposition*

B

94 - (9702/12_Summer_2021_Q26) - *Superposition*

C

95 - (9702/11_Summer_2021_Q27) - *Superposition*

A

96 - (9702/12_Summer_2021_Q27) - *Superposition*

B

97 - (9702/13_Summer_2021_Q27) - *Superposition*

C

98 - (9702/11_Summer_2021_Q28) - *Superposition*

B

99 - (9702/12_Summer_2021_Q28) - *Superposition*

B

100 - (9702/13_Summer_2021_Q28) - *Superposition*

B

101 - (9702/11_Summer_2021_Q29) - *Superposition*

B

102 - (9702/12_Summer_2021_Q29) - *Superposition*

C

103 - (9702/13_Summer_2021_Q29) - *Superposition*

A

104 - (9702/13_Summer_2021_Q30) - *Superposition*

B

105 - (9702/11_Winter_2021_Q26) - *Superposition*

A

106 - (9702/11_Winter_2021_Q27) - *Superposition*

D

107 - (9702/12_Winter_2021_Q27) - *Superposition*

C

108 - (9702/13_Winter_2021_Q27) - *Superposition*

A

109 - (9702/11_Winter_2021_Q28) - *Superposition*

C

110 - (9702/12_Winter_2021_Q28) - *Superposition*

B

111 - (9702/13_Winter_2021_Q28) - *Superposition*

C

112 - (9702/11_Winter_2021_Q29) - *Superposition*

C

113 - (9702/12_Winter_2021_Q29) - *Superposition*

A

114 - (9702/13_Winter_2021_Q29) - *Superposition*

D

115 - (9702/13_Winter_2021_Q30) - *Superposition*

B

116 - (9702/12_Summer_2022_Q27) - *Superposition*

B

117 - (9702/11_Summer_2022_Q28) - *Superposition*

A

118 - (9702/12_Summer_2022_Q28) - *Superposition*

D

119 - (9702/13_Summer_2022_Q28) - *Superposition*

C

120 - (9702/11_Summer_2022_Q29) - *Superposition*

B

121 - (9702/12_Summer_2022_Q29) - *Superposition*

D

122 - (9702/13_Summer_2022_Q29) - *Superposition*

B

123 - (9702/11_Summer_2022_Q30) - *Superposition*

D

124 - (9702/12_Summer_2022_Q30) - *Superposition*

C

125 - (9702/13_Summer_2022_Q30) - *Superposition*

B

126 - (9702/13_Summer_2022_Q31) - *Superposition*

D

127 - (9702/13_Winter_2022_Q25) - *Superposition*

C

128 - (9702/11_Winter_2022_Q26) - *Superposition*

A

129 - (9702/13_Winter_2022_Q26) - *Superposition*

B

130 - (9702/11_Winter_2022_Q27) - *Superposition*

A

131 - (9702/13_Winter_2022_Q27) - *Superposition*

C

132 - (9702/11_Winter_2022_Q28) - *Superposition*

B

133 - (9702/13_Winter_2022_Q28) - *Superposition*

C

134 - (9702/11_Winter_2022_Q29) - *Superposition*

D

135 - (9702/12_Winter_2022_Q29) - *Superposition*

C

136 - (9702/13_Winter_2022_Q29) - *Superposition*

D

A-Level Cambridge	PHYSICS – P1	CH15 - SUPERPOSITION
137 - (9702/11_Winter_2022_Q30) - <i>Superposition</i> C		
138 - (9702/12_Winter_2022_Q30) - <i>Superposition</i> D		
139 - (9702/11_Summer_2023_Q25) - <i>Superposition</i> B		
140 - (9702/11_Summer_2023_Q26) - <i>Superposition</i> A		
141 - (9702/11_Summer_2023_Q28) - <i>Superposition</i> D		
142 - (9702/11_Summer_2023_Q29) - <i>Superposition</i> A		
143 - (9702/12_Summer_2023_Q25) - <i>Superposition</i> A		
144 - (9702/12_Summer_2023_Q26) - <i>Superposition</i> A		
145 - (9702/12_Summer_2023_Q29) - <i>Superposition</i> C		

146 - (9702/13_Summer_2023_Q25) - *Superposition*

B

147 - (9702/13_Summer_2023_Q26) - *Superposition*

A

148 - (9702/13_Summer_2023_Q29) - *Superposition*

D

149 - (9702/11_Winter_2023_Q24) - *Superposition*

D

150 - (9702/11_Winter_2023_Q25) - *Superposition*

A

151 - (9702/11_Winter_2023_Q26) - *Superposition*

B

152 - (9702/11_Winter_2023_Q28) - *Superposition*

D

153 - (9702/11_Winter_2023_Q29) - *Superposition*

A

154 - (9702/12_Winter_2023_Q24) - *Superposition*

C

155 - (9702/12_Winter_2023_Q25) - *Superposition*

C

156 - (9702/12_Winter_2023_Q27) - *Superposition*

B

157 - (9702/12_Winter_2023_Q28) - *Superposition*

A

158 - (9702/12_Winter_2023_Q29) - *Superposition*

D

159 - (9702/13_Winter_2023_Q24) - *Superposition*

C

160 - (9702/13_Winter_2023_Q25) - *Superposition*

A

161 - (9702/13_Winter_2023_Q26) - *Superposition*

B

162 - (9702/13_Winter_2023_Q27) - *Superposition*

A

163 - (9702/13_Winter_2023_Q28) - *Superposition*

A

164 - (9702/13_Winter_2023_Q29) - *Superposition*

C

1 - (9702/12_Winter_2023_Q26) - *Communication*

B

A-Level Cambridge	PHYSICS – P1	CH17 - ELECTRIC FIELDS
1 - (9702/11_Summer_2017_Q11) - <i>Electric Fields</i> A		
2 - (9702/13_Summer_2017_Q29) - <i>Electric Fields</i> D		
3 - (9702/11_Summer_2017_Q30) - <i>Electric Fields</i> A		
4 - (9702/12_Summer_2017_Q30) - <i>Electric Fields</i> C		
5 - (9702/13_Summer_2017_Q30) - <i>Electric Fields</i> D		
6 - (9702/11_Summer_2017_Q31) - <i>Electric Fields</i> B		
7 - (9702/12_Summer_2017_Q31) - <i>Electric Fields</i> C		
8 - (9702/13_Summer_2017_Q31) - <i>Electric Fields</i> B		
9 - (9702/11_Winter_2017_Q31) - <i>Electric Fields</i> C		
10 - (9702/12_Winter_2017_Q31) - <i>Electric Fields</i> A		

11 - (9702/13_Winter_2017_Q31) - *Electric Fields*

A

12 - (9702/11_Winter_2017_Q32) - *Electric Fields*

C

13 - (9702/12_Winter_2017_Q32) - *Electric Fields*

B

14 - (9702/13_Winter_2017_Q32) - *Electric Fields*

C

15 - (9702/13_Summer_2018_Q27) - *Electric Fields*

A

16 - (9702/11_Summer_2018_Q28) - *Electric Fields*

D

17 - (9702/13_Summer_2018_Q28) - *Electric Fields*

B

18 - (9702/11_Summer_2018_Q29) - *Electric Fields*

B

19 - (9702/13_Summer_2018_Q29) - *Electric Fields*

C

A-Level Cambridge	PHYSICS –P1	CH17 - ELECTRIC FIELDS
20 - (9702/12_Summer_2018_Q30) - <i>Electric Fields</i> D		
21 - (9702/12_Summer_2018_Q31) - <i>Electric Fields</i> A		
22 - (9702/11_Winter_2018_Q10) - <i>Electric Fields</i> A		
23 - (9702/12_Winter_2018_Q11) - <i>Dynamics, Electric Fields</i> D		
24 - (9702/11_Winter_2018_Q30) - <i>Electric Fields</i> B		
25 - (9702/13_Winter_2018_Q30) - <i>Electric Fields</i> B		
26 - (9702/11_Winter_2018_Q31) - <i>Electric Fields</i> B		
27 - (9702/12_Winter_2018_Q31) - <i>Electric Fields</i> C		
28 - (9702/13_Winter_2018_Q31) - <i>Electric Fields</i> D		

29 - (9702/11_Winter_2018_Q32) - *Electric Fields*

D

30 - (9702/12_Winter_2018_Q32) - *Electric Fields*

D

31 - (9702/11_Summer_2019_Q8) - *Electric Fields*

A

32 - (9702/13_Summer_2019_Q10) - *Electric Fields*

B

33 - (9702/12_Summer_2019_Q13) - *Electric Fields, Work, Energy & Power*

C

34 - (9702/11_Summer_2019_Q31) - *Electric Fields*

A

35 - (9702/13_Summer_2019_Q31) - *Electric Fields*

D

36 - (9702/12_Summer_2019_Q32) - *Electric Fields*

A

37 - (9702/12_Winter_2019_Q10) - *Dynamics, Electric Fields*

A

A-Level Cambridge	PHYSICS – P1	CH17 - ELECTRIC FIELDS
38 - (9702/12_Winter_2019_Q29) - <i>Electric Fields</i> C		
39 - (9702/12_Winter_2019_Q30) - <i>Electric Fields</i> B		
40 - (9702/13_Winter_2019_Q31) - <i>Electric Fields</i> D		
41 - (9702/13_Winter_2019_Q32) - <i>Electric Fields</i> D		
42 - (9702/11_Summer_2020_Q31) - <i>Electric Fields</i> D		
43 - (9702/13_Summer_2020_Q31) - <i>Electric Fields</i> D		
44 - (9702/11_Summer_2020_Q32) - <i>Electric Fields</i> A		
45 - (9702/12_Summer_2020_Q32) - <i>Electric Fields</i> A		
46 - (9702/13_Summer_2020_Q32) - <i>Electric Fields</i> D		

47 - (9702/13_Summer_2020_Q33) - *Electric Fields*

C

48 - (9702/11_Winter_2020_Q11) - *Electric Fields*

B

49 - (9702/11_Winter_2020_Q31) - *Electric Fields*

A

50 - (9702/12_Winter_2020_Q31) - *Electric Fields*

B

51 - (9702/13_Winter_2020_Q31) - *Electric Fields*

D

52 - (9702/12_Winter_2020_Q32) - *Electric Fields*

B

53 - (9702/13_Winter_2020_Q32) - *Electric Fields*

D

54 - (9702/12_Winter_2020_Q33) - *Electric Fields*

A

55 - (9702/11_Summer_2021_Q11) - *Electric Fields*

A

56 - (9702/12_Summer_2021_Q11) - *Electric Fields*

A

57 - (9702/11_Summer_2021_Q30) - *Electric Fields*

D

58 - (9702/12_Summer_2021_Q30) - *Electric Fields*

A

59 - (9702/11_Summer_2021_Q31) - *Electric Fields*

C

60 - (9702/12_Summer_2021_Q31) - *Electric Fields*

D

61 - (9702/13_Summer_2021_Q31) - *Electric Fields*

D

62 - (9702/13_Summer_2021_Q32) - *Electric Fields*

A

63 - (9702/11_Winter_2021_Q30) - *Electric Fields*

B

64 - (9702/11_Winter_2021_Q31) - *Electric Fields*

A

65 - (9702/12_Winter_2021_Q32) - *Electric Fields*

C

66 - (9702/13_Winter_2021_Q32) - *Electric Fields*

D

67 - (9702/12_Winter_2021_Q33) - *Electric Fields*

B

68 - (9702/12_Winter_2023_Q30) - *Electric Fields*

B

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
1 - (9702/11_Summer_2017_Q32) - <i>Current Of Electricity</i> A		
2 - (9702/12_Summer_2017_Q32) - <i>Current Of Electricity</i> A		
3 - (9702/13_Summer_2017_Q32) - <i>Current Of Electricity</i> B		
4 - (9702/11_Summer_2017_Q33) - <i>Current Of Electricity</i> C		
5 - (9702/12_Summer_2017_Q33) - <i>Current Of Electricity</i> A		
6 - (9702/13_Summer_2017_Q33) - <i>Current Of Electricity</i> C		
7 - (9702/11_Summer_2017_Q34) - <i>Current Of Electricity</i> A		
8 - (9702/12_Summer_2017_Q34) - <i>Current Of Electricity</i> C		
9 - (9702/13_Summer_2017_Q34) - <i>Current Of Electricity</i> B		
10 - (9702/12_Winter_2017_Q19) - <i>Work, Energy & Power, Current Of Electricity</i> B		

11 - (9702/11_Winter_2017_Q33) - *Current Of Electricity, D.c. Circuits*

C

12 - (9702/12_Winter_2017_Q33) - *Current Of Electricity*

D

13 - (9702/13_Winter_2017_Q33) - *Current Of Electricity*

D

14 - (9702/11_Winter_2017_Q34) - *Current Of Electricity*

A

15 - (9702/11_Winter_2017_Q35) - *Current Of Electricity*

D

16 - (9702/12_Winter_2017_Q35) - *Current Of Electricity, D.c. Circuits*

A

17 - (9702/11_Winter_2017_Q36) - *Current Of Electricity, Alternating Currents*

B

18 - (9702/12_Winter_2017_Q36) - *Current Of Electricity, D.c. Circuits*

B

19 - (9702/12_Winter_2017_Q37) - *Current Of Electricity, D.c. Circuits*

B

20 - (9702/13_Winter_2017_Q38) - *Current Of Electricity, D.c. Circuits*

D

21 - (9702/12_Summer_2018_Q16) - *Work, Energy & Power, Current Of Electricity*

B

22 - (9702/11_Summer_2018_Q30) - *Current Of Electricity*

C

23 - (9702/13_Summer_2018_Q30) - *Current Of Electricity*

A

24 - (9702/11_Summer_2018_Q31) - *Current Of Electricity*

A

25 - (9702/13_Summer_2018_Q31) - *Current Of Electricity, D.c. Circuits*

B

26 - (9702/11_Summer_2018_Q32) - *Current Of Electricity*

D

27 - (9702/12_Summer_2018_Q32) - *Current Of Electricity*

A

28 - (9702/13_Summer_2018_Q32) - *Current Of Electricity*

D

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
29 - (9702/12_Summer_2018_Q33) - <i>Current Of Electricity</i> B		
30 - (9702/13_Summer_2018_Q33) - <i>Current Of Electricity</i> B		
31 - (9702/13_Summer_2018_Q34) - <i>Current Of Electricity, D.c. Circuits</i> A		
32 - (9702/13_Summer_2018_Q36) - <i>Current Of Electricity, D.c. Circuits</i> D		
33 - (9702/11_Summer_2018_Q37) - <i>Current Of Electricity, D.c. Circuits</i> D		
34 - (9702/13_Winter_2018_Q32) - <i>Current Of Electricity</i> A		
35 - (9702/11_Winter_2018_Q33) - <i>Current Of Electricity</i> A		
36 - (9702/12_Winter_2018_Q33) - <i>Current Of Electricity</i> A		
37 - (9702/13_Winter_2018_Q33) - <i>Current Of Electricity, D.c. Circuits</i> B		

38 - (9702/11_Winter_2018_Q34) - *Current Of Electricity*

B

39 - (9702/12_Winter_2018_Q34) - *Current Of Electricity, D.c. Circuits*

A

40 - (9702/13_Winter_2018_Q34) - *Current Of Electricity*

C

41 - (9702/11_Winter_2018_Q35) - *Current Of Electricity*

B

42 - (9702/12_Winter_2018_Q35) - *Current Of Electricity*

D

43 - (9702/13_Winter_2018_Q35) - *Current Of Electricity, D.c. Circuits*

A

44 - (9702/11_Winter_2018_Q36) - *Current Of Electricity, D.c. Circuits*

A

45 - (9702/12_Winter_2018_Q36) - *Current Of Electricity, D.c. Circuits*

B

46 - (9702/11_Winter_2018_Q37) - *Current Of Electricity, D.c. Circuits*

A

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
47 - (9702/11_Winter_2018_Q38) - <i>Current Of Electricity</i> B		
48 - (9702/12_Winter_2018_Q38) - <i>Current Of Electricity, D.c. Circuits</i> C		
49 - (9702/11_Summer_2019_Q32) - <i>Current Of Electricity</i> D		
50 - (9702/13_Summer_2019_Q32) - <i>Current Of Electricity</i> B		
51 - (9702/11_Summer_2019_Q33) - <i>Current Of Electricity</i> B		
52 - (9702/12_Summer_2019_Q33) - <i>Current Of Electricity</i> B		
53 - (9702/13_Summer_2019_Q33) - <i>Current Of Electricity</i> A		
54 - (9702/11_Summer_2019_Q34) - <i>Current Of Electricity</i> B		
55 - (9702/12_Summer_2019_Q34) - <i>Current Of Electricity</i> A		

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
56 - (9702/13_Summer_2019_Q34) - <i>Current Of Electricity</i> D		
57 - (9702/11_Summer_2019_Q35) - <i>Current Of Electricity, D.c. Circuits</i> A		
58 - (9702/12_Summer_2019_Q35) - <i>Current Of Electricity, D.c. Circuits</i> C		
59 - (9702/13_Summer_2019_Q35) - <i>Current Of Electricity</i> A		
60 - (9702/11_Summer_2019_Q36) - <i>Current Of Electricity, D.c. Circuits</i> C		
61 - (9702/11_Summer_2019_Q37) - <i>Current Of Electricity, D.c. Circuits</i> C		
62 - (9702/11_Winter_2019_Q30) - <i>Current Of Electricity</i> B		
63 - (9702/11_Winter_2019_Q31) - <i>Current Of Electricity</i> B		
64 - (9702/12_Winter_2019_Q31) - <i>Current Of Electricity</i> B		

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
65 - (9702/11_Winter_2019_Q32) - <i>Current Of Electricity</i> B		
66 - (9702/12_Winter_2019_Q32) - <i>Current Of Electricity</i> C		
67 - (9702/11_Winter_2019_Q33) - <i>Current Of Electricity</i> A		
68 - (9702/12_Winter_2019_Q33) - <i>Current Of Electricity</i> C		
69 - (9702/13_Winter_2019_Q33) - <i>Current Of Electricity</i> C		
70 - (9702/13_Winter_2019_Q34) - <i>Current Of Electricity</i> C		
71 - (9702/13_Winter_2019_Q35) - <i>Current Of Electricity</i> D		
72 - (9702/13_Winter_2019_Q36) - <i>Current Of Electricity</i> A		
73 - (9702/11_Summer_2020_Q33) - <i>Current Of Electricity</i> C		

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
74 - (9702/12_Summer_2020_Q33) - <i>Current Of Electricity</i> D		
75 - (9702/11_Summer_2020_Q34) - <i>Current Of Electricity</i> B		
76 - (9702/12_Summer_2020_Q34) - <i>Current Of Electricity</i> B		
77 - (9702/13_Summer_2020_Q34) - <i>Current Of Electricity</i> D		
78 - (9702/11_Summer_2020_Q35) - <i>Current Of Electricity</i> C		
79 - (9702/12_Summer_2020_Q35) - <i>Current Of Electricity</i> A		
80 - (9702/13_Summer_2020_Q36) - <i>Current Of Electricity</i> B		
81 - (9702/11_Summer_2020_Q37) - <i>Current Of Electricity</i> B		
82 - (9702/11_Winter_2020_Q32) - <i>Current Of Electricity</i> A		

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
83 - (9702/11_Winter_2020_Q33) - <i>Current Of Electricity</i> D		
84 - (9702/13_Winter_2020_Q33) - <i>Current Of Electricity</i> B		
85 - (9702/11_Winter_2020_Q34) - <i>Current Of Electricity</i> A		
86 - (9702/12_Winter_2020_Q34) - <i>Current Of Electricity</i> B		
87 - (9702/13_Winter_2020_Q34) - <i>Current Of Electricity</i> A		
88 - (9702/12_Winter_2020_Q35) - <i>Current Of Electricity</i> D		
89 - (9702/13_Winter_2020_Q35) - <i>Current Of Electricity</i> C		
90 - (9702/11_Summer_2021_Q32) - <i>Current Of Electricity</i> A		
91 - (9702/12_Summer_2021_Q32) - <i>Current Of Electricity</i> A		

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
92 - (9702/11_Summer_2021_Q33) - <i>Current Of Electricity</i> C		
93 - (9702/12_Summer_2021_Q33) - <i>Current Of Electricity</i> A		
94 - (9702/13_Summer_2021_Q33) - <i>Current Of Electricity</i> C		
95 - (9702/11_Summer_2021_Q34) - <i>Current Of Electricity</i> B		
96 - (9702/13_Summer_2021_Q34) - <i>Current Of Electricity</i> A		
97 - (9702/13_Summer_2021_Q35) - <i>Current Of Electricity</i> A		
98 - (9702/11_Winter_2021_Q32) - <i>Current Of Electricity</i> C		
99 - (9702/11_Winter_2021_Q33) - <i>Current Of Electricity</i> D		
100 - (9702/13_Winter_2021_Q33) - <i>Current Of Electricity</i> D		

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
101 - (9702/11_Winter_2021_Q34) - <i>Current Of Electricity</i> A		
102 - (9702/12_Winter_2021_Q34) - <i>Current Of Electricity</i> B		
103 - (9702/13_Winter_2021_Q34) - <i>Current Of Electricity</i> D		
104 - (9702/11_Winter_2021_Q35) - <i>Current Of Electricity</i> D		
105 - (9702/12_Winter_2021_Q35) - <i>Current Of Electricity</i> B		
106 - (9702/13_Winter_2021_Q35) - <i>Current Of Electricity</i> B		
107 - (9702/12_Winter_2021_Q36) - <i>Current Of Electricity</i> C		
108 - (9702/13_Winter_2021_Q36) - <i>Current Of Electricity</i> A		
109 - (9702/12_Winter_2021_Q37) - <i>Current Of Electricity</i> A		

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
110 - (9702/13_Winter_2021_Q37) - <i>Current Of Electricity</i> A		
111 - (9702/11_Summer_2022_Q31) - <i>Current Of Electricity</i> C		
112 - (9702/12_Summer_2022_Q31) - <i>Current Of Electricity</i> B		
113 - (9702/11_Summer_2022_Q32) - <i>Current Of Electricity</i> B		
114 - (9702/13_Summer_2022_Q32) - <i>Current Of Electricity</i> D		
115 - (9702/11_Summer_2022_Q33) - <i>Current Of Electricity</i> D		
116 - (9702/12_Summer_2022_Q33) - <i>Current Of Electricity</i> D		
117 - (9702/13_Summer_2022_Q33) - <i>Current Of Electricity</i> D		
118 - (9702/11_Summer_2022_Q34) - <i>Current Of Electricity</i> D		

119 - (9702/12_Summer_2022_Q34) - *Current Of Electricity*

A

120 - (9702/13_Summer_2022_Q34) - *Current Of Electricity*

B

121 - (9702/11_Summer_2022_Q35) - *Current Of Electricity*

D

122 - (9702/13_Winter_2022_Q30) - *Current Of Electricity*

D

123 - (9702/11_Winter_2022_Q31) - *Current Of Electricity*

B

124 - (9702/12_Winter_2022_Q31) - *Current Of Electricity*

B

125 - (9702/13_Winter_2022_Q31) - *Current Of Electricity*

D

126 - (9702/11_Winter_2022_Q32) - *Current Of Electricity*

C

127 - (9702/12_Winter_2022_Q32) - *Current Of Electricity*

B

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
128 - (9702/13_Winter_2022_Q32) - <i>Current Of Electricity</i> A		
129 - (9702/11_Winter_2022_Q33) - <i>Current Of Electricity</i> A		
130 - (9702/12_Winter_2022_Q33) - <i>Current Of Electricity</i> D		
131 - (9702/13_Winter_2022_Q33) - <i>Current Of Electricity</i> C		
132 - (9702/13_Winter_2022_Q34) - <i>Current Of Electricity</i> B		
133 - (9702/11_Summer_2023_Q30) - <i>Current Of Electricity</i> C		
134 - (9702/11_Summer_2023_Q31) - <i>Current Of Electricity</i> B		
135 - (9702/11_Summer_2023_Q32) - <i>Current Of Electricity</i> D		
136 - (9702/11_Summer_2023_Q33) - <i>Current Of Electricity</i> B		

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
137 - (9702/11_Summer_2023_Q34) - <i>Current Of Electricity</i> C		
138 - (9702/11_Summer_2023_Q35) - <i>Current Of Electricity</i> A		
139 - (9702/11_Summer_2023_Q36) - <i>Current Of Electricity</i> B		
140 - (9702/11_Summer_2023_Q37) - <i>Current Of Electricity</i> D		
141 - (9702/12_Summer_2023_Q30) - <i>Current Of Electricity</i> C		
142 - (9702/12_Summer_2023_Q31) - <i>Current Of Electricity</i> A		
143 - (9702/12_Summer_2023_Q32) - <i>Current Of Electricity</i> D		
144 - (9702/12_Summer_2023_Q33) - <i>Current Of Electricity</i> C		
145 - (9702/12_Summer_2023_Q34) - <i>Current Of Electricity</i> D		

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
146 - (9702/12_Summer_2023_Q35) - <i>Current Of Electricity</i> A		
147 - (9702/12_Summer_2023_Q36) - <i>Current Of Electricity</i> B		
148 - (9702/12_Summer_2023_Q37) - <i>Current Of Electricity</i> C		
149 - (9702/13_Summer_2023_Q30) - <i>Current Of Electricity</i> A		
150 - (9702/13_Summer_2023_Q31) - <i>Current Of Electricity</i> D		
151 - (9702/13_Summer_2023_Q32) - <i>Current Of Electricity</i> B		
152 - (9702/13_Summer_2023_Q33) - <i>Current Of Electricity</i> B		
153 - (9702/13_Summer_2023_Q34) - <i>Current Of Electricity</i> A		
154 - (9702/13_Summer_2023_Q35) - <i>Current Of Electricity</i> A		

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
155 - (9702/13_Summer_2023_Q36) - <i>Current Of Electricity</i> C		
156 - (9702/13_Summer_2023_Q37) - <i>Current Of Electricity</i> A		
157 - (9702/11_Winter_2023_Q30) - <i>Current Of Electricity</i> C		
158 - (9702/11_Winter_2023_Q31) - <i>Current Of Electricity</i> D		
159 - (9702/11_Winter_2023_Q32) - <i>Current Of Electricity</i> A		
160 - (9702/11_Winter_2023_Q33) - <i>Current Of Electricity</i> B		
161 - (9702/11_Winter_2023_Q34) - <i>Current Of Electricity</i> B		
162 - (9702/11_Winter_2023_Q35) - <i>Current Of Electricity</i> A		
163 - (9702/11_Winter_2023_Q36) - <i>Current Of Electricity</i> A		

A-Level Cambridge	PHYSICS – P1	CH19 - CURRENT OF ELECTRICITY
164 - (9702/11_Winter_2023_Q37) - <i>Current Of Electricity</i> B		
165 - (9702/12_Winter_2023_Q31) - <i>Current Of Electricity</i> B		
166 - (9702/12_Winter_2023_Q32) - <i>Current Of Electricity</i> D		
167 - (9702/12_Winter_2023_Q33) - <i>Current Of Electricity</i> A		
168 - (9702/12_Winter_2023_Q34) - <i>Current Of Electricity</i> D		
169 - (9702/12_Winter_2023_Q35) - <i>Current Of Electricity</i> A		
170 - (9702/12_Winter_2023_Q36) - <i>Current Of Electricity</i> B		
171 - (9702/12_Winter_2023_Q37) - <i>Current Of Electricity</i> D		
172 - (9702/13_Winter_2023_Q30) - <i>Current Of Electricity</i> C		

173 - (9702/13_Winter_2023_Q31) - *Current Of Electricity*

A

174 - (9702/13_Winter_2023_Q32) - *Current Of Electricity*

D

175 - (9702/13_Winter_2023_Q33) - *Current Of Electricity*

A

176 - (9702/13_Winter_2023_Q34) - *Current Of Electricity*

C

177 - (9702/13_Winter_2023_Q35) - *Current Of Electricity*

C

178 - (9702/13_Winter_2023_Q36) - *Current Of Electricity*

D

179 - (9702/13_Winter_2023_Q37) - *Current Of Electricity*

D

1 - (9702/11_Summer_2017_Q35) - *D.c. Circuits*

C

2 - (9702/12_Summer_2017_Q35) - *D.c. Circuits*

A

3 - (9702/13_Summer_2017_Q35) - *D.c. Circuits*

C

4 - (9702/11_Summer_2017_Q36) - *D.c. Circuits*

B

5 - (9702/12_Summer_2017_Q36) - *D.c. Circuits*

B

6 - (9702/13_Summer_2017_Q36) - *D.c. Circuits*

A

7 - (9702/11_Summer_2017_Q37) - *D.c. Circuits*

C

8 - (9702/12_Summer_2017_Q37) - *D.c. Circuits*

B

9 - (9702/11_Winter_2017_Q33) - *Current Of Electricity, D.c. Circuits*

C

10 - (9702/12_Winter_2017_Q34) - *D.c. Circuits*

C

11 - (9702/13_Winter_2017_Q34) - *D.c. Circuits*

D

12 - (9702/12_Winter_2017_Q35) - *Current Of Electricity, D.c. Circuits*

A

13 - (9702/13_Winter_2017_Q35) - *D.c. Circuits, Electronics*

C

14 - (9702/12_Winter_2017_Q36) - *Current Of Electricity, D.c. Circuits*

B

15 - (9702/13_Winter_2017_Q36) - *D.c. Circuits*

B

16 - (9702/11_Winter_2017_Q37) - *D.c. Circuits*

B

17 - (9702/12_Winter_2017_Q37) - *Current Of Electricity, D.c. Circuits*

B

18 - (9702/13_Winter_2017_Q37) - *D.c. Circuits*

C

19 - (9702/11_Winter_2017_Q38) - *D.c. Circuits*

D

20 - (9702/12_Winter_2017_Q38) - *D.c. Circuits*

A

21 - (9702/13_Winter_2017_Q38) - *Current Of Electricity, D.c. Circuits*

D

22 - (9702/13_Summer_2018_Q31) - *Current Of Electricity, D.c. Circuits*

B

23 - (9702/11_Summer_2018_Q33) - *D.c. Circuits*

A

24 - (9702/11_Summer_2018_Q34) - *D.c. Circuits*

C

25 - (9702/12_Summer_2018_Q34) - *D.c. Circuits*

B

26 - (9702/13_Summer_2018_Q34) - *Current Of Electricity, D.c. Circuits*

A

27 - (9702/11_Summer_2018_Q35) - *D.c. Circuits*

B

28 - (9702/12_Summer_2018_Q35) - *D.c. Circuits*

A

29 - (9702/13_Summer_2018_Q35) - *D.c. Circuits*

C

30 - (9702/11_Summer_2018_Q36) - *D.c. Circuits*

B

31 - (9702/12_Summer_2018_Q36) - *D.c. Circuits*

A

32 - (9702/13_Summer_2018_Q36) - *Current Of Electricity, D.c. Circuits*

D

33 - (9702/11_Summer_2018_Q37) - *Current Of Electricity, D.c. Circuits*

D

34 - (9702/12_Summer_2018_Q37) - *D.c. Circuits*

C

35 - (9702/13_Summer_2018_Q37) - *D.c. Circuits*

D

36 - (9702/13_Summer_2018_Q38) - *D.c. Circuits*

D

37 - (9702/13_Winter_2018_Q33) - *Current Of Electricity, D.c. Circuits*

B

38 - (9702/12_Winter_2018_Q34) - *Current Of Electricity, D.c. Circuits*

A

39 - (9702/13_Winter_2018_Q35) - *Current Of Electricity, D.c. Circuits*

A

40 - (9702/11_Winter_2018_Q36) - *Current Of Electricity, D.c. Circuits*

A

41 - (9702/12_Winter_2018_Q36) - *Current Of Electricity, D.c. Circuits*

B

42 - (9702/13_Winter_2018_Q36) - *D.c. Circuits*

D

43 - (9702/11_Winter_2018_Q37) - *Current Of Electricity, D.c. Circuits*

A

44 - (9702/12_Winter_2018_Q37) - *D.c. Circuits*

B

45 - (9702/13_Winter_2018_Q37) - *D.c. Circuits*

C

46 - (9702/12_Winter_2018_Q38) - *Current Of Electricity, D.c. Circuits*

C

47 - (9702/11_Summer_2019_Q35) - *Current Of Electricity, D.c. Circuits*

A

48 - (9702/12_Summer_2019_Q35) - *Current Of Electricity, D.c. Circuits*

C

49 - (9702/11_Summer_2019_Q36) - *Current Of Electricity, D.c. Circuits*

C

50 - (9702/12_Summer_2019_Q36) - *D.c. Circuits*

A

51 - (9702/13_Summer_2019_Q36) - *D.c. Circuits*

C

52 - (9702/11_Summer_2019_Q37) - *Current Of Electricity, D.c. Circuits*

C

53 - (9702/12_Summer_2019_Q37) - *D.c. Circuits*

A

54 - (9702/13_Summer_2019_Q37) - *D.c. Circuits*

B

55 - (9702/11_Summer_2019_Q38) - *D.c. Circuits*

A

56 - (9702/13_Summer_2019_Q38) - *D.c. Circuits*

B

57 - (9702/11_Winter_2019_Q34) - *D.c. Circuits*

B

58 - (9702/12_Winter_2019_Q34) - *D.c. Circuits*

A

59 - (9702/11_Winter_2019_Q35) - *D.c. Circuits*

D

60 - (9702/12_Winter_2019_Q35) - *D.c. Circuits*

C

61 - (9702/11_Winter_2019_Q36) - *D.c. Circuits*

D

62 - (9702/12_Winter_2019_Q36) - *D.c. Circuits*

C

63 - (9702/11_Winter_2019_Q37) - *D.c. Circuits*

C

64 - (9702/12_Winter_2019_Q37) - *D.c. Circuits*

A

65 - (9702/13_Winter_2019_Q37) - *D.c. Circuits*

A

66 - (9702/11_Winter_2019_Q38) - *D.c. Circuits*

D

67 - (9702/13_Winter_2019_Q38) - *D.c. Circuits*

B

68 - (9702/13_Summer_2020_Q35) - *D.c. Circuits*

C

69 - (9702/11_Summer_2020_Q36) - *D.c. Circuits*

D

70 - (9702/12_Summer_2020_Q36) - *D.c. Circuits*

C

71 - (9702/12_Summer_2020_Q37) - *D.c. Circuits*

A

72 - (9702/13_Summer_2020_Q37) - *D.c. Circuits*

D

73 - (9702/11_Summer_2020_Q38) - *D.c. Circuits*

D

74 - (9702/12_Summer_2020_Q38) - *D.c. Circuits*

A

75 - (9702/13_Summer_2020_Q38) - *D.c. Circuits*

A

76 - (9702/11_Winter_2020_Q35) - *D.c. Circuits*

B

77 - (9702/11_Winter_2020_Q36) - *D.c. Circuits*

B

78 - (9702/12_Winter_2020_Q36) - *D.c. Circuits*

B

79 - (9702/13_Winter_2020_Q36) - *D.c. Circuits*

C

80 - (9702/11_Winter_2020_Q37) - *D.c. Circuits*

A

81 - (9702/12_Winter_2020_Q37) - *D.c. Circuits*

D

82 - (9702/13_Winter_2020_Q37) - *D.c. Circuits*

D

83 - (9702/12_Winter_2020_Q38) - *D.c. Circuits*

D

84 - (9702/13_Winter_2020_Q38) - *D.c. Circuits*

C

85 - (9702/12_Summer_2021_Q34) - *D.c. Circuits*

B

86 - (9702/11_Summer_2021_Q35) - *D.c. Circuits*

D

87 - (9702/12_Summer_2021_Q35) - *D.c. Circuits*

A

88 - (9702/11_Summer_2021_Q36) - *D.c. Circuits*

C

89 - (9702/12_Summer_2021_Q36) - *D.c. Circuits*

C

90 - (9702/13_Summer_2021_Q36) - *D.c. Circuits*

C

91 - (9702/11_Summer_2021_Q37) - *D.c. Circuits*

B

92 - (9702/12_Summer_2021_Q37) - *D.c. Circuits*

A

93 - (9702/13_Summer_2021_Q37) - *D.c. Circuits*

B

94 - (9702/11_Summer_2021_Q38) - *D.c. Circuits*

B

95 - (9702/12_Summer_2021_Q38) - *D.c. Circuits*

C

96 - (9702/13_Summer_2021_Q38) - *D.c. Circuits*

C

97 - (9702/12_Winter_2021_Q38) - *D.c. Circuits*

A

98 - (9702/12_Summer_2022_Q35) - *D.c. Circuits*

B

99 - (9702/13_Summer_2022_Q35) - *D.c. Circuits*

D

100 - (9702/11_Summer_2022_Q36) - *D.c. Circuits*

A

101 - (9702/13_Summer_2022_Q36) - *D.c. Circuits*

A

102 - (9702/12_Summer_2022_Q37) - *D.c. Circuits*

D

103 - (9702/13_Summer_2022_Q37) - *D.c. Circuits*

A

104 - (9702/13_Summer_2022_Q38) - *D.c. Circuits*

B

105 - (9702/11_Winter_2022_Q34) - *D.c. Circuits*

B

106 - (9702/12_Winter_2022_Q34) - *D.c. Circuits*

D

107 - (9702/11_Winter_2022_Q35) - *D.c. Circuits*

C

108 - (9702/12_Winter_2022_Q35) - *D.c. Circuits*

A

109 - (9702/13_Winter_2022_Q35) - *D.c. Circuits*

C

110 - (9702/11_Winter_2022_Q36) - *D.c. Circuits*

D

111 - (9702/12_Winter_2022_Q36) - *D.c. Circuits*

B

112 - (9702/13_Winter_2022_Q36) - *D.c. Circuits*

C

113 - (9702/11_Winter_2022_Q37) - *D.c. Circuits*

C

114 - (9702/12_Winter_2022_Q37) - *D.c. Circuits*

A

115 - (9702/13_Winter_2022_Q37) - *D.c. Circuits*

B

1 - (9702/13_Winter_2017_Q35) - *D.c. Circuits, Electronics*

C

2 - (9702/11_Winter_2021_Q36) - *Electronics*

C

3 - (9702/11_Winter_2021_Q37) - *Electronics*

A

4 - (9702/11_Winter_2021_Q38) - *Electronics*

A

1 - (9702/13_Winter_2017_Q24) - *Alternating Currents*

A

2 - (9702/11_Winter_2017_Q36) - *Current Of Electricity, Alternating Currents*

B

1 - (9702/11_Summer_2023_Q38) - *Quantum Physics*

D

2 - (9702/12_Summer_2023_Q40) - *Quantum Physics*

A

A-Level Cambridge	PHYSICS – P1	CH26 - PARTICLE & NUCLEAR PHYSICS
1 - (9702/13_Summer_2017_Q37) - <i>Particle & Nuclear Physics</i> A		
2 - (9702/11_Summer_2017_Q38) - <i>Particle & Nuclear Physics</i> A		
3 - (9702/12_Summer_2017_Q38) - <i>Particle & Nuclear Physics</i> A		
4 - (9702/13_Summer_2017_Q38) - <i>Particle & Nuclear Physics</i> D		
5 - (9702/11_Summer_2017_Q39) - <i>Particle & Nuclear Physics</i> B		
6 - (9702/12_Summer_2017_Q39) - <i>Particle & Nuclear Physics</i> B		
7 - (9702/13_Summer_2017_Q39) - <i>Particle & Nuclear Physics</i> A		
8 - (9702/11_Summer_2017_Q40) - <i>Particle & Nuclear Physics</i> C		
9 - (9702/12_Summer_2017_Q40) - <i>Particle & Nuclear Physics</i> A		
10 - (9702/13_Summer_2017_Q40) - <i>Particle & Nuclear Physics</i> A		

A-Level Cambridge	PHYSICS – P1	CH26 - PARTICLE & NUCLEAR PHYSICS
11 - (9702/11_Winter_2017_Q39) - <i>Particle & Nuclear Physics</i> B		
12 - (9702/12_Winter_2017_Q39) - <i>Particle & Nuclear Physics</i> A		
13 - (9702/13_Winter_2017_Q39) - <i>Particle & Nuclear Physics</i> C		
14 - (9702/11_Winter_2017_Q40) - <i>Particle & Nuclear Physics</i> A		
15 - (9702/12_Winter_2017_Q40) - <i>Particle & Nuclear Physics</i> C		
16 - (9702/13_Winter_2017_Q40) - <i>Particle & Nuclear Physics</i> B		
17 - (9702/11_Summer_2018_Q38) - <i>Particle & Nuclear Physics</i> C		
18 - (9702/12_Summer_2018_Q38) - <i>Particle & Nuclear Physics</i> C		
19 - (9702/11_Summer_2018_Q39) - <i>Particle & Nuclear Physics</i> D		

A-Level Cambridge	PHYSICS – P1	CH26 - PARTICLE & NUCLEAR PHYSICS
20 - (9702/12_Summer_2018_Q39) - <i>Particle & Nuclear Physics</i> B		
21 - (9702/13_Summer_2018_Q39) - <i>Particle & Nuclear Physics</i> C		
22 - (9702/11_Summer_2018_Q40) - <i>Particle & Nuclear Physics</i> D		
23 - (9702/12_Summer_2018_Q40) - <i>Particle & Nuclear Physics</i> B		
24 - (9702/13_Summer_2018_Q40) - <i>Particle & Nuclear Physics</i> A		
25 - (9702/13_Winter_2018_Q38) - <i>Particle & Nuclear Physics</i> C		
26 - (9702/11_Winter_2018_Q39) - <i>Particle & Nuclear Physics</i> D		
27 - (9702/12_Winter_2018_Q39) - <i>Particle & Nuclear Physics</i> C		
28 - (9702/13_Winter_2018_Q39) - <i>Particle & Nuclear Physics</i> A		

A-Level Cambridge	PHYSICS – P1	CH26 - PARTICLE & NUCLEAR PHYSICS
29 - (9702/11_Winter_2018_Q40) - <i>Particle & Nuclear Physics</i> B		
30 - (9702/12_Winter_2018_Q40) - <i>Particle & Nuclear Physics</i> A		
31 - (9702/13_Winter_2018_Q40) - <i>Particle & Nuclear Physics</i> A		
32 - (9702/12_Summer_2019_Q38) - <i>Particle & Nuclear Physics</i> C		
33 - (9702/11_Summer_2019_Q39) - <i>Particle & Nuclear Physics</i> A		
34 - (9702/12_Summer_2019_Q39) - <i>Particle & Nuclear Physics</i> C		
35 - (9702/13_Summer_2019_Q39) - <i>Particle & Nuclear Physics</i> A		
36 - (9702/11_Summer_2019_Q40) - <i>Particle & Nuclear Physics</i> D		
37 - (9702/12_Summer_2019_Q40) - <i>Particle & Nuclear Physics</i> D		

A-Level Cambridge	PHYSICS – P1	CH26 - PARTICLE & NUCLEAR PHYSICS
38 - (9702/13_Summer_2019_Q40) - <i>Particle & Nuclear Physics</i> A		
39 - (9702/12_Winter_2019_Q38) - <i>Particle & Nuclear Physics</i> B		
40 - (9702/11_Winter_2019_Q39) - <i>Particle & Nuclear Physics</i> B		
41 - (9702/12_Winter_2019_Q39) - <i>Particle & Nuclear Physics</i> C		
42 - (9702/13_Winter_2019_Q39) - <i>Particle & Nuclear Physics</i> D		
43 - (9702/11_Winter_2019_Q40) - <i>Particle & Nuclear Physics</i> D		
44 - (9702/12_Winter_2019_Q40) - <i>Particle & Nuclear Physics</i> B		
45 - (9702/13_Winter_2019_Q40) - <i>Particle & Nuclear Physics</i> A		
46 - (9702/11_Summer_2020_Q39) - <i>Particle & Nuclear Physics</i> B		

A-Level Cambridge	PHYSICS – P1	CH26 - PARTICLE & NUCLEAR PHYSICS
47 - (9702/12_Summer_2020_Q39) - <i>Particle & Nuclear Physics</i>		B
48 - (9702/13_Summer_2020_Q39) - <i>Particle & Nuclear Physics</i>		A
49 - (9702/11_Summer_2020_Q40) - <i>Particle & Nuclear Physics</i>		C
50 - (9702/12_Summer_2020_Q40) - <i>Particle & Nuclear Physics</i>		A
51 - (9702/13_Summer_2020_Q40) - <i>Particle & Nuclear Physics</i>		C
52 - (9702/11_Winter_2020_Q38) - <i>Particle & Nuclear Physics</i>		D
53 - (9702/11_Winter_2020_Q39) - <i>Particle & Nuclear Physics</i>		A
54 - (9702/12_Winter_2020_Q39) - <i>Particle & Nuclear Physics</i>		C
55 - (9702/13_Winter_2020_Q39) - <i>Particle & Nuclear Physics</i>		D

A-Level Cambridge	PHYSICS – P1	CH26 - PARTICLE & NUCLEAR PHYSICS
56 - (9702/11_Winter_2020_Q40) - <i>Particle & Nuclear Physics</i>		
A		
57 - (9702/12_Winter_2020_Q40) - <i>Particle & Nuclear Physics</i>		
D		
58 - (9702/13_Winter_2020_Q40) - <i>Particle & Nuclear Physics</i>		
B		
59 - (9702/11_Summer_2021_Q39) - <i>Particle & Nuclear Physics</i>		
B		
60 - (9702/12_Summer_2021_Q39) - <i>Particle & Nuclear Physics</i>		
C		
61 - (9702/13_Summer_2021_Q39) - <i>Particle & Nuclear Physics</i>		
C		
62 - (9702/11_Summer_2021_Q40) - <i>Particle & Nuclear Physics</i>		
A		
63 - (9702/13_Summer_2021_Q40) - <i>Particle & Nuclear Physics</i>		
D		
64 - (9702/13_Winter_2021_Q38) - <i>Particle & Nuclear Physics</i>		
B		

A-Level Cambridge	PHYSICS – P1	CH26 - PARTICLE & NUCLEAR PHYSICS
65 - (9702/11_Winter_2021_Q39) - <i>Particle & Nuclear Physics</i> C		
66 - (9702/12_Winter_2021_Q39) - <i>Particle & Nuclear Physics</i> C		
67 - (9702/13_Winter_2021_Q39) - <i>Particle & Nuclear Physics</i> D		
68 - (9702/12_Winter_2021_Q40) - <i>Particle & Nuclear Physics</i> B		
69 - (9702/13_Winter_2021_Q40) - <i>Particle & Nuclear Physics</i> B		
70 - (9702/11_Summer_2022_Q37) - <i>Particle & Nuclear Physics</i> D		
71 - (9702/11_Summer_2022_Q38) - <i>Particle & Nuclear Physics</i> D		
72 - (9702/12_Summer_2022_Q38) - <i>Particle & Nuclear Physics</i> C		
73 - (9702/11_Summer_2022_Q39) - <i>Particle & Nuclear Physics</i> C		

A-Level Cambridge	PHYSICS – P1	CH26 - PARTICLE & NUCLEAR PHYSICS
74 - (9702/12_Summer_2022_Q39) - <i>Particle & Nuclear Physics</i> C		
75 - (9702/13_Summer_2022_Q39) - <i>Particle & Nuclear Physics</i> B		
76 - (9702/11_Summer_2022_Q40) - <i>Particle & Nuclear Physics</i> C		
77 - (9702/12_Summer_2022_Q40) - <i>Particle & Nuclear Physics</i> B		
78 - (9702/13_Summer_2022_Q40) - <i>Particle & Nuclear Physics</i> A		
79 - (9702/11_Winter_2022_Q38) - <i>Particle & Nuclear Physics</i> B		
80 - (9702/12_Winter_2022_Q38) - <i>Particle & Nuclear Physics</i> C		
81 - (9702/13_Winter_2022_Q38) - <i>Particle & Nuclear Physics</i> A		
82 - (9702/11_Winter_2022_Q39) - <i>Particle & Nuclear Physics</i> A		

A-Level Cambridge	PHYSICS – P1	CH26 - PARTICLE & NUCLEAR PHYSICS
83 - (9702/12_Winter_2022_Q39) - <i>Particle & Nuclear Physics</i> B		
84 - (9702/13_Winter_2022_Q39) - <i>Particle & Nuclear Physics</i> D		
85 - (9702/11_Winter_2022_Q40) - <i>Particle & Nuclear Physics</i> D		
86 - (9702/12_Winter_2022_Q40) - <i>Particle & Nuclear Physics</i> B		
87 - (9702/13_Winter_2022_Q40) - <i>Particle & Nuclear Physics</i> D		
88 - (9702/11_Summer_2023_Q39) - <i>Particle & Nuclear Physics</i> D		
89 - (9702/11_Summer_2023_Q40) - <i>Particle & Nuclear Physics</i> A		
90 - (9702/12_Summer_2023_Q38) - <i>Particle & Nuclear Physics</i> C		
91 - (9702/12_Summer_2023_Q39) - <i>Particle & Nuclear Physics</i> D		

A-Level Cambridge	PHYSICS – P1	CH26 - PARTICLE & NUCLEAR PHYSICS
92 - (9702/13_Summer_2023_Q38) - <i>Particle & Nuclear Physics</i> D		
93 - (9702/13_Summer_2023_Q39) - <i>Particle & Nuclear Physics</i> A		
94 - (9702/13_Summer_2023_Q40) - <i>Particle & Nuclear Physics</i> A		
95 - (9702/11_Winter_2023_Q38) - <i>Particle & Nuclear Physics</i> D		
96 - (9702/11_Winter_2023_Q39) - <i>Particle & Nuclear Physics</i> C		
97 - (9702/11_Winter_2023_Q40) - <i>Particle & Nuclear Physics</i> B		
98 - (9702/12_Winter_2023_Q38) - <i>Particle & Nuclear Physics</i> A		
99 - (9702/12_Winter_2023_Q39) - <i>Particle & Nuclear Physics</i> B		
100 - (9702/12_Winter_2023_Q40) - <i>Particle & Nuclear Physics</i> C		

101 - (9702/13_Winter_2023_Q38) - *Particle & Nuclear Physics*

B

102 - (9702/13_Winter_2023_Q39) - *Particle & Nuclear Physics*

A

103 - (9702/13_Winter_2023_Q40) - *Particle & Nuclear Physics*

D