

MATHEMATICS A

Paper 3HR

2015 — Winter 2019

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1 - (4MA0-W 2015-Paper 3HR-Q1) - NUMBER

In a school, there is a total of 640 children.

The ratio of the number of girls to the number of boys is 7 : 9

How many boys are there in this school?

.....
(Total for Question is 2 marks)

2 - (4MA0-W 2015-Paper 3HR-Q2) - NUMBER

(a) Use your calculator to work out the value of

$$125^2 + \frac{173}{9.3 - 6.8}$$

Give your answer as a decimal.

.....
(2)

(b) Write your answer to part (a) correct to 3 significant figures.

.....
(1)

(Total for Question is 3 marks)



3 - (4MA0-W 2015-Paper 3HR-Q8) - *NUMBER*

Lisa sees a dress in a sale.

The normal price of the dress is \$45

The price of the dress is reduced by 12% in the sale.

(a) Work out the price of the dress in the sale.

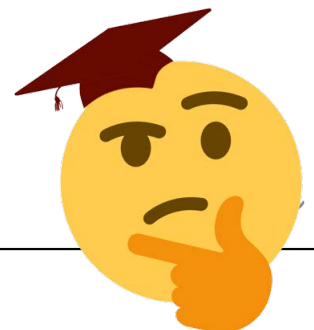
\$
(3)

Lisa's weekly pay increases from \$525 to \$546

(b) Calculate her percentage pay increase.

..... %
(3)

(Total for Question is 6 marks)



4 - (4MA0-W 2015-Paper 3HR-Q9) - *NUMBER*

Show that $7\frac{1}{2} - 4\frac{2}{3} = 2\frac{5}{6}$

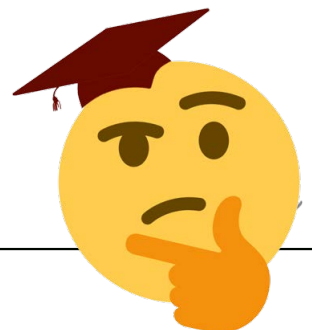
(Total for Question is 3 marks)

5 - (4MA0-W 2015-Paper 3HR-Q13) - *NUMBER*

Given that $A = 2^3 \times 3$ and $B = 2^2 \times 3^2$

find the Lowest Common Multiple (LCM) of A and B .

(Total for Question is 2 marks)



6 - (4MA0-W 2015-Paper 3HR-Q20) - NUMBER

R is **inversely** proportional to the square of c .

When $c = 4$, $R = 30$

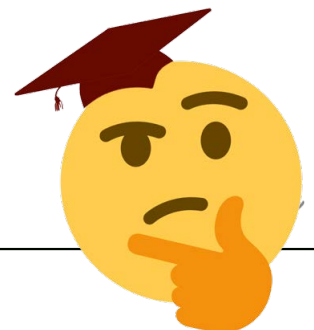
(a) Find a formula for R in terms of c .

.....
(3)

(b) Calculate the positive value of c when $R = 1920$

$c =$
(2)

(Total for Question 6 is 5 marks)



7 - (4MA0-S 2016-Paper 3HR-Q1) - NUMBER

Rafael and Roger played tennis against each other 30 times.
Each of the times they played, either Rafael won or Roger won.
The ratio of the number of times Rafael won to the number of times Roger won is 7:3

(a) Work out the number of times Rafael won.

.....
(2)

In a school, there are 75 girls in the tennis squad.
The ratio of the number of boys in the tennis squad to the number of girls in the tennis squad is 4:3

(b) Work out the number of boys in the tennis squad.

.....
(2)



8 - (4MA0-S 2016-Paper 3HR-Q5) - NUMBER

In a sale, normal prices are reduced by 8%

(a) The normal price of a jacket is £28

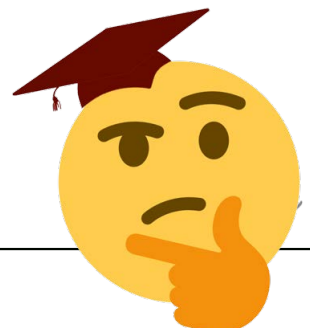
Work out the price of the jacket in the sale.

£
(3)

(b) In the sale, the price of a shirt decreases by £3

Work out the normal price of the shirt.

£
(3)



9 - (4MA0-S 2016-Paper 3HR-Q7) - *NUMBER*

Write 792 as a product of its prime factors.
Show your working clearly.

3 marks

10 - (4MA0-W 2016-Paper 3HR-Q1) - *NUMBER*

Work out the value of $\frac{21.89 - 7.75}{0.65 + 2.85}$

(Total for Question 10 is 2 marks)



11 - (4MA0-W 2016-Paper 3HR-Q6) - *NUMBER*

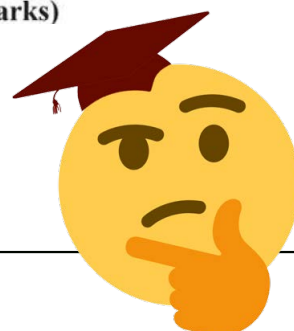
- (a) Express 600 as a product of powers of its prime factors.
Show your working clearly.

.....
(3)

- (b) Simplify $\frac{5^{12}}{5^2 \times 5}$
Give your answer as a power of 5

.....
(2)

(Total for Question 11 is 5 marks)



12 - (4MA0-W 2016-Paper 3HR-Q8) - *NUMBER*

In 1981, the population of India was 683 million.

Between 1981 and 1991, the population of India increased by 163 million.

- (a) Express 163 million as a percentage of 683 million.
Give your answer correct to 3 significant figures.

..... %
(2)

In 2001, the population of India was 1028 million.

Between 2001 and 2011, the population of India increased by 17.6%

- (b) Increase 1028 million by 17.6%
Give your answer to the nearest million.

..... million
(3)

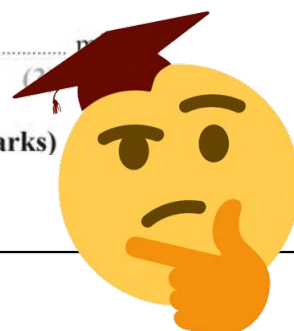
In 2001, the population of India was 1028 million.

Between 1971 and 2001, the population of India increased by 87.6%

- (c) Work out the population of India in 1971.
Give your answer correct to the nearest million.

..... million
(3)

(Total for Question 12 is 8 marks)



13 - (4MA0-S 2017-Paper 3HR-Q4) - *NUMBER*

The currency in Bangladesh is the taka.

1 pound (£) = 119 taka

(a) Change 3500 taka to pounds.

Give your answer correct to 2 decimal places.

£
(2)

The currency in Thailand is the baht.

1 pound (£) = 52 baht

(b) Change 8500 baht to taka.

Give your answer correct to the nearest whole number.

..... taka
(3)

An aeroplane takes 2 hours and 24 minutes to fly from Bangkok to Dhaka.

The aeroplane flies a distance of 1534 km.

(c) Work out the average speed of the aeroplane.

Give your answer in kilometres per hour correct to 3 significant figures.

..... kilometres per hour
(3)

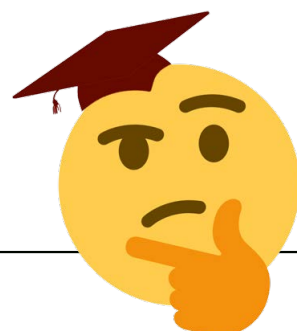


14 - (4MA0-S 2017-Paper 3HR-Q7) - *NUMBER*

Write 336 as a product of its prime factors.
Show your working clearly.

.....

3 marks



15 - (4MA0-S 2017-Paper 3HR-Q10) - *NUMBER*

The price of 1 kg of silver on 1st January 2010 was \$607

By 1st January 2015, the price of 1 kg of silver had decreased by 9.4%

- (a) Work out the price of 1 kg of silver on 1st January 2015.
Give your answer correct to the nearest dollar (\$).

\$
(3)

Between 1st January 2010 and 1st January 2015, the price of 1 tonne of copper decreased by 20%

This was a decrease of \$1320

- (b) Work out the price of 1 tonne of copper on 1st January 2010.

\$
(3)



16 - (4MA0-S 2017-Paper 3HR-Q20) - *NUMBER*

$$k = 2^p - 1 \text{ where } p \text{ is an integer } > 1$$

$$N = k^2 - 1$$

Show that 2^{p+1} is a factor of N

3 marks)

17 - (4MA0-W 2017-Paper 3HR-Q1) - *NUMBER*

The area of the floor of a room is 12m^2

Change 12m^2 into cm^2

..... cm^2

(Total for Question 17 is 2 marks)



18 - (4MA0-W 2017-Paper 3HR-Q4) - *NUMBER*

A plane flew 8740 km from Nairobi to Hong Kong.
The flight time was 13 hours 15 minutes.

Work out the average speed of the plane.
Give your answer, in kilometres per hour, correct to the nearest whole number.

..... kilometres per hour

(Total for Question is 3 marks)



19 - (4MA0-W 2017-Paper 3HR-Q5) - *NUMBER*

There are 80 counters in a bag.
The counters are either red or blue.

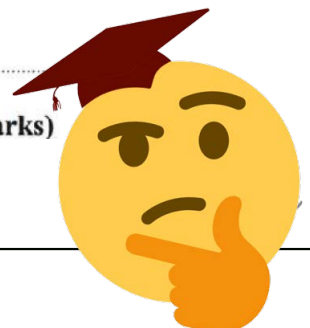
The ratio of the number of red counters to the number of blue counters is 3 : 1

Michael takes 15% of the red counters out of the bag.

Alison takes $\frac{1}{5}$ of the blue counters out of the bag.

How many counters are now in the bag?

(Total for Question is 5 marks)



20 - (4MA0-W 2017-Paper 3HR-Q8) - *NUMBER*

A lion is 224 cm long.

Simon makes a scale model of the lion.

He uses a scale of 1 : 8

(a) Work out the length of the scale model.

..... cm
(2)

In 2010, there were 411 Asiatic lions in India.

In 2015, there were 523 Asiatic lions in India.

(b) Work out the percentage increase in the number of Asiatic lions in India from 2010 to 2015

Give your answer correct to 1 decimal place.

..... %
(3)

(Total for Question is 5 marks)



21 - (4MA0-W 2017-Paper 3HR-Q13) - *NUMBER*

(a) Write 7.9×10^{-4} as an ordinary number.

.....
(1)

(b) Work out $(6.5 \times 10^5) \times (3.1 \times 10^4)$
Give your answer in standard form.

.....
(2)

(Total for Question is 3 marks)

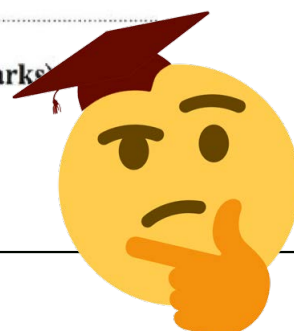
22 - (4MA0-W 2017-Paper 3HR-Q14) - *NUMBER*

Amil invests £9000 for 3 years in a savings account.
He gets 1.8% per year compound interest.

How much money will Amil have in his savings account at the end of 3 years?

£.....

(Total for Question is 3 marks)



23 - (4MA0-S 2018-Paper 3HR-Q1) - *NUMBER*

- (a) Work out the value of $\left(\frac{125.6}{4.7}\right)^2$

Write down all the figures on your calculator display.

.....
(2)

- (b) Write your answer to part (a) correct to 3 significant figures.

.....
(1)

24 - (4MA0-S 2018-Paper 3HR-Q2) - *NUMBER*

Helga has played a game many times.

She scored 9 or more in $\frac{5}{6}$ of these games.

Helga is going to play the game another 60 times.

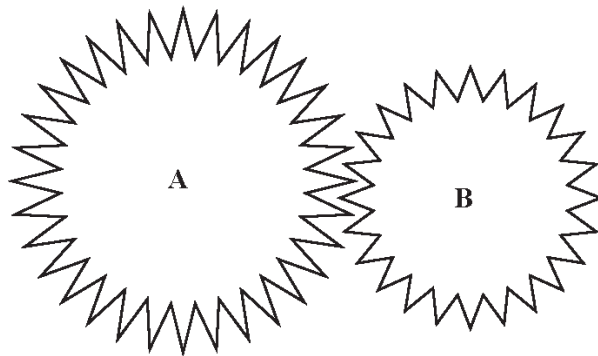
Work out an estimate for the number of times she will score 9 or more in these 60 games.

.....
(Total for Question is 2 marks)



25 - (4MA0-S 2018-Paper 3HR-Q4) - NUMBER

The diagram shows two cogs, **A** and **B**.



There are 32 teeth on cog **A**.

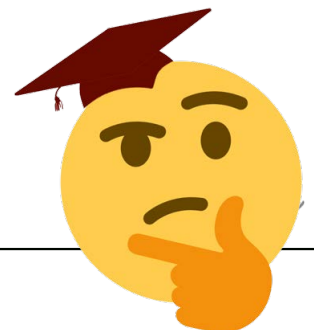
There are 24 teeth on cog **B**.

The two cogs both rotate.

Cog **A** completes 12 full turns while cog **B** completes 16 full turns.

Work out the number of full turns that cog **A** completes while cog **B** completes 60 full turns.

.....
(Total for Question is 2 marks)



26 - (4MA0-S 2018-Paper 3HR-Q9) - *NUMBER*

Show that $3\frac{3}{8} \div 2\frac{1}{4} = 1\frac{1}{2}$

(Total for Question is 3 marks)



27 - (4MA0-S 2018-Paper 3HR-Q16) - NUMBER

Daniel buys a new car.

In the first year, the value of the car decreases by 24% of its original value.

The value of the car at the end of the first year is \$13 300

(a) Work out the original value of the car.

\$
(3)

The value of the car at the end of the first year is \$13 300

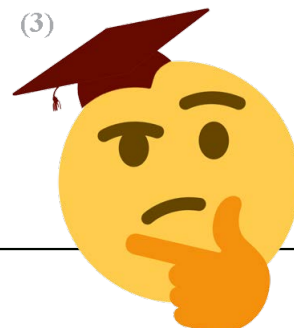
In each of the second year, the third year and the fourth year, the value of the car decreases by $x\%$ of its value at the beginning of each year.

The value of the car at the end of the fourth year is \$6500

(b) Work out the value of x .

Give your answer correct to 3 significant figures.

$x =$
(3)



28 - (4MA0-W 2018-Paper 3HR-Q3) - *NUMBER*

Faisal lives in the USA.

He wants to buy one cotton sheet.

In the USA one sheet costs 79 US dollars.

Faisal knows that the same type of sheet costs 210 Egyptian pounds when bought in Egypt.

He also knows these exchange rates.

1 euro = 1.10 US dollars
1 euro = 9.72 Egyptian pounds

How much cheaper is the cost of one sheet when bought in Egypt than when bought in the USA?

Give your answer in US dollars correct to the nearest dollar.

.....US dollars

(Total for Question is 4 marks)



29 - (4MA0-W 2018-Paper 3HR-Q7) - *NUMBER*

Ahmed bought one box of lemons.
The box of lemons cost \$4
There were 24 lemons in the box.

Ahmed sold $\frac{3}{4}$ of all the lemons he bought for 30 cents each.

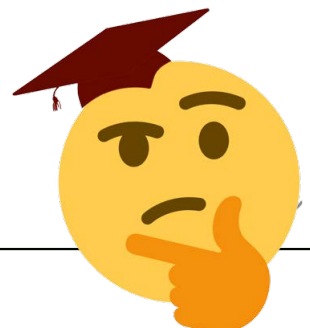
He then sold the rest of the lemons for 20 cents each.

Calculate the percentage profit that Ahmed made.

Use \$1 = 100 cents.

.....%

(Total for Question is 4 marks)



30 - (4MA0-W 2018-Paper 3HR-Q8) - *NUMBER*

The scale of a map is 1:50 000

The length of a road on the map is 30 cm.

Work out the length of the real road.

Give your answer in km.

.....km

(Total for Question is 3 marks)



31 - (4MA0-W 2018-Paper 3HR-Q9) - *NUMBER*

There are 320 students at a school.

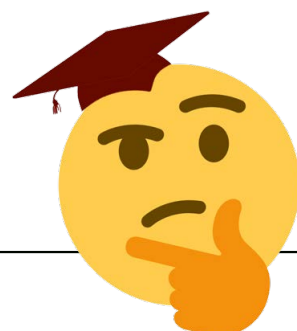
$\frac{5}{8}$ of these students are girls.

$\frac{3}{4}$ of the girls have blue eyes.

$\frac{2}{3}$ of the boys have blue eyes.

What fraction of the students at the school have blue eyes?

.....
(Total for Question . is 4 marks)



32 - (4MA0-W 2018-Paper 3HR-Q13) - *NUMBER*

A train travels at a constant speed of v kilometres per hour.
The train crosses a bridge.

The length of the bridge is b metres.
The length of the train is x metres.

T seconds is the time between the instant that the front of the train moves onto the bridge
and the instant that the back of the train leaves the bridge.

Find a formula for T in terms of b , x and v .
Give your answer in its simplest form.

.....
(Total for Question is 3 marks)

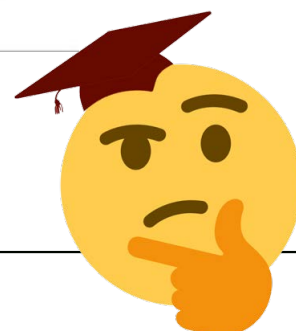
33 - (4MA0-W 2018-Paper 3HR-Q14) - *NUMBER*

Andrew invests £3000 in an account for 3 years at 2.4% compound interest per year.
At the end of the 3 years, a deduction of 40% of the **total interest** is made from the account.

Work out the amount in the account at the end of the 3 years, after the deduction has been made.

£.....

(Total for Question is 4 marks)



34 - (4MA0-W 2019-Paper 3HR-Q1) - *NUMBER*

Pierre's weekly pay is 560 euros.
He gets a pay increase of 7%

(a) Work out Pierre's weekly pay after the increase.

(3) euros

Lucienne also gets a pay increase of 7%
Her weekly pay increases by 42 euros.

(b) Work out Lucienne's weekly pay before the increase.

(3) euros

35 - (4MA0-W 2019-Paper 3HR-Q5) - *NUMBER*

Express 630 as a product of its prime factors.
Show your working clearly.



36 - (4MA0-W 2019-Paper 3HR-Q8) - *NUMBER*

Ben, Carlos and Delanna share \$760 in the ratios 2 : 3 : 5

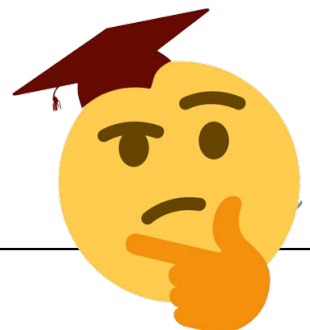
Ben gives half of his share to charity.

Carlos gives $\frac{2}{3}$ of his share to charity.

Delanna gives 30% of her share to charity.

Work out how much of the \$760 is given to charity.

\$



37 - (4MA0-W 2019-Paper 3HR-Q11) - NUMBER

- (a) Write 0.000 000 54 in standard form.

(1)

The population of Sweden is 9.92×10^6

The population of Denmark is 57.6% of the population of Sweden.

- (b) Work out the population of Denmark.

Give your answer in standard form correct to 2 significant figures.

(2)

The population of China is 1.4×10^9

The population of Hong Kong is 7.4×10^6

The population of China is k times the population of Hong Kong.

- (c) Calculate the value of k .

Give your answer correct to the nearest whole number.

$k =$

(2)



1 - (4MA0-W 2015-Paper 3HR-Q4) - ALGEBRA

(a) Factorise $6w + 15$

.....
(1)

(b) Expand and simplify $(x + 4)(x + 7)$

.....
(2)

(c) Solve $3(x - 5) = 7x + 12$
Show clear algebraic working.

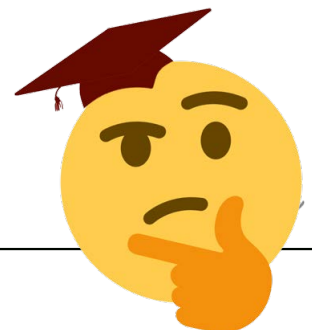
$x =$
(3)

(Total for Question is 6 marks)

2 - (4MA0-W 2015-Paper 3HR-Q15) - ALGEBRA

Simplify $\left(2x^{\frac{3}{2}}y\right)^4$

.....
(Total for Question is 2 marks)



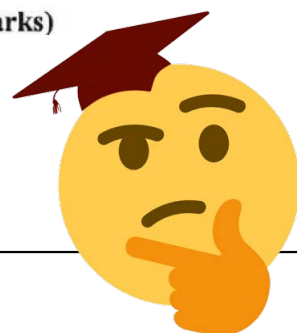
3 - (4MA0-W 2015-Paper 3HR-Q24) - ALGEBRA

Solve the simultaneous equations

$$\begin{aligned}y &= 2x - 3 \\x^2 + y^2 &= 41\end{aligned}$$

Show clear algebraic working.

(Total for Question is 6 marks)



4 - (4MA0-S 2016-Paper 3HR-Q2) - ALGEBRA

(a) Factorise fully $2x^2 - 4x$

.....
(2)

$$A = 2p + 3q$$

(b) Work out the value of p when $A = 32$ and $q = 7$

$$p = \text{.....}$$

(3)

5 marks

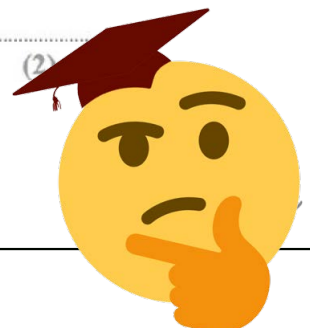
5 - (4MA0-S 2016-Paper 3HR-Q6) - ALGEBRA

(a) Solve the inequalities $-4 < 3x + 5 \leq 11$

.....
(3)

(b) Write down the integer values of x which satisfy $-4 < 3x + 5 \leq 11$

.....
(2)



6 - (4MA0-S 2016-Paper 3HR-Q12) - ALGEBRA

(a) Simplify fully $\frac{a^{11}}{a^2 \times a^5}$

.....
(2)

(b) Make p the subject of $p + 4q = 3p + 5$

.....
(2)

(c) Expand and simplify $(2y + 3)(4y - 1)$

.....
(2)

(d) Simplify $(8a^6b^3)^{\frac{1}{3}}$

.....
(2)



7 - (4MA0-S 2016-Paper 3HR-Q20) - ALGEBRA

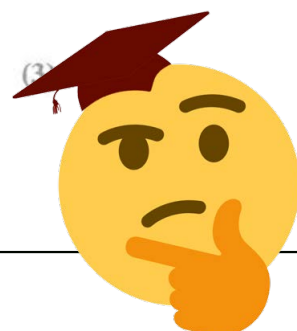
- (a) Simplify fully $\frac{50x^2 - 8}{10x - 4}$
Show clear algebraic working.

(3)

- (b) Given that a is a positive integer, show that

$$\sqrt{3a}(\sqrt{12a} + a\sqrt{3a})$$

is always a multiple of 3



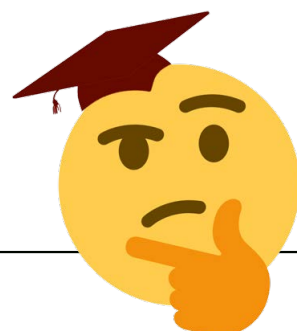
8 - (4MA0-S 2016-Paper 3HR-Q21) - ALGEBRA

Solve $3 \times 4^{2k+8} = 24$

Show your working clearly.

$k = \dots\dots\dots$

4 marks



9 - (4MA0-W 2016-Paper 3HR-Q2) - ALGEBRA

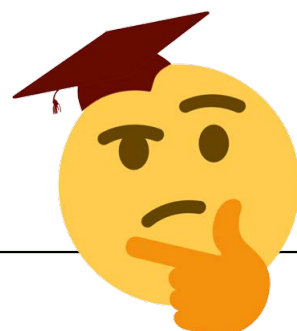
(a) Factorise fully $18c - 27$

.....
(2)

(b) Expand and simplify $(t - 4)(t + 5)$

.....
(2)

(Total for Question is 4 marks)



10 - (4MA0-W 2016-Paper 3HR-Q7) - ALGEBRA

(a) Solve the inequality $e - 2 < 0$

.....
(1)

(b) Solve the inequality $5 - 3e < 4$

.....
(2)

(c) Write down the integer value of e that satisfies both of the inequalities

$$e - 2 < 0 \quad \text{and} \quad 5 - 3e < 4$$

.....
(1)

(Total for Question is 4 marks)



11 - (4MA0-W 2016-Paper 3HR-Q11) - ALGEBRA

Solve the simultaneous equations

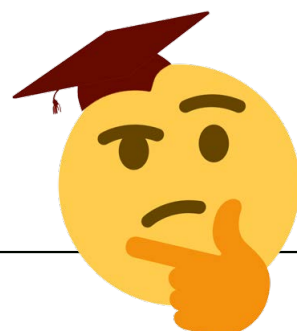
$$\begin{aligned}c + 5d &= -13 \\ 4c - 5d &= 48\end{aligned}$$

Show clear algebraic working.

$$c = \dots\dots\dots$$

$$d = \dots\dots\dots$$

(Total for Question is 3 marks)



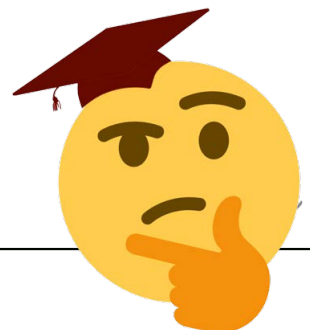
12 - (4MA0-W 2016-Paper 3HR-Q12) - ALGEBRA

A stone is thrown vertically upwards from a point O .

The height above O of the stone t seconds after it was thrown from O is h metres,
where $h = 17t - 5t^2$

Work out the values of t when the height of the stone above O is 12 metres.
Show your working clearly.

.....
(Total for Question 12 is 3 marks)



13 - (4MA0-W 2016-Paper 3HR-Q13) - ALGEBRA

(a) Simplify $\left(4h^{\frac{2}{3}}\right)^3$

$$\frac{a\sqrt{a}}{\sqrt[3]{a^2}} = a^k$$

(b) Work out the value of k .

.....
(2)

$k =$
(3)

(Total for Question is 5 marks)

14 - (4MA0-S 2017-Paper 3HR-Q1) - ALGEBRA

$$a = 6 \quad b = 2.84 \quad c = \sqrt{5}$$

Work out the value of $\frac{a-b}{c^2}$

.....
2 marks)



15 - (4MA0-S 2017-Paper 3HR-Q2) - ALGEBRA

Solve $5x - 8 = x - 10$

Show clear algebraic working.

$x =$

3 marks)

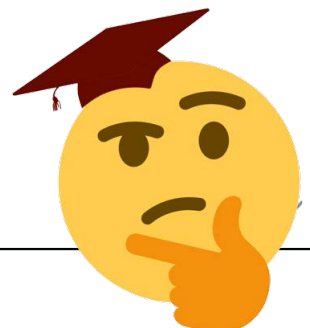
16 - (4MA0-S 2017-Paper 3HR-Q9) - ALGEBRA

(a) Simplify $2e^2f \times 5e^3f$

.....
(2)

(b) Factorise $x^2 - 5x - 6$

.....
(2)



17 - (4MA0-S 2017-Paper 3HR-Q16) - ALGEBRA

Make x the subject of the formula $y = \frac{ax + b}{cx + d}$

.....
(4 marks)



18 - (4MA0-S 2017-Paper 3HR-Q18) - ALGEBRA

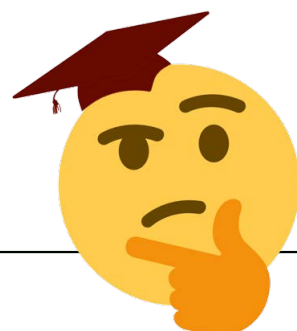
Solve the simultaneous equations

$$y^2 + 4x = 12$$

$$2x + 3y = 10$$

Show clear algebraic working.

(6 marks)



19 - (4MA0-W 2017-Paper 3HR-Q11) - ALGEBRA

(a) Solve
$$\begin{aligned} 7x + 2y &= 16 \\ 5x - 2y &= 20 \end{aligned}$$

Show clear algebraic working.

$$x = \dots\dots\dots$$

$$y = \dots\dots\dots$$

(3)

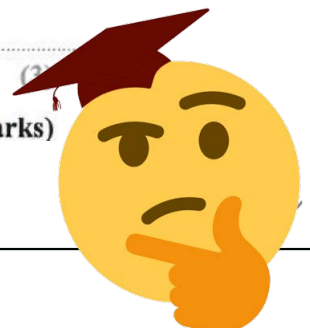
(b) Expand and simplify $(k + 9)(k - 5)$

(c) Simplify $\left(\frac{y^5}{8x^6y^8}\right)^{-\frac{1}{3}}$

$$\dots\dots\dots$$

(2)

(Total for Question is 8 marks)



20 - (4MA0-W 2017-Paper 3HR-Q16) - ALGEBRA

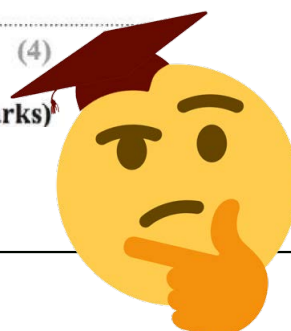
(a) Solve $\frac{3x+1}{5} - \frac{x-4}{3} = 2$

Show clear algebraic working.

$x = \dots\dots\dots$
(3)

(b) Make p the subject of the formula $t = \frac{7-2p}{3p+1}$

(Total for Question 20 is 7 marks)



21 - (4MA0-W 2017-Paper 3HR-Q18) - ALGEBRA

Given that p is a prime number, rationalise the denominator of $\frac{7\sqrt{p} - p^2}{\sqrt{p^3}}$
Simplify your answer.

.....
(Total for Question is 3 marks)



22 - (4MA0-S 2018-Paper 3HR-Q7) - ALGEBRA

The diagram shows a rectangle and an isosceles triangle.
All measurements are in centimetres.

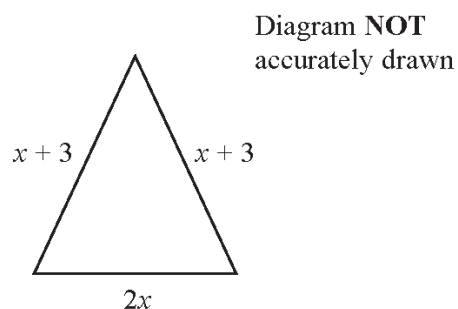
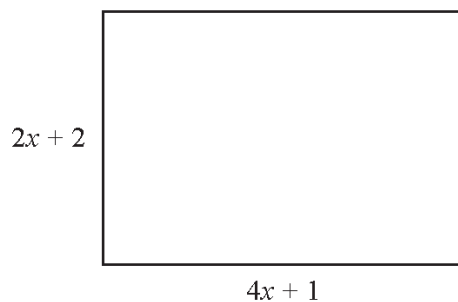


Diagram **NOT**
accurately drawn

(a) Write down an expression in terms of x for

(i) the perimeter of the rectangle,

..... cm

(ii) the perimeter of the triangle.

..... cm

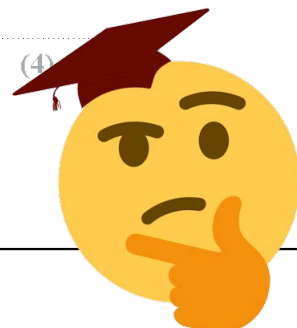
(2)

The perimeter of the rectangle is equal to 2 times the perimeter of the triangle.

(b) Work out the value of x .

Show clear algebraic working.

.....
(4)



23 - (4MA0-S 2018-Paper 3HR-Q14) - ALGEBRA

(a) Solve the inequality $\frac{1}{4}p < 7$

.....
(1)

(b) Solve the inequality $16q^2 > 9$

.....
(3)



24 - (4MA0-S 2018-Paper 3HR-Q19) - ALGEBRA

Solve the simultaneous equations

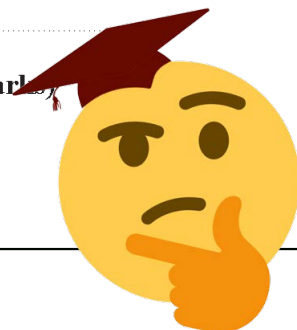
$$y = 5x^2$$

$$y - 4 = 3x$$

Show your working clearly.

Give your solutions correct to 2 decimal places.

(Total for Question is 4 marks)



25 - (4MA0-S 2018-Paper 3HR-Q20) - ALGEBRA

Show that $\frac{\sqrt{50} - \sqrt{18}}{4}$ can be written in the form $\frac{1}{\sqrt{k}}$ where k is an integer.

Show your working clearly.

(Total for Question is 3 marks)



26 - (4MA0-S 2018-Paper 3HR-Q22) - *ALGEBRA*

Simplify fully $\frac{12x^2 - 3}{6x^2 + 5x - 4}$

.....
(Total for Question is 3 marks)



27 - (4MA0-W 2018-Paper 3HR-Q1) - ALGEBRA

(a) Expand and simplify

$$5(x + y) - 3x + 3y$$

.....
(2)

(b) Simplify $t^3 \times t^7$

.....
(1)

(c) Simplify $(m^4)^3$

.....
(1)

28 - (4MA0-W 2018-Paper 3HR-Q15) - ALGEBRA

Solve

$$\begin{aligned} 3x - 4y &= 8 \\ 5x - 2y &= 11 \end{aligned}$$

Show clear algebraic working.

 $x =$ $y =$

(Total for Question is 3 marks)



29 - (4MA0-W 2018-Paper 3HR-Q17) - ALGEBRA

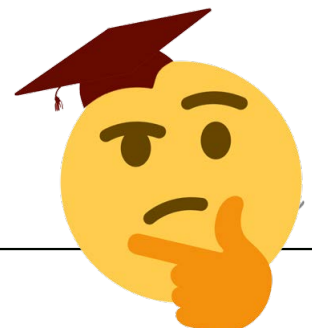
(a) Show that $\frac{x+1}{2x+1} - \frac{1}{(2x+1)(x+1)} = \frac{x^2+2x}{(2x+1)(x+1)}$

(2)

(b) Hence, solve $\frac{x+1}{2x+1} - \frac{1}{(2x+1)(x+1)} = \frac{1}{(2x+1)(x+1)}$

Give your solutions correct to 3 significant figures.
Show your working clearly.

(4)



30 - (4MA0-W 2018-Paper 3HR-Q21) - ALGEBRA

$$y = 4ax^2$$

$$z = a^2x^3$$

Given that $y = 4a^kz^w$ find

(a) (i) the value of w ,

$$w = \frac{\dots\dots\dots}{(2)}$$

(ii) the value of k .

$$k = \frac{\dots\dots\dots}{(2)}$$

$$m = 10^3$$

$$N = m \times m^m$$

(b) Write N in the form 10^n where n is an integer.

$$\frac{\dots\dots\dots}{(3)}$$

(Total for Question 30 is 7 marks)



31 - (4MA0-W 2019-Paper 3HR-Q9) - ALGEBRA

(a) Simplify $c^{12} \div c^4$

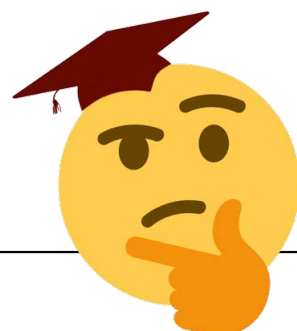
(1)

(b) Simplify $5y \div y$

(1)

(c) Expand and simplify $4(2x - 3y) - 2(3x + y)$

(2)



32 - (4MA0-W 2019-Paper 3HR-Q12) - ALGEBRA

Solve the simultaneous equations

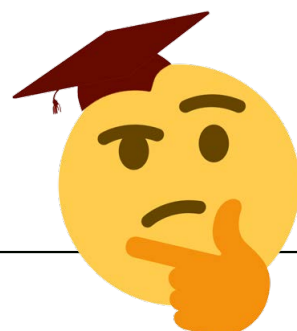
$$3x + 2y = 5.5$$

$$5x - 3y = -13$$

Show clear algebraic working.

$x =$

$y =$



33 - (4MA0-W 2019-Paper 3HR-Q14) - ALGEBRA

(a) Solve $\frac{2w-3}{7} + \frac{2w-5}{3} = 2$

Show clear algebraic working.

$$w =$$

(3)

(b) Make e the subject of the formula $t = \sqrt{\frac{3e+7}{e-3}}$



34 - (4MA0-W 2019-Paper 3HR-Q16) - ALGEBRA

p is directly proportional to the cube of w

$p = 37.5$ when $w = 5$

(a) Find a formula for p in terms of w

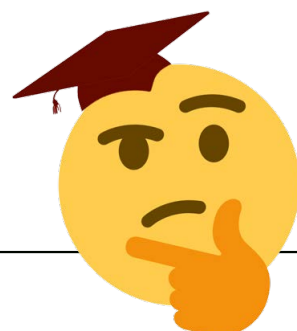
(3)

(b) Calculate the value of p when $w = 4$

(1)

35 - (4MA0-W 2019-Paper 3HR-Q17) - ALGEBRA

Simplify $\left(5h^{\frac{4}{3}}g^2\right)^3$



36 - (4MA0-W 2019-Paper 3HR-Q21) - ALGEBRA

Here is a right-angled triangle.

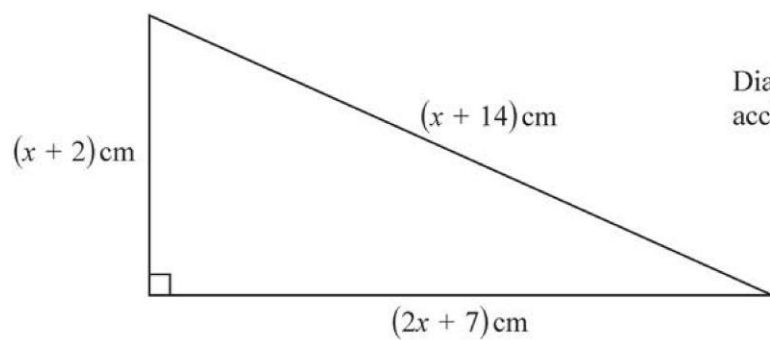


Diagram **NOT**
accurately drawn

The area of the triangle is $A\text{ cm}^2$

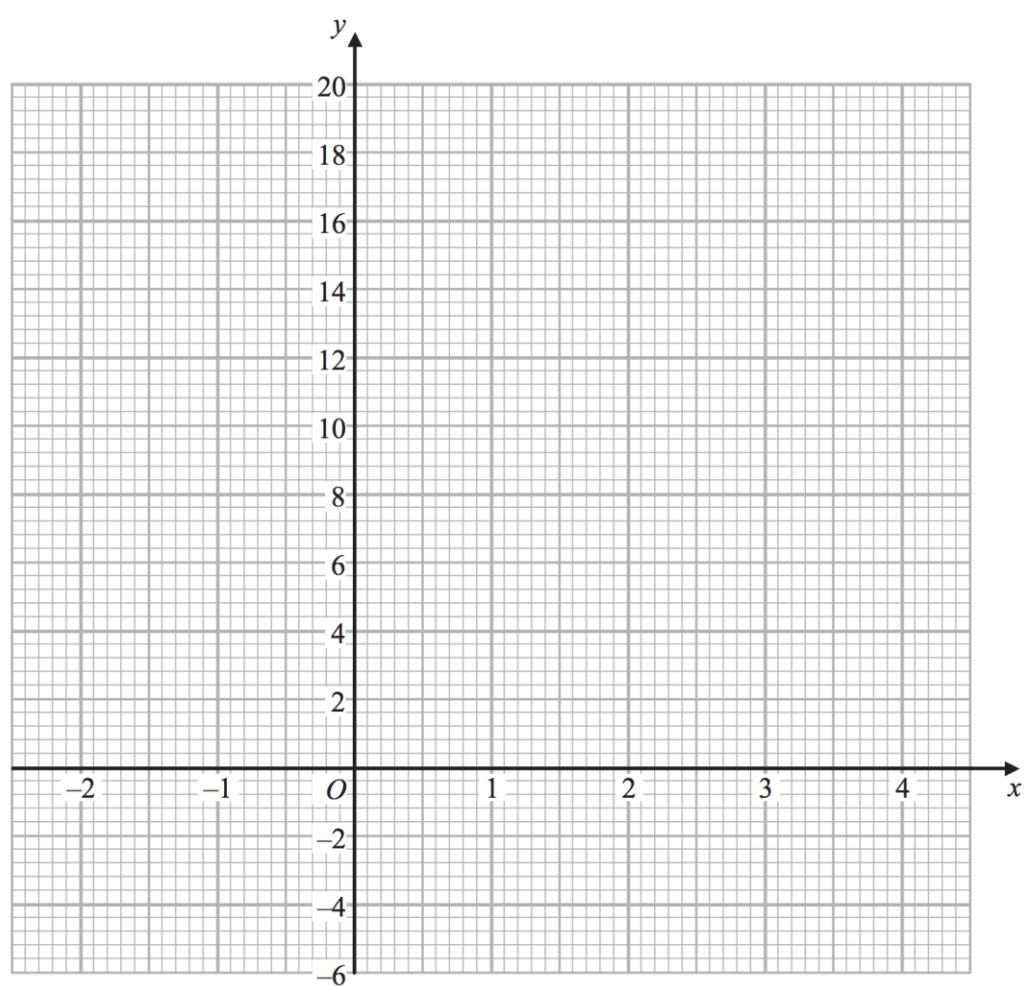
Work out the value of A .
Show your working clearly.

$A =$

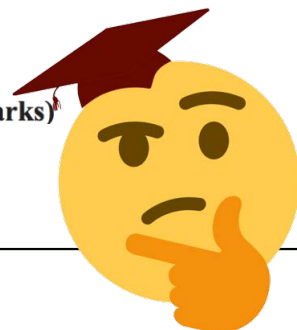


1 - (4MA0-W 2015-Paper 3HR-Q5) - FUNCTIONS & GRAPHS

On the grid, draw the graph of $y = 3x + 2$ for values of x from -2 to 4



(Total for Question is 4 marks)



2 - (4MA0-W 2015-Paper 3HR-Q21) - *FUNCTIONS & GRAPHS*

The functions g and h are defined as

$$g(x) = \frac{x}{2x - 5}$$

$$h(x) = x + 4$$

(a) Find the value of $g(1)$

.....
(1)

(b) State which value of x must be excluded from any domain of g

.....
(1)

(c) Find $gh(x)$
Simplify your answer.

$$gh(x) = \text{.....}$$

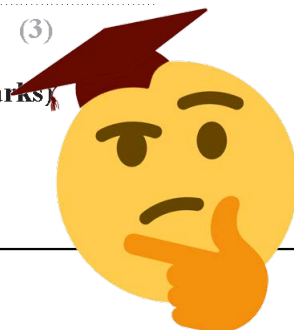
(2)

(d) Express the inverse function g^{-1} in the form $g^{-1}(x) = \dots$

$$g^{-1}(x) = \text{.....}$$

(3)

(Total for Question 2 is 7 marks)



3 - (4MA0-S 2016-Paper 3HR-Q18) - *FUNCTIONS & GRAPHS*

f is the function such that

$$f(x) = \frac{x}{3x + 1}$$

(a) Find $f(0.5)$

.....
(1)

(b) Find $ff(-1)$

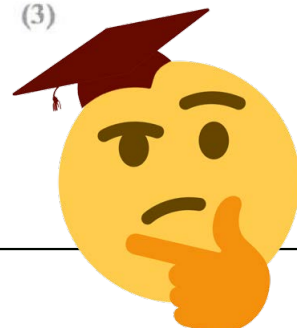
.....
(2)

(c) Find the value of x that cannot be included in any domain of f

.....
(1)

(d) Express the inverse function f^{-1} in the form $f^{-1}(x) = \dots$
Show clear algebraic working.

$f^{-1}(x) = \dots$
(3)



4 - (4MA0-W 2016-Paper 3HR-Q9) - *FUNCTIONS & GRAPHS*

The point A has coordinates $(0, 2)$

The point B has coordinates $(-4, -1)$

(a) Find the coordinates of the midpoint of AB .

.....
(2)

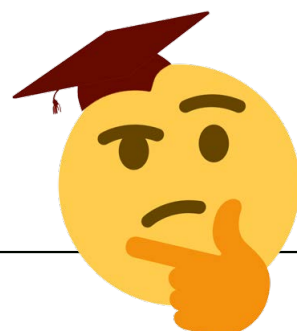
(b) Work out the gradient of the line AB .

.....
(2)

(c) Find an equation of the line AB .

.....
(2)

(Total for Question 4 is 6 marks)



5 - (4MA0-W 2016-Paper 3HR-Q16) - *FUNCTIONS & GRAPHS*

$$f(x) = \frac{2x}{x-1}$$

(a) Find the value of $f(11)$

.....
(1)

(b) State which value of x must be excluded from any domain of f

.....
(1)

(c) Find $f^{-1}(x)$

.....
(3)

(d) State the value which cannot be in any range of f

.....
(1)

(Total for Question is 6 marks)

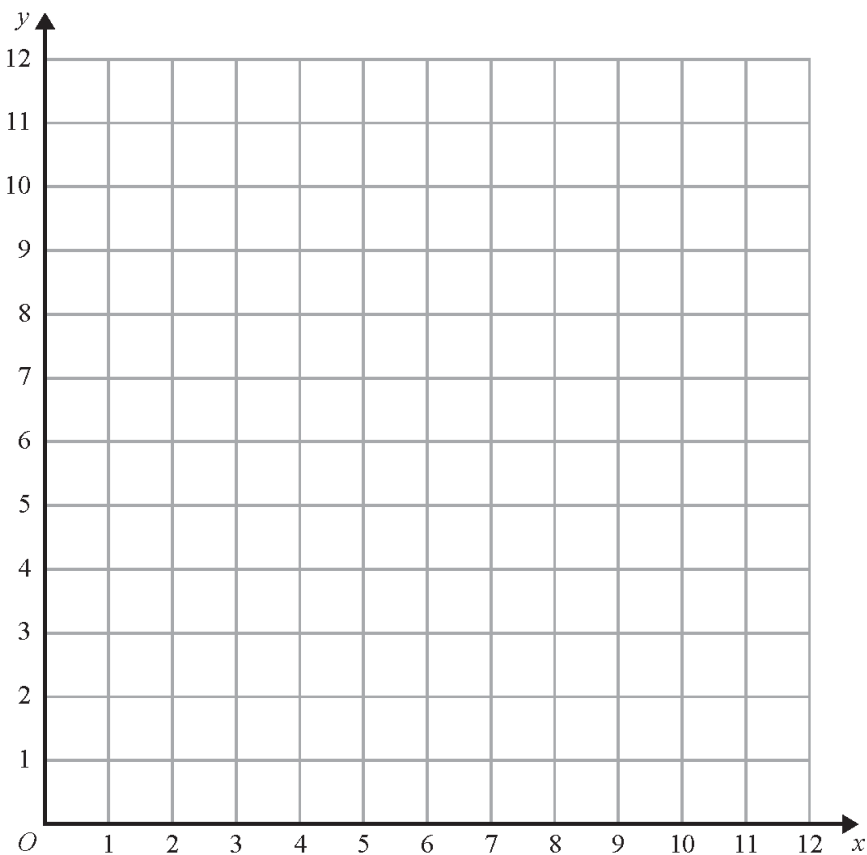


6 - (4MA0-S 2017-Paper 3HR-Q13) - *FUNCTIONS & GRAPHS*

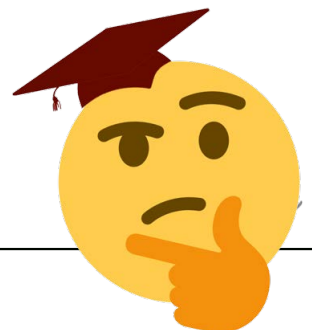
On the grid, show by shading the region defined by the inequalities

$$y > 5 \quad \text{and} \quad y < 2x + 1 \quad \text{and} \quad x + y < 10$$

Label your region **R**.

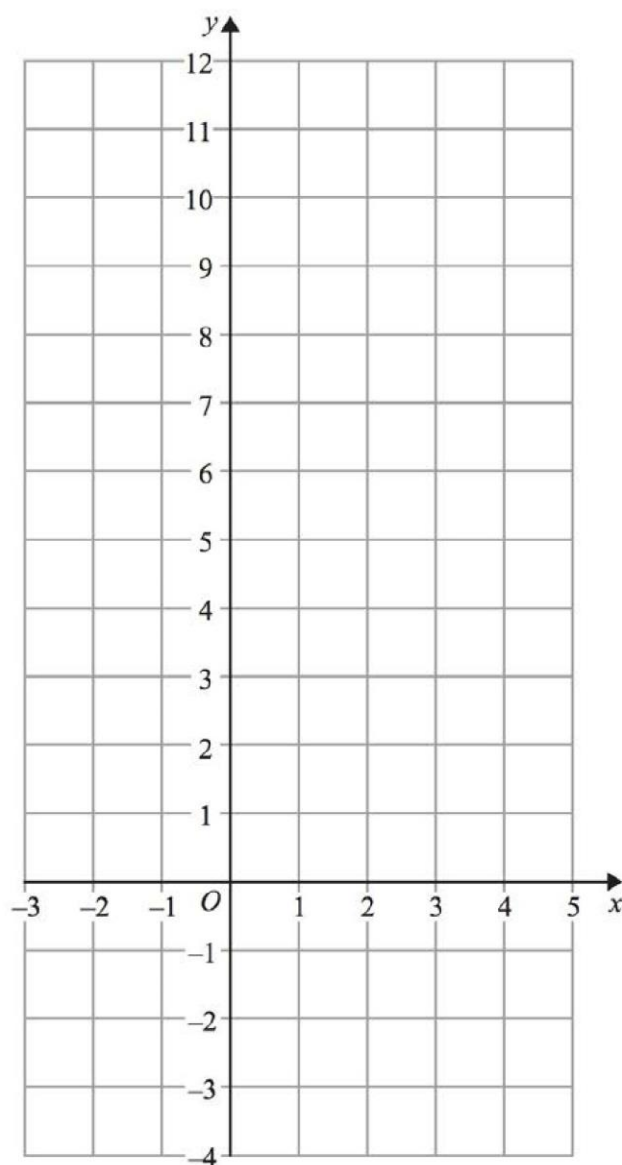


3 marks)

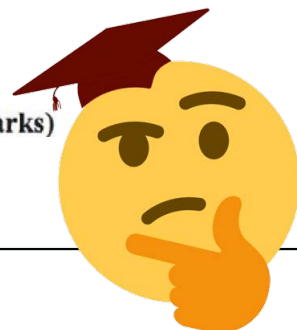


7 - (4MA0-W 2017-Paper 3HR-Q7) - FUNCTIONS & GRAPHS

On the grid, draw the graph of $y + 2x = 6$ for values of x from -2 to 4



(Total for Question is 4 marks)



8 - (4MA0-W 2017-Paper 3HR-Q19) - *FUNCTIONS & GRAPHS*

The function f is defined as $f(x) = \frac{3}{2-x}$

(a) State the value of x which cannot be included in any domain of f .

.....
(1)

(b) Find $f(-4)$

.....
(1)

(c) Express the inverse function f^{-1} in the form $f^{-1}(x) = \dots$

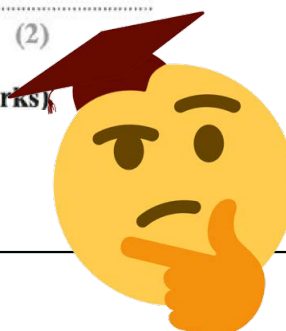
$f^{-1}(x) = \dots$
(2)

The function g is defined as $g(x) = \frac{2x+1}{3}$

(d) Express the function fg in the form $fg(x) = \dots$
Simplify your answer.

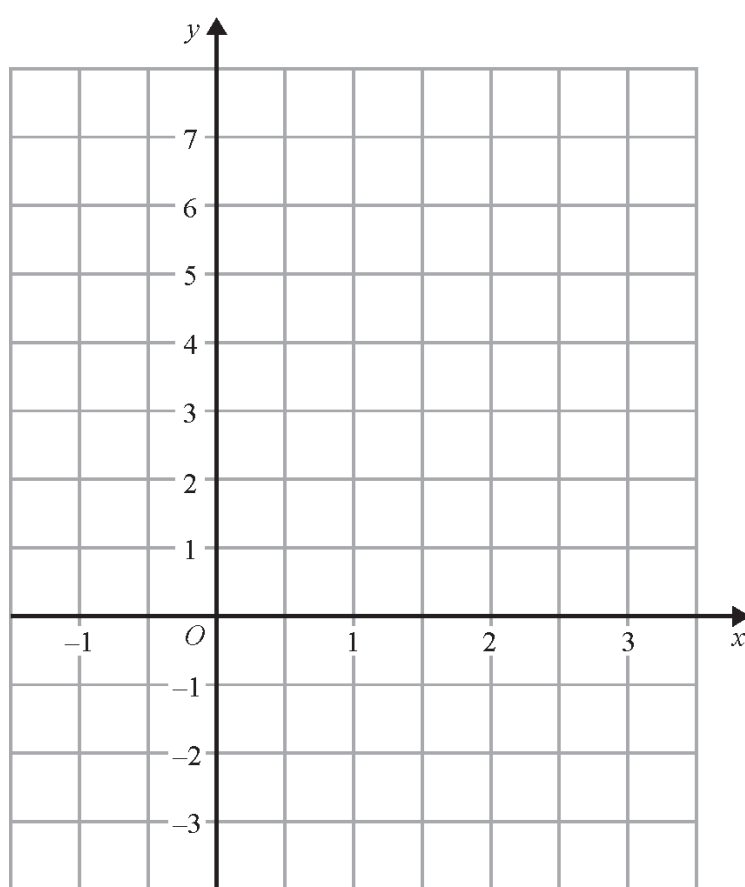
$fg(x) = \dots$
(2)

(Total for Question is 6 marks)



9 - (4MA0-S 2018-Paper 3HR-Q3) - *FUNCTIONS & GRAPHS*

(a) On the grid, draw the graph of $y = 4 - 2x$ for values of x from -1 to 3



(3)

(b) Write down the coordinates of the point where the graph of $y = 4 - 2x$ crosses the line $y = 1$

(.....,)
(1)



10 - (4MA0-S 2018-Paper 3HR-Q23) - *FUNCTIONS & GRAPHS*

f is the function such that $f(x) = \sqrt{4x}$ for $x \geq 0$

(a) State which values of x must be excluded from any domain of f

.....
(1)

The inverse function f^{-1} has domain $x \geq 0$

(b) Find $f^{-1}(x)$

$f^{-1}(x) = \dots\dots\dots$
(2)

g is the function such that $g(x) = (5 - x)(x - 1)$

The composite function fg has domain $x \geq 3$

(c) Find $fg(x)$

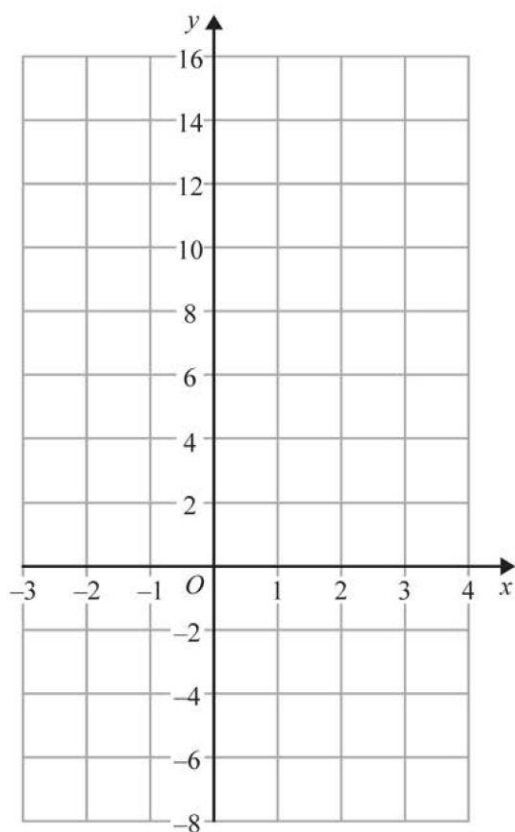
Give your answer in its simplest form.

$fg(x) = \dots\dots\dots$
(4)



11 - (4MA0-W 2018-Paper 3HR-Q4) - FUNCTIONS & GRAPHS

(a) On the grid, draw the graph of $y = 4x + 2$ for values of x from -2 to 3



(3)

The point with coordinates $(p, 50)$ lies on the line with equation $y = 4x + 2$

(b) Work out the value of p .

$p = \dots\dots\dots$
(2)



12 - (4MA0-W 2018-Paper 3HR-Q23) - *FUNCTIONS & GRAPHS*

f is the function such that $f(x) = (x + 1)^2$ for $x > 0$

- (a) Find the value of a for which $f(a) = \frac{25}{9}$

Show clear algebraic working.

$$a = \dots\dots\dots (3)$$

g is the function such that $g(x) = \frac{1}{x}$ for $x > 0$

- (b) Show that $x^2fg(x) = f(x)$ for all $x > 0$

(2)

h is the function such that $hf(x) = x$ for all $x > 1$

- (c) Find the function h in the form $h(x) = \dots$

$$h(x) = \dots\dots\dots (2)$$

(Total for Question is 7 marks)



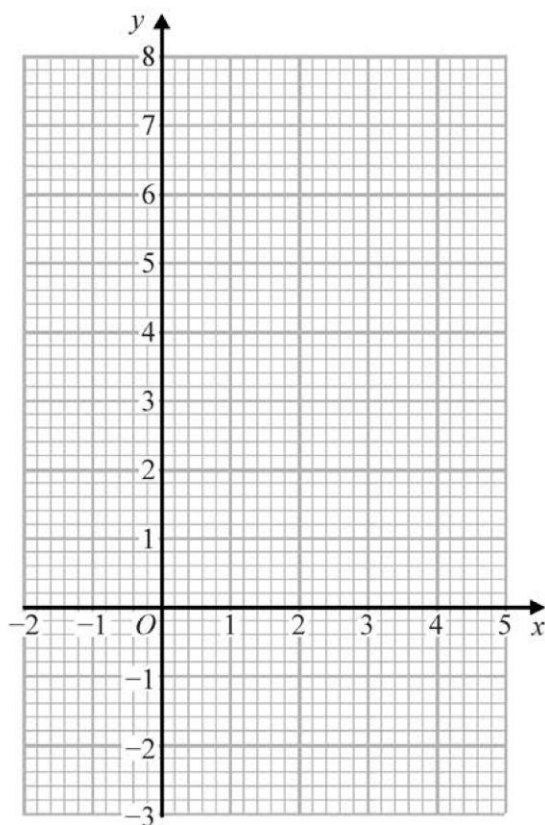
13 - (4MA0-W 2019-Paper 3HR-Q6) - *FUNCTIONS & GRAPHS*

(a) Complete the table of values for $y = x^2 - 2x - 1$

x	-1	0	1	2	3	4
y			-2	-1		

(2)

(b) On the grid, draw the graph of $y = x^2 - 2x - 1$ for values of x from -1 to 4



(2)

(c) Use your graph to find estimates for the solutions of the equation $x^2 - 2x - 1 = 1$



14 - (4MA0-W 2019-Paper 3HR-Q10) - *FUNCTIONS & GRAPHS*

The straight line **L** passes through the point with coordinates $(6, -4)$ and is parallel to the straight line with equation $y = 5 - 3x$

Find an equation for **L**.



15 - (4MA0-W 2019-Paper 3HR-Q18) - *FUNCTIONS & GRAPHS*

The functions f and g are defined as

$$f(x) = \frac{3x}{4-x} \quad x \neq 4$$

$$g(x) = \frac{2x+1}{3}$$

(a) Find $gf(7)$

(2)

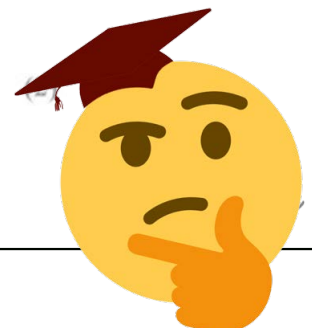
(b) Express the inverse function g^{-1} in the form $g^{-1}(x) = \dots$

$$g^{-1}(x) =$$

(2)

(c) Find $fg(x)$
Simplify your answer.

$$fg(x) =$$



1 - (4MA0-W 2015-Paper 3HR-Q10) - MENSURATION

The diagram shows a solid cylinder.

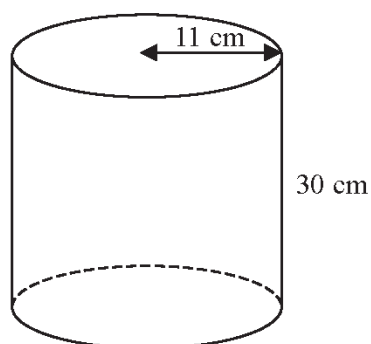


Diagram **NOT**
accurately drawn

The cylinder has a height of 30 cm and a radius 11 cm.

- (a) Work out the **total** surface area of the cylinder.
Give your answer correct to 2 significant figures.

..... cm²
(4)

- (b) The height of the cylinder is 30 cm, correct to the nearest centimetre.

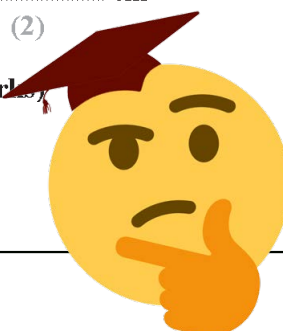
- (i) Write down the lower bound of the height of the cylinder.

..... cm

- (ii) Write down the upper bound of the height of the cylinder.

..... cm
(2)

(Total for Question 1 is 6 marks)



2 - (4MA0-W 2015-Paper 3HR-Q18) - MENSURATION

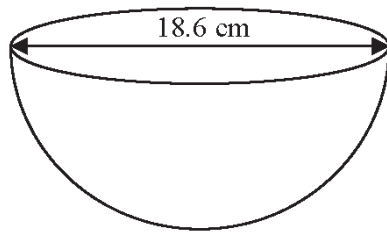


Diagram **NOT**
accurately drawn

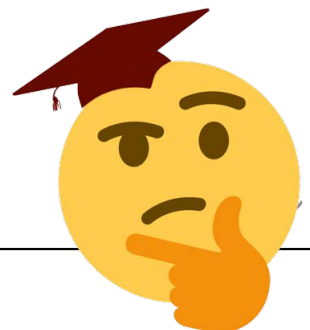
The diagram shows a hemisphere with a diameter of 18.6 cm.

Work out the volume of the hemisphere.

Give your answer correct to 3 significant figures.

..... cm³

(Total for Question is 3 marks)



3 - (4MA0-W 2016-Paper 3HR-Q15) - *MENSURATION*

The diagram shows a cylinder inside a cone on a horizontal base.

The cone and the cylinder have the same vertical axis.

The base of the cylinder lies on the base of the cone.

The circumference of the top face of the cylinder touches the curved surface of the cone.

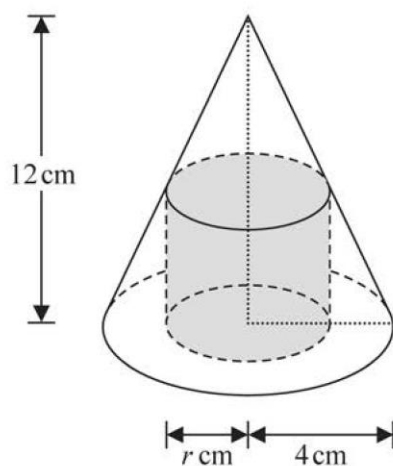


Diagram **NOT**
accurately drawn

The height of the cone is 12 cm and the radius of the base of the cone is 4 cm.

(a) Work out the curved surface area of the cone.

Give your answer correct to 3 significant figures.

..... cm²
(3)



The cylinder has radius r cm and volume V cm³

(b) Show that $V = 12\pi r^2 - 3\pi r^3$

(3)

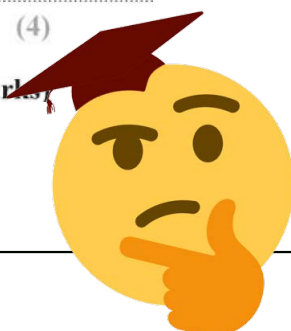
(c) $V = 12\pi r^2 - 3\pi r^3$

Find the value of r for which V is a maximum.

$r = \dots\dots\dots$

(4)

(Total for Question 11 is 10 marks)



4 - (4MA0-S 2017-Paper 3HR-Q5) - *MENSURATION*

There is a World Peace Bell in South Korea.

At its widest, the bell has a circular cross section with a diameter of 2.5 m.

- (a) Work out the circumference of a circle with diameter 2.5 m.

Give your answer correct to 3 significant figures.

..... m
(2)

The World Peace Bell in South Korea has a height of 4.7 m.

At its widest, the bell has a circular cross section with a diameter of 2.5 m.

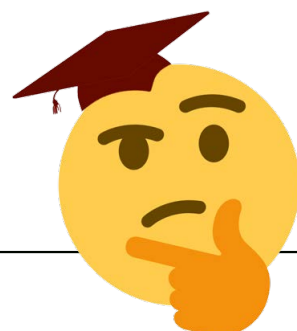
A scale model is made of the bell.

At its widest, the scale model has a circular cross section with a diameter 10 cm.

- (b) Work out the height of the scale model.

Give your answer in centimetres.

..... cm
(2)



5 - (4MA0-S 2017-Paper 3HR-Q19) - *MENSURATION*

The diagram shows two solid shapes, shape **A** and shape **B**.

Shape **A** is made of a hemisphere and a cone.

Shape **B** is a cylinder.

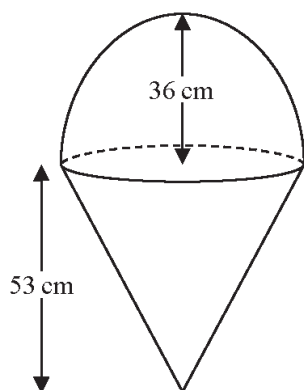
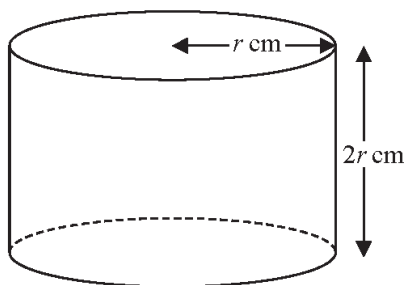
**A**

Diagram **NOT**
accurately drawn

**B**

For shape **A**

radius of the hemisphere is 36 cm

radius of the base of the cone is 36 cm

height of the cone is 53 cm

For shape **B**

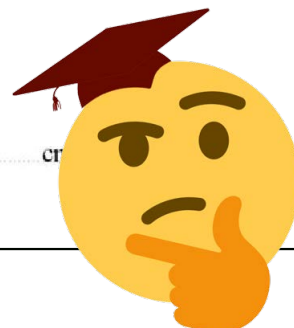
radius of the cylinder is r cm

height of the cylinder is $2r$ cm

The volume of shape **A** = the volume of shape **B**

Calculate the height of shape **B**.

6 marks)



6 - (4MA0-W 2017-Paper 3HR-Q10) - *MENSURATION*

Here is an isosceles triangle.

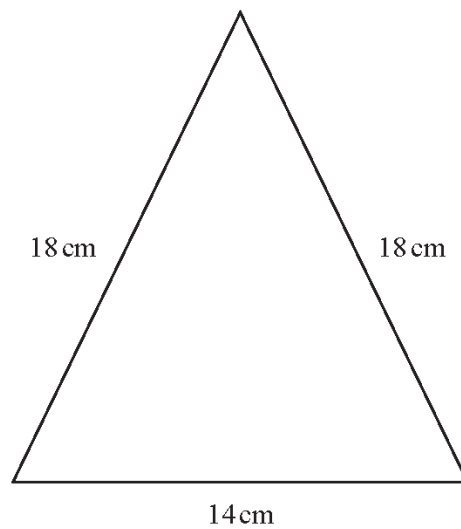
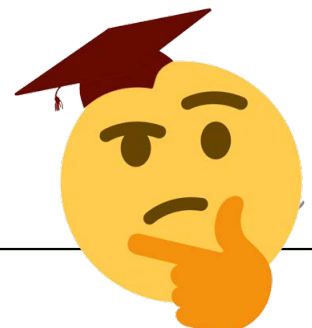


Diagram **NOT**
accurately drawn

Work out the area of the triangle.
Give your answer correct to 3 significant figures.

..... cm²

(Total for Question is 4 marks)



7 - (4MA0-S 2018-Paper 3HR-Q15) - MENSURATION

Cylinder **A** has height 12 cm and diameter 8 cm.

- (a) Work out the volume of cylinder **A**.
Give your answer correct to 3 significant figures.

..... cm³
(2)

Cylinder **B** is similar to cylinder **A**.

The height of cylinder **B** is 21 cm.

- (b) Work out the diameter of cylinder **B**.

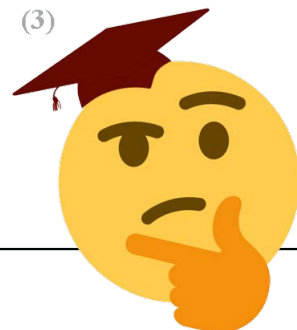
..... cm
(2)

Cylinder **C** is similar to cylinder **A**.

The volume of cylinder **C** is 64 times the volume of cylinder **A**.

- (c) Work out the height of cylinder **C**.

..... cm
(3)



8 - (4MA0-W 2018-Paper 3HR-Q5) - *MENSURATION*

Here is a trapezium and a square.

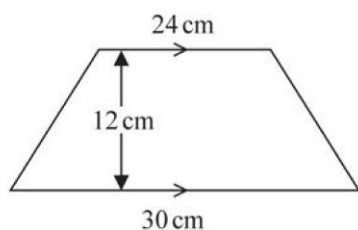


Diagram **NOT**
accurately drawn

The lengths of the parallel sides of the trapezium are 24 cm and 30 cm.

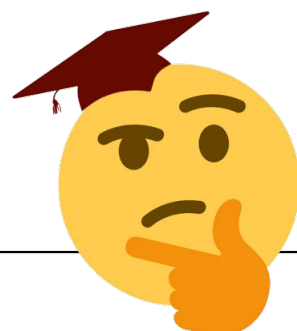
The height of the trapezium is 12 cm.

The area of the square is equal to the area of the trapezium.

Work out the perimeter of the square.

.....cm

(Total for Question is 4 marks)



9 - (4MA0-W 2018-Paper 3HR-Q6) - MENSURATION

Here is a field in the shape of a circle.

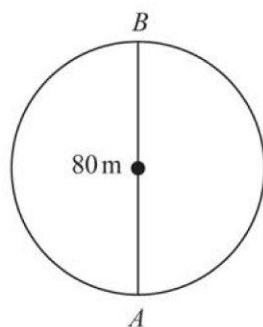


Diagram **NOT**
accurately drawn

The field is crossed by a path AB where AB is a diameter of the circle.
 $AB = 80$ metres.

Anil runs once around the circumference of the circle.

Sachin runs along the path from A to B and then runs back along the path to A .

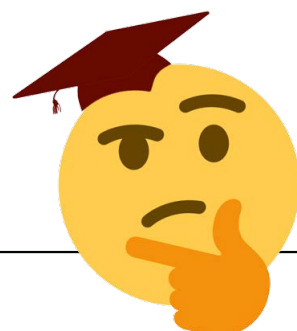
Anil runs further than Sachin.

How much further?

Give your answer in metres, correct to 1 decimal place.

.....m

(Total for Question is 3 marks)



10 - (4MA0-W 2018-Paper 3HR-Q22) - MENSURATION

Here is a solid shape made from a cone and a hemisphere.

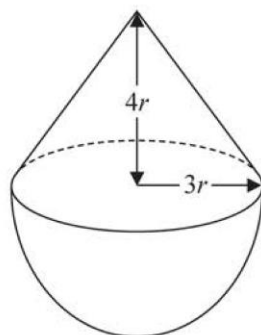


Diagram **NOT**
accurately drawn

The radius of the hemisphere is $3r$ cm.

The radius of the base of the cone is $3r$ cm.

The height of the cone is $4r$ cm.

The volume of the solid shape is $330\pi \text{ cm}^3$

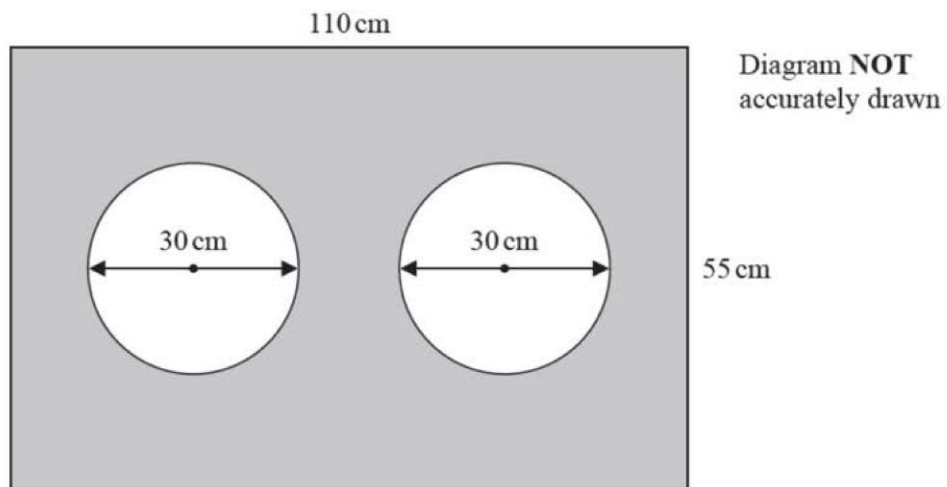
Find the value of r in the form $\sqrt[3]{n}$ where n is an integer.

(Total for Question ____ is 5 marks)

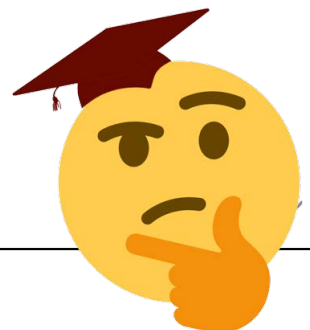


11 - (4MA0-W 2019-Paper 3HR-Q2) - MENSURATION

The diagram shows two circles, each of diameter 30 cm, inside a rectangle.



Work out the area of the shaded region.
Give your answer correct to 3 significant figures.



12 - (4MA0-W 2019-Paper 3HR-Q22) - MENSURATION

The diagram shows a sector OAC of a circle, centre O and radius 15 cm.

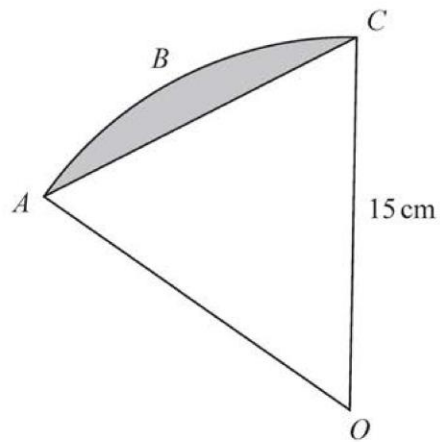
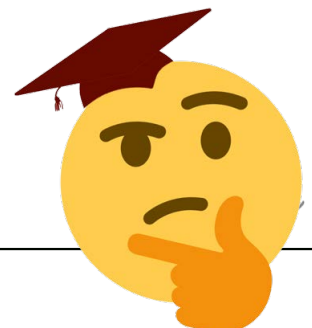


Diagram **NOT**
accurately drawn

The length of arc $ABC = 3\pi$ cm.

Work out the area of the shaded segment.
Give your answer correct to 1 decimal place.

cm²



1 - (4MA0-W 2015-Paper 3HR-Q6) - *GEOMETRY*

A is the point with coordinates $(4, 1)$

B is the point with coordinates $(1, 9)$

Find the coordinates of the midpoint of AB .

(.....,)

(Total for Question is 2 marks)



2 - (4MA0-W 2015-Paper 3HR-Q14) - *GEOMETRY*

The size of each interior angle of a regular polygon with n sides is 140°

Work out the size of each interior angle of a regular polygon with $2n$ sides.

○

(Total for Question is 5 marks)



3 - (4MA0-W 2015-Paper 3HR-Q19) - GEOMETRY

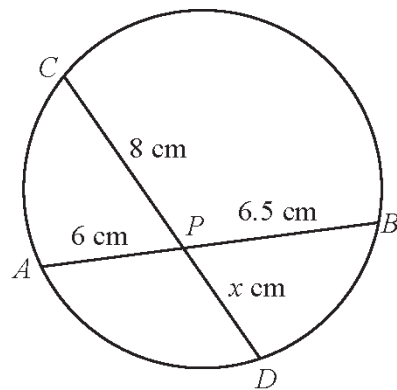


Diagram **NOT**
accurately drawn

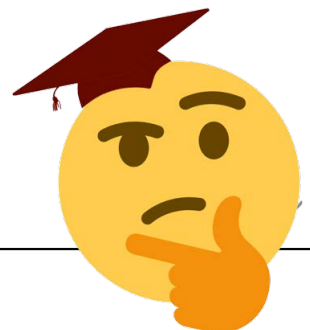
APB and CPD are chords of a circle.

$AP = 6 \text{ cm}$, $PB = 6.5 \text{ cm}$, $CP = 8 \text{ cm}$, $PD = x \text{ cm}$

Work out the value of x .

$x = \dots\dots\dots$

(Total for Question is 2 marks)



4 - (4MA0-S 2016-Paper 3HR-Q4) - *GEOMETRY*

Work out the size of an exterior angle of a regular polygon with 8 sides.

2 marks



5 - (4MA0-S 2016-Paper 3HR-Q11) - *GEOMETRY*

The line **L** passes through the point (3, 1) and is parallel to the line with equation $y = \frac{7}{2} - 2x$.

Find an equation for the line **L**.

.....
3 marks)



6 - (4MA0-S 2016-Paper 3HR-Q13) - GEOMETRY

Here is the quadrilateral $ABCD$.

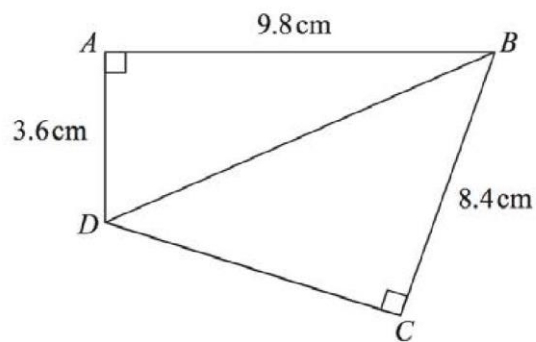


Diagram **NOT**
accurately drawn

Angle $BAD = 90^\circ$ and angle $BCD = 90^\circ$

$AB = 9.8\text{ cm}$

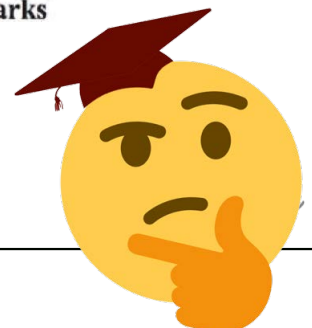
$AD = 3.6\text{ cm}$

$BC = 8.4\text{ cm}$

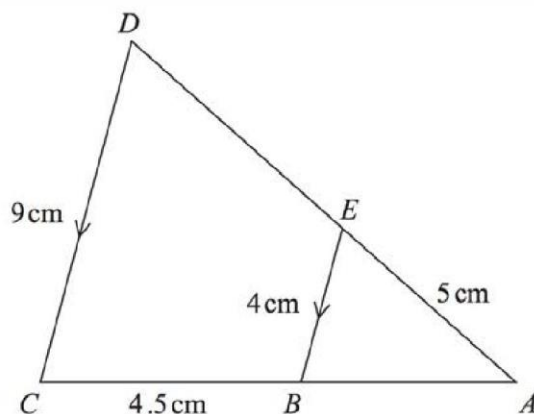
Calculate the length of DC .

..... cm

4 marks



7 - (4MA0-S 2016-Paper 3HR-Q17) - GEOMETRY

Diagram **NOT**
accurately drawn

Triangle ABE is similar to triangle ACD .
 AED and ABC are straight lines.
 EB and DC are parallel.
 $AE = 5\text{ cm}$, $BC = 4.5\text{ cm}$, $BE = 4\text{ cm}$, $CD = 9\text{ cm}$

(a) Calculate the length of AD .

..... cm
 (2)

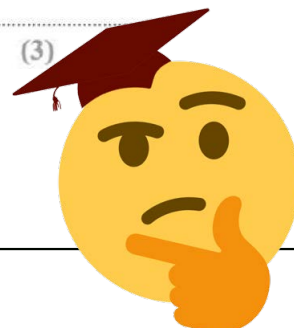
(b) Calculate the length of AB .

..... cm
 (2)

The area of quadrilateral $BCDE$ is $x\text{ cm}^2$
 The area of triangle ABE is $y\text{ cm}^2$

(c) Find an expression for y in terms of x .
 Give your answer as simply as possible.

$y =$
 (3)



8 - (4MA0-S 2016-Paper 3HR-Q19) - GEOMETRY

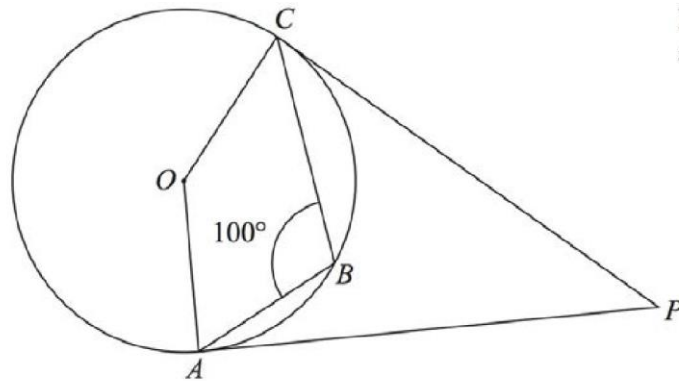
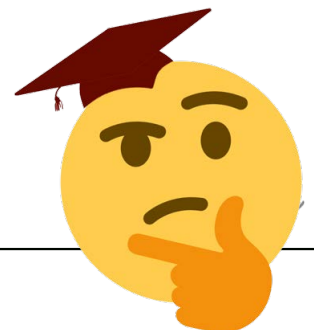


Diagram **NOT**
accurately drawn

A , B and C are points on a circle, centre O .
 PA and PC are tangents to the circle.
Angle $ABC = 100^\circ$

Calculate the size of angle APC .

.....
3 marks



9 - (4MA0-W 2016-Paper 3HR-Q5) - GEOMETRY

The diagram shows a circle with centre O and radius 6.5 cm

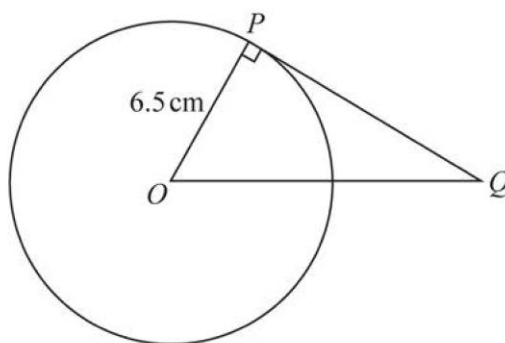


Diagram **NOT**
accurately drawn

- (a) Work out the area of the circle.
Give your answer correct to 3 significant figures.

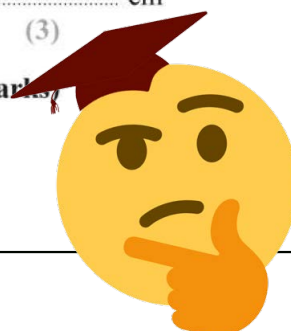
..... cm^2
(2)

PQ is the tangent to the circle at P
 $OQ = 10.5\text{ cm}$

- (b) Work out the length of PQ
Give your answer correct to 3 significant figures.

..... cm
(3)

(Total for Question is 5 marks)



10 - (4MA0-W 2016-Paper 3HR-Q10) - GEOMETRY

The diagram shows a circle with centre O .
The points A , B and C lie on the circle.

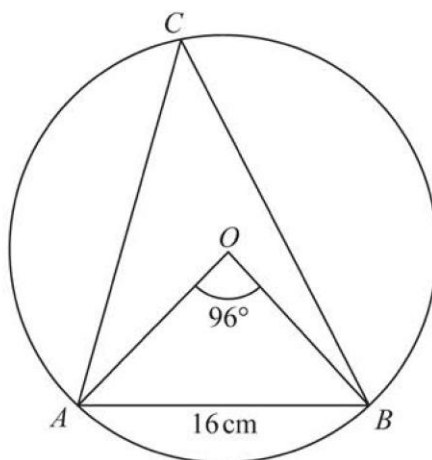


Diagram **NOT**
accurately drawn

Angle $AOB = 96^\circ$

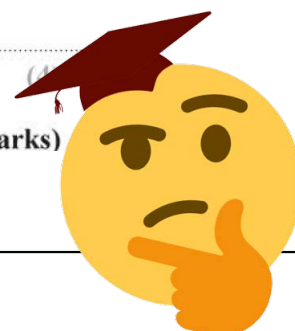
(a) Work out the size of angle ACB .

.....
(1)

$AB = 16\text{ cm}$

(b) Work out the radius of the circle.
Give your answer correct to 3 significant figures.

.....
(1)
(Total for Question is 5 marks)



11 - (4MA0-S 2017-Paper 3HR-Q3) - GEOMETRY

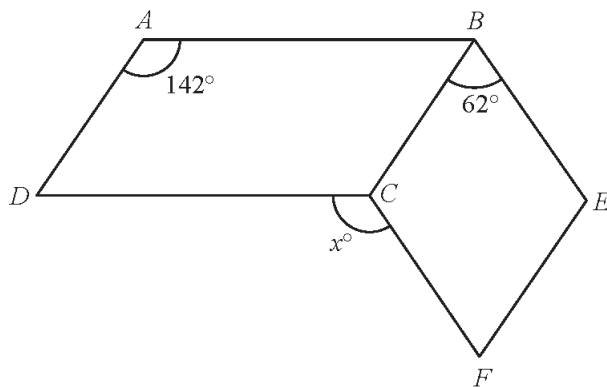


Diagram **NOT**
accurately drawn

$ABCD$ is a parallelogram.
 $BEFC$ is a rhombus.

Angle $DAB = 142^\circ$

Angle $CBE = 62^\circ$

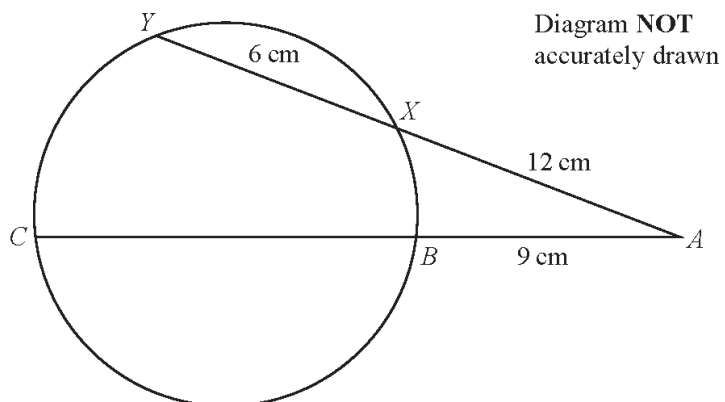
Calculate the value of x .

$x = \dots\dots\dots$

3 marks



12 - (4MA0-S 2017-Paper 3HR-Q17) - GEOMETRY



The points B , C , Y and X lie on a circle.
 AXY and ABC are straight lines.
 $AX = 12\text{ cm}$ $XY = 6\text{ cm}$ $AB = 9\text{ cm}$

Calculate the length of BC .

..... cm

3 marks)

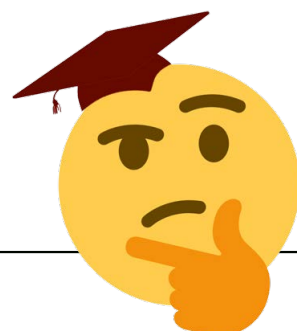


13 - (4MA0-W 2017-Paper 3HR-Q2) - *GEOMETRY*

Each exterior angle of a regular polygon is 18°

Work out the number of sides of this regular polygon.

.....
(Total for Question is 2 marks)



14 - (4MA0-W 2017-Paper 3HR-Q3) - *GEOMETRY*

A is the point with coordinates $(4, 11)$

B is the point with coordinates $(8, 3)$

Work out the coordinates of the midpoint of AB .

(..... ,)

(Total for Question is 2 marks)



15 - (4MA0-W 2017-Paper 3HR-Q15) - *GEOMETRY*

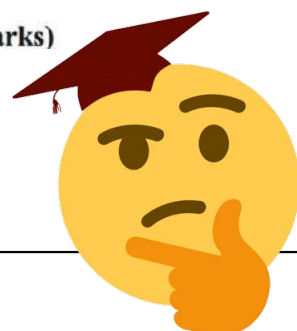
Line **A** has equation $3x - 4y = 5$

Line **B** goes through the points (4, 7) and (–1, 3)

Are lines **A** and **B** parallel?

Show your working clearly.

(Total for Question is 4 marks)



16 - (4MA0-W 2017-Paper 3HR-Q17) - GEOMETRY

P , R , Q and S are four points on a circle.

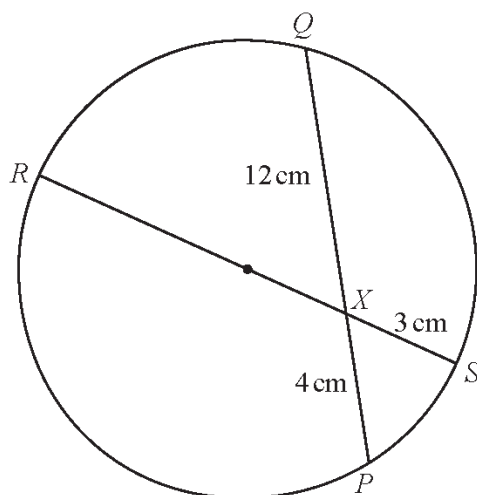


Diagram **NOT**
accurately drawn

RXS is a diameter of the circle.

PXQ is a chord of the circle.

$PX = 4\text{ cm}$, $QX = 12\text{ cm}$, $SX = 3\text{ cm}$.

Work out the radius of the circle.

..... cm

(Total for Question is 3 marks)

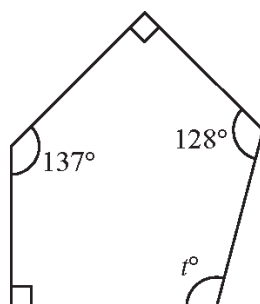


17 - (4MA0-S 2018-Paper 3HR-Q5) - *GEOMETRY*

The size of each exterior angle of a regular polygon is 24°

(a) Work out the number of sides of the polygon.

Here is a pentagon.

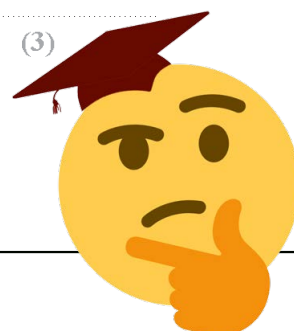


(b) Work out the value of t .

(2)

Diagram **NOT**
accurately drawn

(3)



18 - (4MA0-S 2018-Paper 3HR-Q10) - GEOMETRY

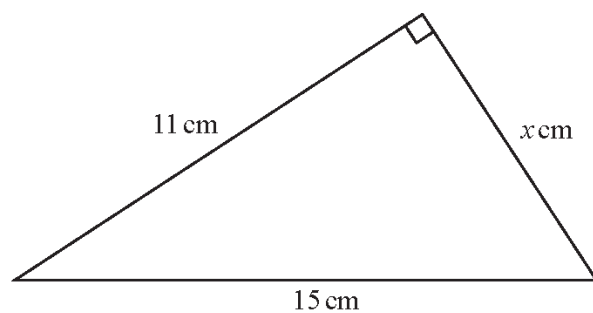


Diagram **NOT**
accurately drawn

Work out the value of x .
Give your answer correct to 3 significant figures.

.....
(Total for Question is 3 marks)



19 - (4MA0-S 2018-Paper 3HR-Q11) - *GEOMETRY*

The line **L** has equation $4x + 5y = 20$

(a) Work out the gradient of **L**.

.....
(2)

The line **M** has gradient 2
L and **M** both cross the y -axis at the same point.

(b) Find an equation for **M**.

.....
(2)



20 - (4MA0-S 2018-Paper 3HR-Q12) - GEOMETRY

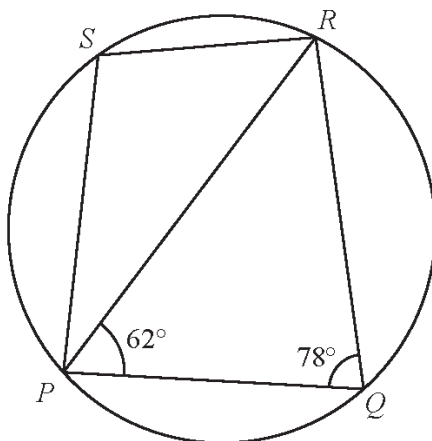


Diagram **NOT**
accurately drawn

P , Q , R and S are points on a circle.
Angle $RPQ = 62^\circ$ and angle $PQR = 78^\circ$

(a) (i) Find the size of angle PSR .

.....
.....

(ii) Give a reason for your answer.

.....

.....

(2)

(b) Work out the size of angle PSQ .

.....
.....

(2)



21 - (4MA0-W 2018-Paper 3HR-Q2) - GEOMETRY

$ABCD$ is a parallelogram.

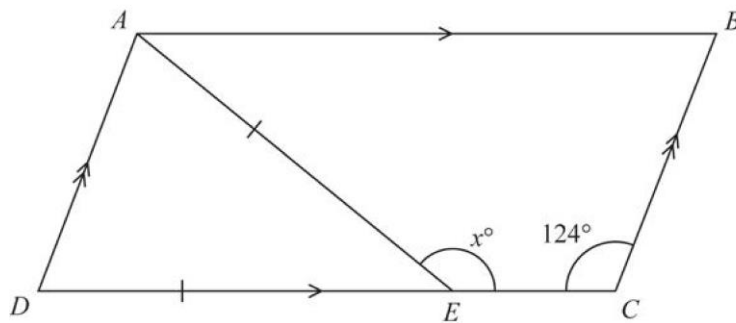


Diagram **NOT**
accurately drawn

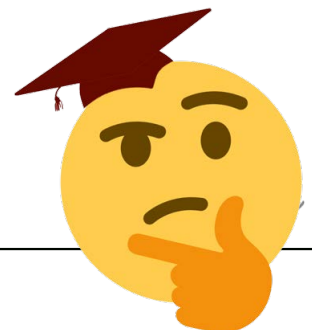
Angle $DCB = 124^\circ$

E is the point on DC such that $AE = DE$.

Angle $AEC = x^\circ$

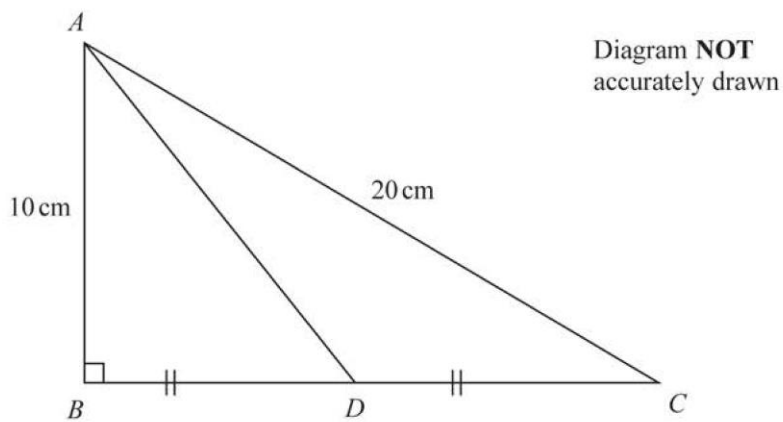
Work out the value of x .

(Total for Question is 4 marks)



22 - (4MA0-W 2018-Paper 3HR-Q11) - GEOMETRY

Here is a right-angled triangle ABC .



Angle $ABC = 90^\circ$

$AC = 20 \text{ cm}$

$AB = 10 \text{ cm}$

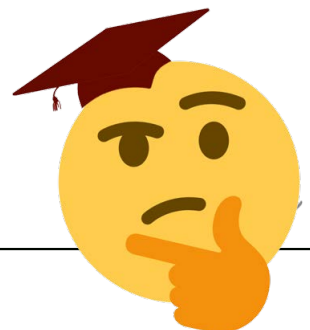
D is the midpoint of BC .

Work out the length of AD .

Give your answer correct to 1 decimal place.

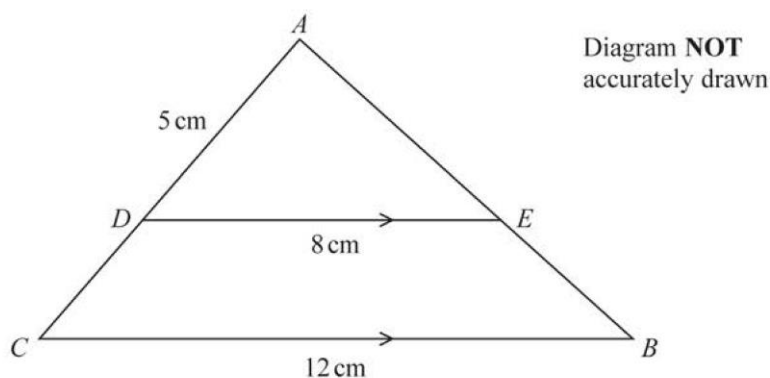
.....cm

(Total for Question is 4 marks)



23 - (4MA0-W 2018-Paper 3HR-Q12) - GEOMETRY

Here is a triangle ABC .



ADC and AEB are straight lines.
 DE is parallel to CB .

$AD = 5$ cm
 $DE = 8$ cm
 $CB = 12$ cm

(a) Work out the length of AC .

.....cm
(2)

$AB = 13.5$ cm

(b) Work out the length of EB .

.....cm
(2)

(Total for Question is 4 marks)



24 - (4MA0-W 2018-Paper 3HR-Q19) - GEOMETRY

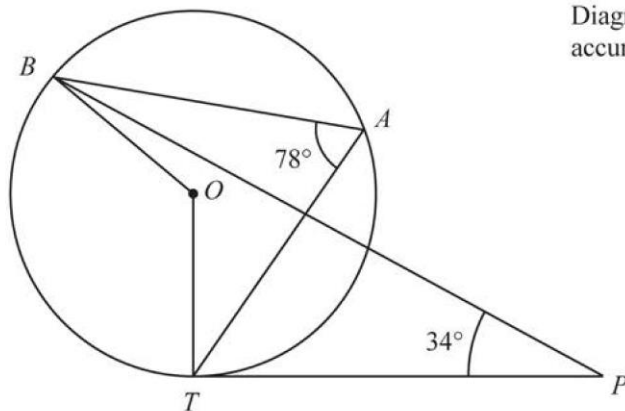


Diagram **NOT**
accurately drawn

A , B and T are points on a circle, centre O .

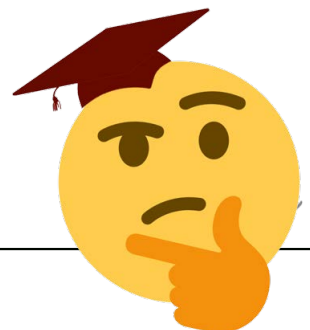
PT is the tangent at T to the circle.

Angle $TPB = 34^\circ$

Angle $TAB = 78^\circ$

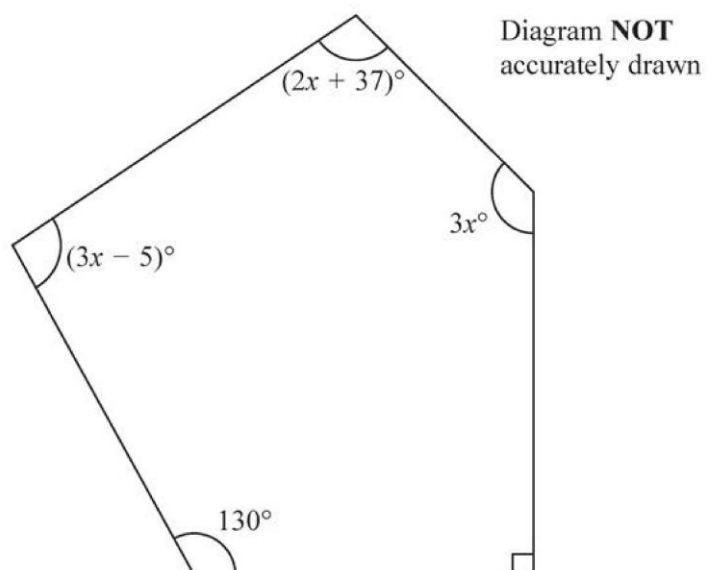
Work out the size of angle OBP .

(Total for Question is 4 marks)



25 - (4MA0-W 2019-Paper 3HR-Q7) - *GEOMETRY*

Here is a pentagon.



Work out the value of x .

$x =$



1 - (4MA0-W 2015-Paper 3HR-Q11) - *TRIGONOMETRY*

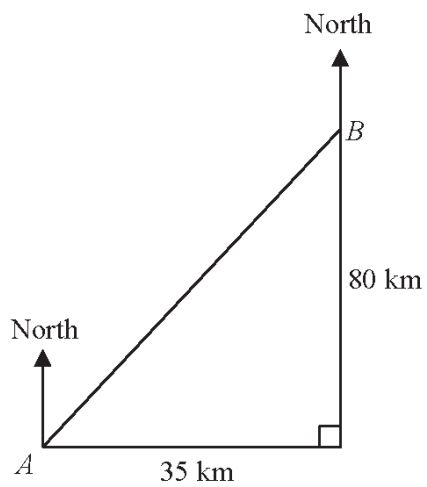


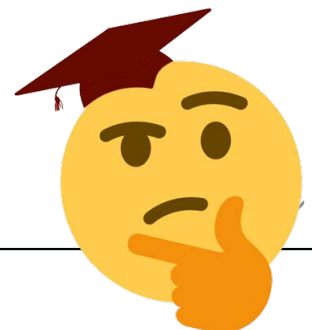
Diagram **NOT**
accurately drawn

Town B is 35 km east and 80 km north of town A .

Work out the bearing of A from B .

Give your answer correct to the nearest degree.

(Total for Question 1 is 4 marks)



2 - (4MA0-W 2015-Paper 3HR-Q23) - TRIGONOMETRY

Here is triangle LMN , where angle LMN is an obtuse angle.

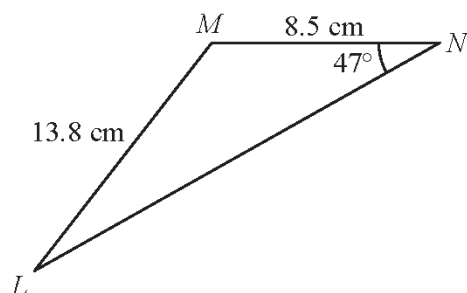


Diagram **NOT**
accurately drawn

$$ML = 13.8 \text{ cm}$$

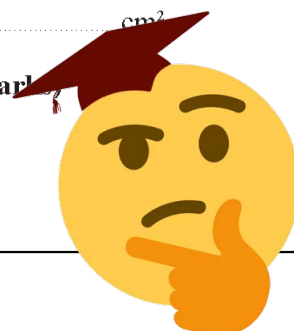
$$MN = 8.5 \text{ cm}$$

$$\text{Angle } MNL = 47^\circ$$

Work out the area of triangle LMN .

Give your answer correct to 3 significant figures.

(Total for Question is 6 marks)



3 - (4MA0-S 2016-Paper 3HR-Q22) - TRIGONOMETRY

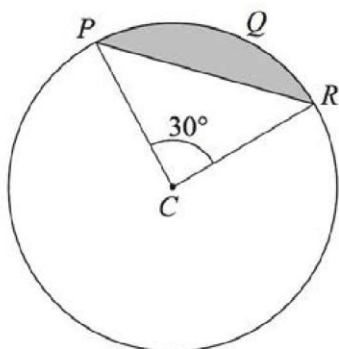


Diagram **NOT**
accurately drawn

The diagram shows a circle, centre C .

PR is a chord of the circle.

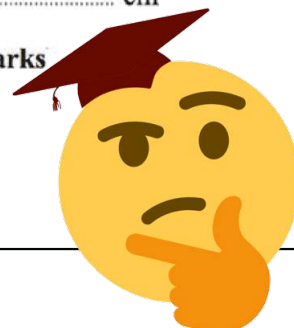
The area of the shaded region is 100 cm^2

Angle $PCR = 30^\circ$

Calculate the length of the arc PQR .

Give your answer correct to 3 significant figures.

..... cm
6 marks



4 - (4MA0-S 2017-Paper 3HR-Q14) - TRIGONOMETRY

$ABCDE$ is a regular pentagon with sides of length 10 cm.

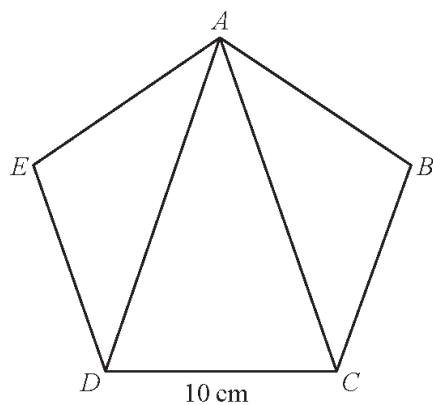


Diagram **NOT**
accurately drawn

Calculate the area of triangle ACD .
Give your answer correct to 3 significant figures.

.....cm²

6 marks)



5 - (4MA0-S 2017-Paper 3HR-Q21) - TRIGONOMETRY

Here is a shape $ABCDE$.

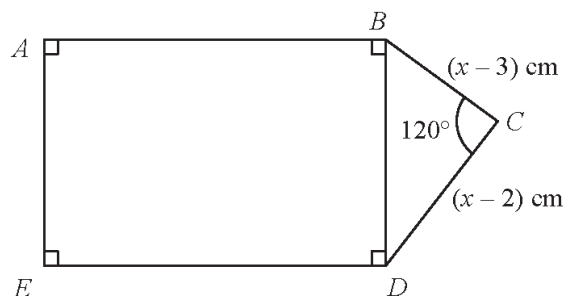


Diagram **NOT**
accurately drawn

$ABDE$ is a rectangle in which $AB = 2BD$

BCD is a triangle in which angle $BCD = 120^\circ$

$BC = (x - 3)$ cm $CD = (x - 2)$ cm

The area of the rectangle $ABDE$ is S cm²

Show that S can be expressed in the form $S = ax^2 + bx + c$
where a , b and c are integers to be found.

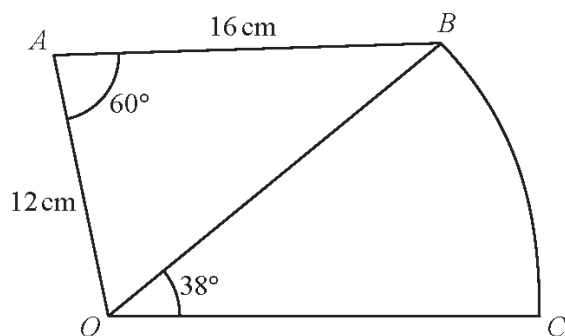
$S = \dots\dots\dots$

5 marks)



6 - (4MA0-W 2017-Paper 3HR-Q21) - TRIGONOMETRY

The shape $OABC$ is made from a triangle and a sector of a circle.



OAB is a triangle.

OBC is a sector of a circle, centre O .

$OA = 12 \text{ cm}$

$AB = 16 \text{ cm}$

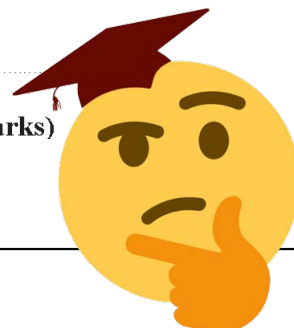
Angle $OAB = 60^\circ$

Angle $BOC = 38^\circ$

Work out the area of $OABC$.

Give your answer correct to 3 significant figures.

(Total for Question 6 is 5 marks)



7 - (4MA0-S 2018-Paper 3HR-Q21) - TRIGONOMETRY

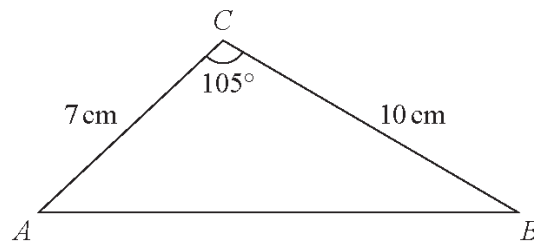
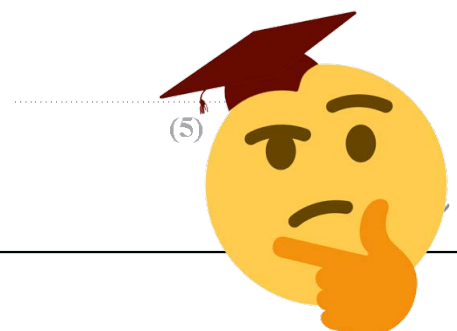


Diagram **NOT**
accurately drawn

- (a) Work out the area of triangle ABC .
Give your answer correct to 3 significant figures.

..... cm^2
(2)

- (b) Work out the size of angle BAC .
Give your answer correct to 1 decimal place.



8 - (4MA0-W 2019-Paper 3HR-Q19) - TRIGONOMETRY

The diagram shows a rectangular based pyramid.

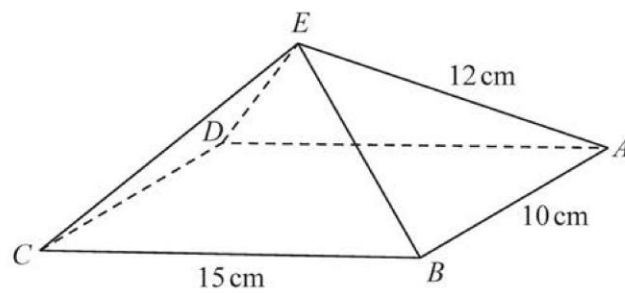
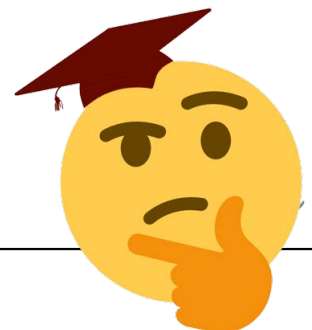


Diagram **NOT**
accurately drawn

$$AE = BE = CE = DE = 12 \text{ cm}$$
$$AB = 10 \text{ cm and } CB = 15 \text{ cm}$$

Calculate the size of angle CEA .
Give your answer correct to 1 decimal place.



1 - (4MA0-W 2016-Paper 3HR-Q17) - SETS

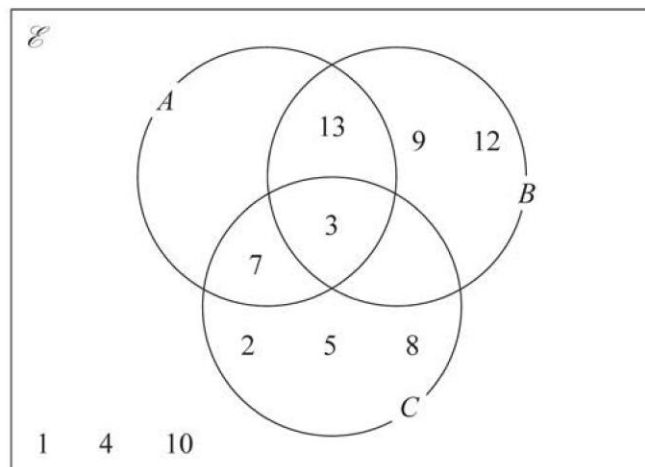
$$\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13\}$$

$$A = \{3, 7, 11, 13\}$$

$$B = \{3, 6, 9, 12, 13\}$$

$$C = \{2, 3, 5, 6, 7, 8\}$$

(a) Complete the Venn diagram.



(1)

(b) List the members of the set $B' \cap C$

.....
(1)

(c) List the members of the set $(A \cup C)' \cap B$

.....
(1)

(d) Find $n(A' \cap B')$

.....
(1)

(Total for Question is 4 marks)



2 - (4MA0-S 2018-Paper 3HR-Q6) - SETS

$\mathcal{E} = \{\text{fish in Jake's lake}\}$

$A = \{\text{fish of length greater than 20 cm}\}$

$B = \{\text{fish that weigh more than 1 kg}\}$

$C = \{\text{fish less than 1 year old}\}$

A fish in Jake's lake is caught.

The fish is 2 years old, weighs 1.2kg and is 19 cm in length.

(a) Write down the set, A or B or C , of which this fish is a member.

.....
(1)

(b) Describe in words fish that are members of the set $A \cup B$

.....
.....
(2)

$B \cap C = \emptyset$

(c) Explain what this statement tells us about the fish in Jake's lake.

.....
.....
(1)



3 - (4MA0-W 2018-Paper 3HR-Q10) - SETS

$$\mathcal{E} = \{2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13\}$$

$$A = \{2, 4, 6, 8, 10, 12\}$$

$$B = \{3, 6, 9, 12\}$$

(a) List the members of the set $A \cup B$

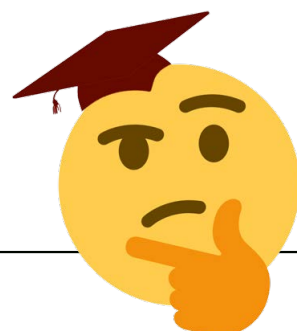
.....
(1)

C is a set with 4 members.

$$A \cap C = \emptyset \text{ and } B \cap C = \emptyset$$

(b) List the members of set C

.....
(2)



1 - (4MA0-W 2015-Paper 3HR-Q3) - STATISTICS

The table shows information about the numbers of goals scored by some football teams last week.

Number of goals	Number of teams
0	5
1	8
2	2
3	3
4	2

Work out the total number of goals scored by these football teams last week.

.....
(Total for Question is 2 marks)



2 - (4MA0-W 2015-Paper 3HR-Q12) - STATISTICS

Here are the marks scored in a test by the girls in class 8C.

2 8 10 12 15 16 16 17 18 19 20

(a) Work out the interquartile range of the girls' marks.

.....
(2)

The boys in class 8C did the same test.

The boys' marks had a range of 19 and an interquartile range of 11 marks.

Gareth says that the girls' marks are more spread out than the boys' marks.

(b) Is Gareth right?

Tick (✓) the appropriate box.

Yes

☐

No

☐

Give a reason for your answer.

.....
(1)

(Total for Question is 3 marks)



3 - (4MA0-W 2015-Paper 3HR-Q16) - STATISTICS

The table shows information about the lengths of time that 120 people spent in a supermarket.

Time (t minutes)	Frequency
$0 < t \leq 10$	8
$10 < t \leq 20$	17
$20 < t \leq 30$	25
$30 < t \leq 40$	40
$40 < t \leq 50$	22
$50 < t \leq 60$	8

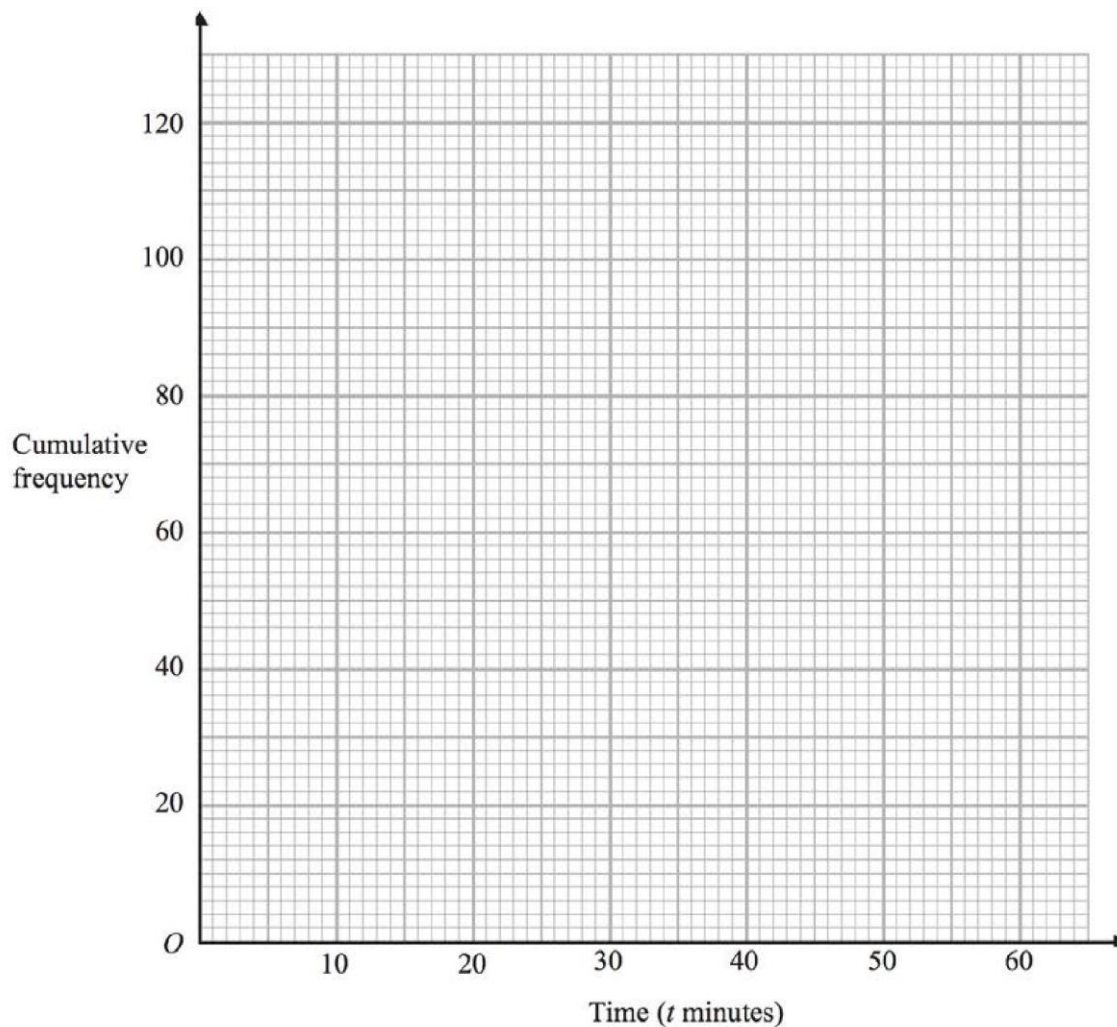
(a) Complete the cumulative frequency table.

Time (t minutes)	Cumulative frequency
$0 < t \leq 10$	
$0 < t \leq 20$	
$0 < t \leq 30$	
$0 < t \leq 40$	
$0 < t \leq 50$	
$0 < t \leq 60$	

(1)



(b) On the grid, draw a cumulative frequency graph for your table.



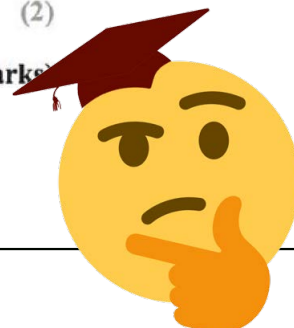
(2)

(c) Use your graph to find an estimate for the median length of time spent in the supermarket by these people.

..... minutes

(2)

(Total for Question is 5 marks)



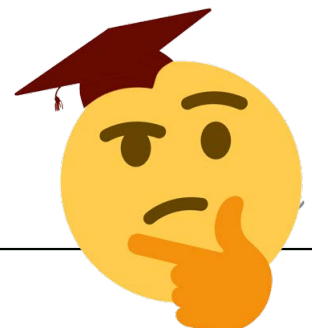
4 - (4MA0-S 2016-Paper 3HR-Q10) - STATISTICS

Julie asked 50 children how many exercise sessions they each took part in last month.
The table shows information about her results.

Number of exercise sessions	Frequency
0 to 6	13
7 to 13	10
14 to 20	16
21 to 27	7
28 to 34	4

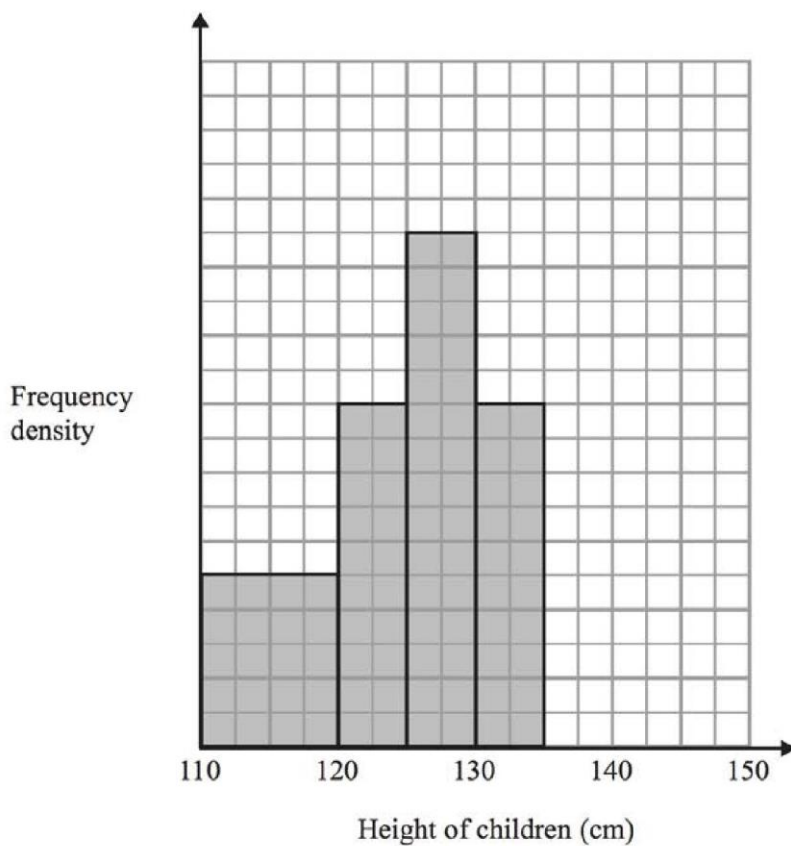
Calculate an estimate for the total number of exercise sessions the children took part in last month.

.....
3 marks)



5 - (4MA0-S 2016-Paper 3HR-Q16) - STATISTICS

The incomplete histogram shows information about the heights of a group of children.



There were 10 children with heights between 130 cm and 135 cm.

(a) How many children had heights between 110 cm and 130 cm?

(3)

There were 6 children with heights between 135 cm and 145 cm.

(b) Show this information on the histogram.

(1)



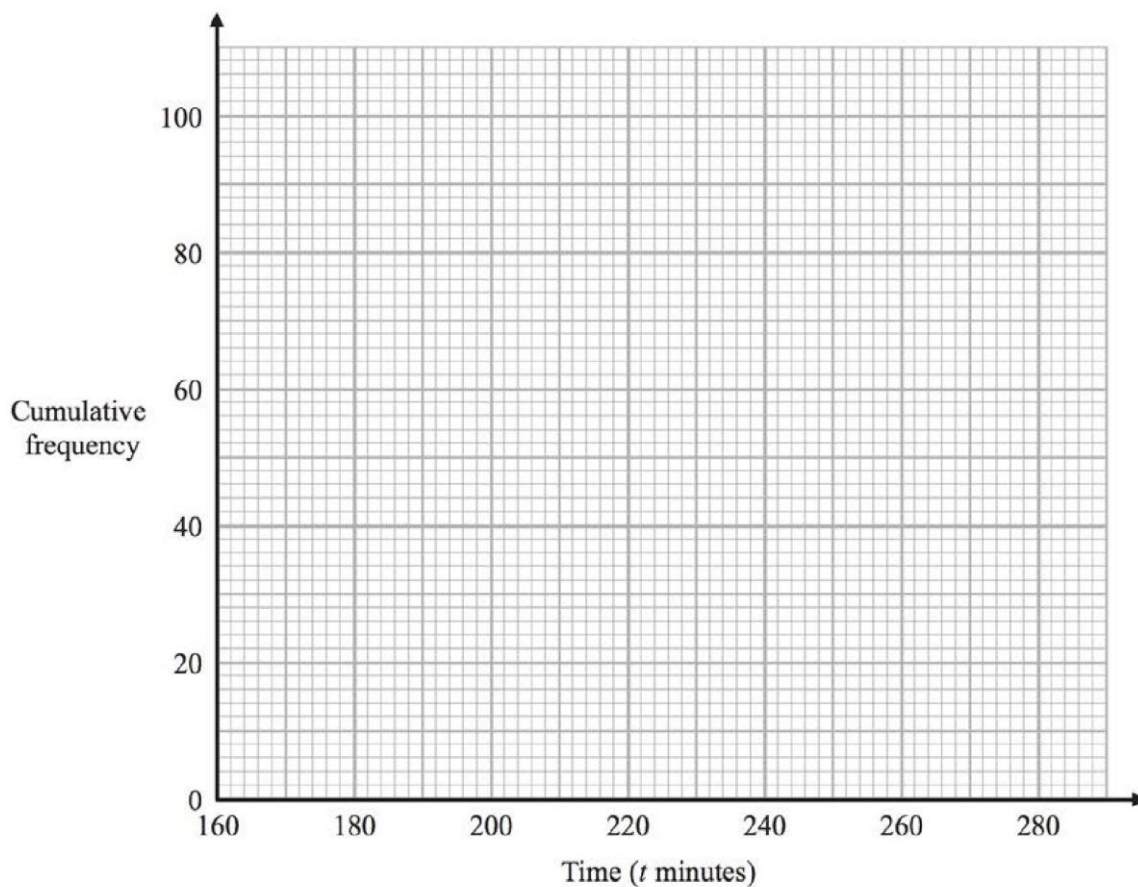
6 - (4MA0-W 2016-Paper 3HR-Q14) - STATISTICS

The cumulative frequency table shows information about the times taken by 92 runners to complete a marathon.

Time (t minutes)	Cumulative frequency
$160 < t \leq 180$	9
$160 < t \leq 200$	35
$160 < t \leq 220$	68
$160 < t \leq 240$	80
$160 < t \leq 260$	89
$160 < t \leq 280$	92



(a) On the grid, draw a cumulative frequency graph for the information in the table.



(2)

(b) Use the graph to find an estimate for the number of runners who took more than 230 minutes to complete the marathon.

(2)

(Total for Question is 4 marks)



7 - (4MA0-S 2017-Paper 3HR-Q6) - *STATISTICS*

Ahmed, Beth and Cleo are three friends.

The mean age, in years, of Ahmed, Beth and Cleo is 21

The mean age, in years, of Ahmed and Beth is 19

(a) Work out Cleo's age.

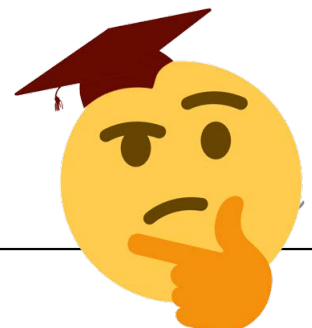
..... years
(3)

Ahmed is the youngest of the three friends.

The median age, in years, of the three friends is 20

(b) Find the range of their ages.

..... years
(3)



8 - (4MA0-S 2017-Paper 3HR-Q12) - STATISTICS

The table gives information about the number of males in each age group in a survey of 100 males working in Singapore in 2014.

Age (A years)	Frequency
$15 \leq A < 20$	2
$20 \leq A < 25$	7
$25 \leq A < 30$	9
$30 \leq A < 35$	10
$35 \leq A < 40$	11
$40 \leq A < 45$	12
$45 \leq A < 50$	12
$50 \leq A < 55$	12
$55 \leq A < 60$	11
$60 \leq A < 65$	14

(a) Complete the cumulative frequency table.

Age (A years)	Cumulative frequency
$15 \leq A < 20$	
$15 \leq A < 25$	
$15 \leq A < 30$	
$15 \leq A < 35$	
$15 \leq A < 40$	
$15 \leq A < 45$	
$15 \leq A < 50$	
$15 \leq A < 55$	
$15 \leq A < 60$	
$15 \leq A < 65$	

(1)

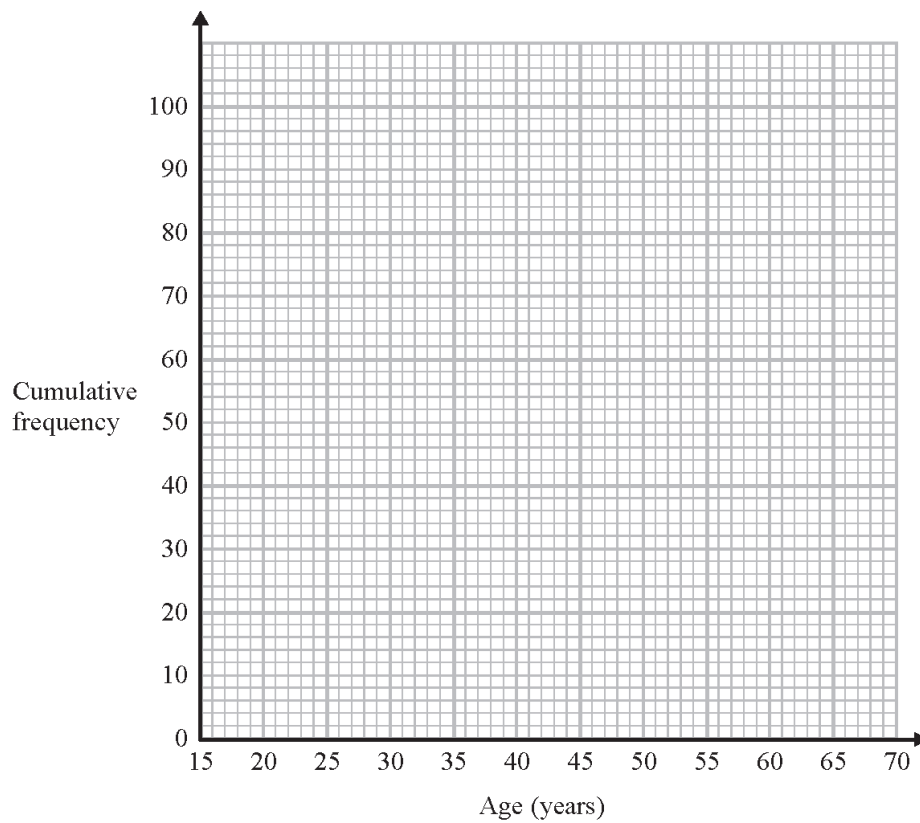
(b) On the grid, draw a cumulative frequency graph for your table.

(2)

(c) Use your graph to find an estimate for the lower quartile.

..... years
(2)



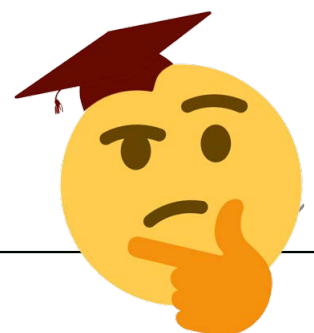


The total number of males aged under 65 working in Singapore in 2014 was 1 200 000

Using this information and your graph,

- (d) work out an estimate for the number of males working in Singapore in 2014 who were less than 52 years old.

(3)



9 - (4MA0-W 2017-Paper 3HR-Q9) - STATISTICS

The table gives information about the weights of 20 rugby players.

Weight (w kg)	Frequency
$80 < w \leq 90$	3
$90 < w \leq 100$	5
$100 < w \leq 110$	7
$110 < w \leq 120$	4
$120 < w \leq 130$	1

(a) Write down the modal class.

.....
(1)

(b) Work out an estimate for the total weight of these 20 rugby players.

..... kg
(3)

(Total for Question is 4 marks)



10 - (4MA0-W 2017-Paper 3HR-Q12) - STATISTICS

The cumulative frequency table shows information about the times, in minutes, 80 people waited at an airport.

Time (t minutes)	Cumulative frequency
$0 < t \leq 20$	5
$0 < t \leq 40$	18
$0 < t \leq 60$	42
$0 < t \leq 80$	66
$0 < t \leq 100$	78
$0 < t \leq 120$	80

(a) On the grid opposite, draw a cumulative frequency graph for the table.

(2)

(b) Use your graph to find an estimate for the median time.

..... minutes

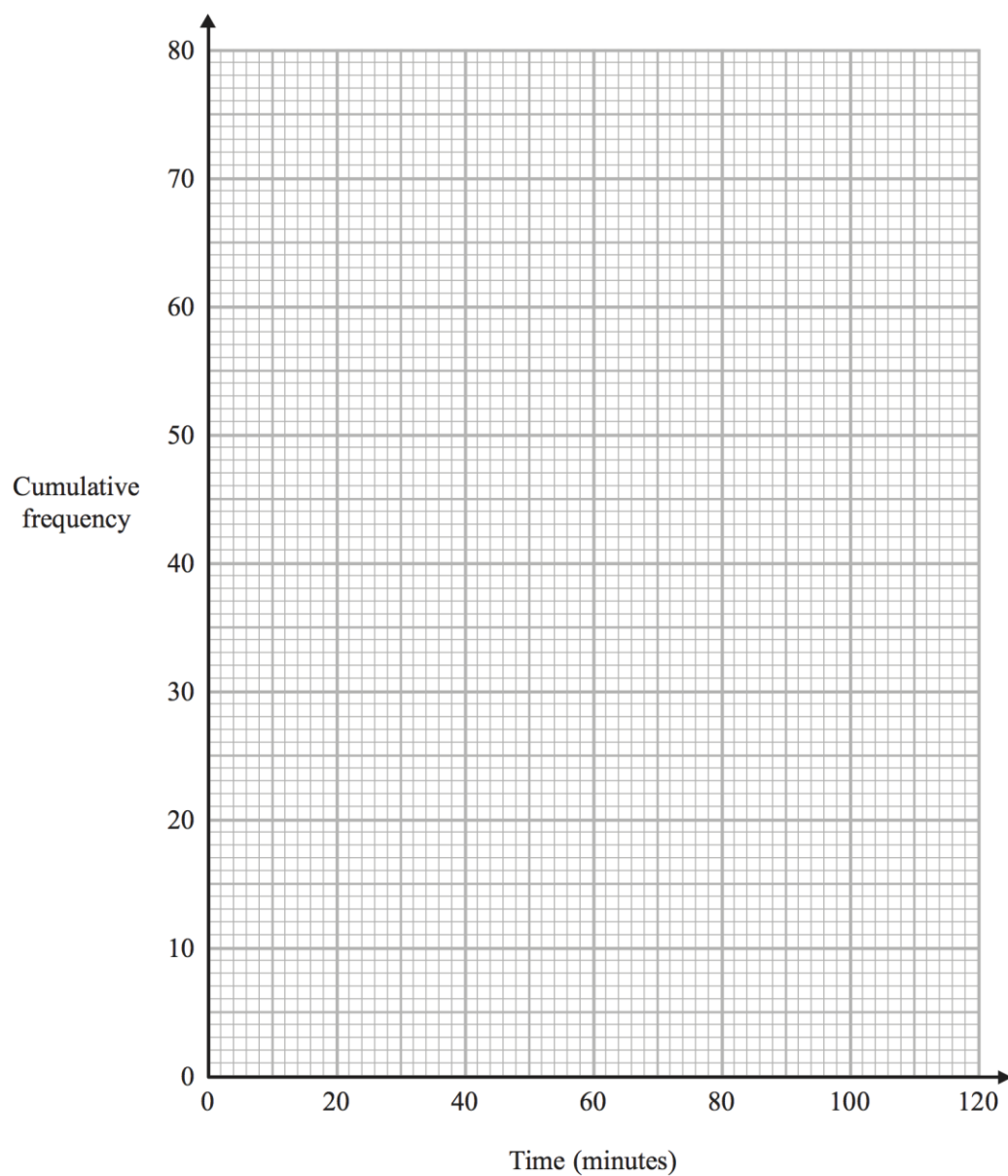
(2)

(c) Use your graph to find an estimate for the number of these people who waited more than $1\frac{1}{2}$ hours at the airport.

.....

(2)





(Total for Question is 6 marks)



11 - (4MA0-S 2018-Paper 3HR-Q8) - *STATISTICS*

Marta breeds dogs.

32 dogs give birth to puppies.

The table shows information about the number of puppies born to each dog.

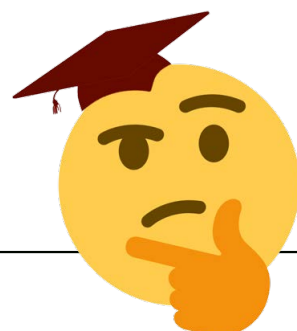
Number of puppies	Frequency
1 – 3	5
4 – 6	12
7 – 9	10
10 – 12	4
13 – 15	1

(a) Write down the modal class.

.....
(1)

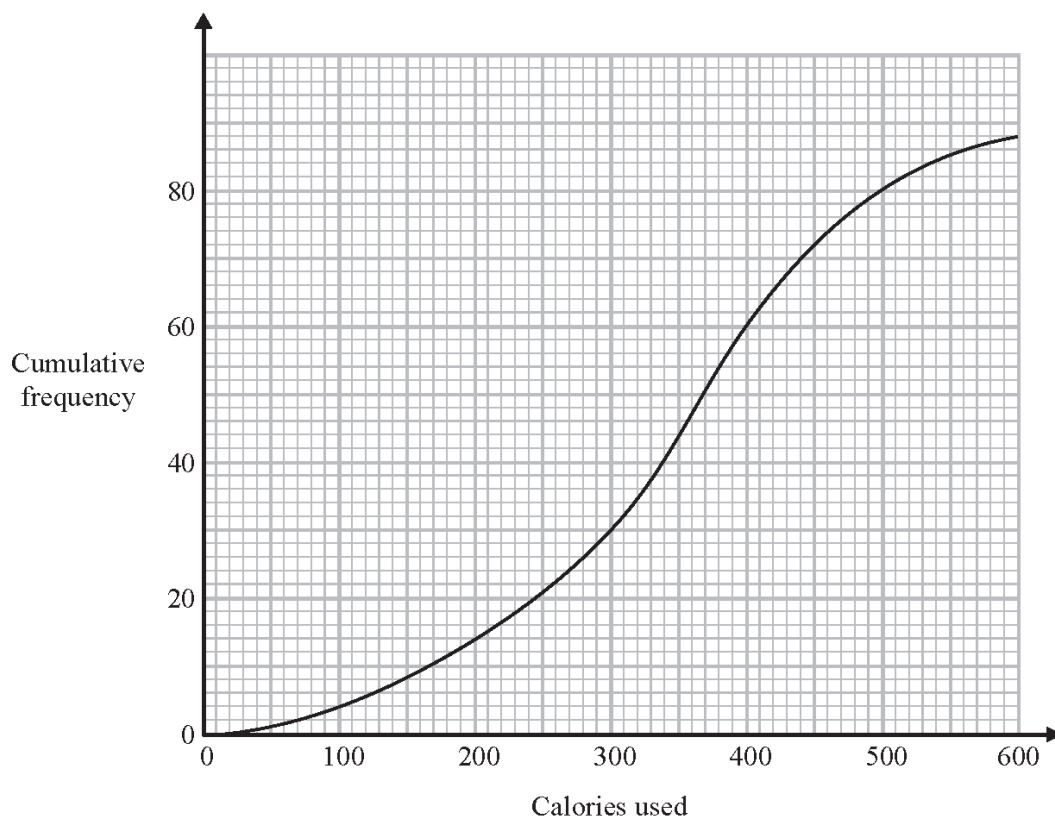
(b) Work out an estimate for the mean number of puppies born to each dog.

.....
(4)



12 - (4MA0-S 2018-Paper 3HR-Q13) - STATISTICS

The cumulative frequency graph shows information about the number of calories used by 88 people during their exercise programme at a sports centre.



- (a) Use the graph to find an estimate for the median number of calories used.

..... calories
(2)

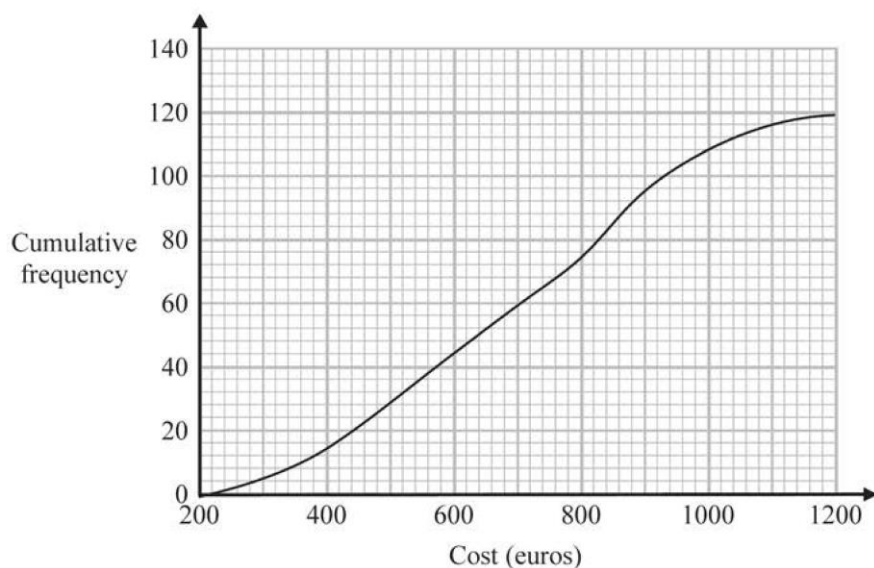
- (b) Use the graph to find an estimate for the number of these 88 people who used more than 500 calories.

.....
(2)



13 - (4MA0-W 2018-Paper 3HR-Q16) - STATISTICS

The cumulative frequency graph gives information about the costs, in euros, of 120 holidays in Cyprus.



(a) Find an estimate for the median cost.

.....euros
(1)

(b) Find an estimate for the interquartile range of the costs.

.....euros
(2)

15% of these holidays had a cost greater than N euros.

(c) Use the graph to find an estimate for the value of N .

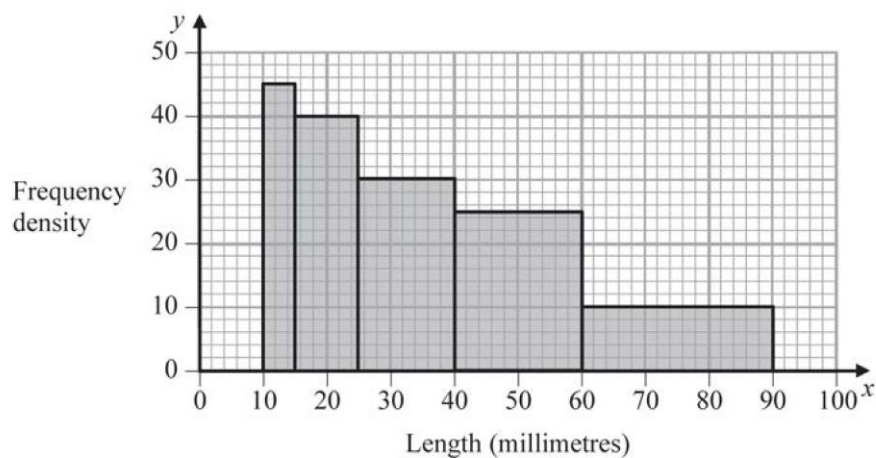
.....
(3)

(Total for Question is 6 marks)



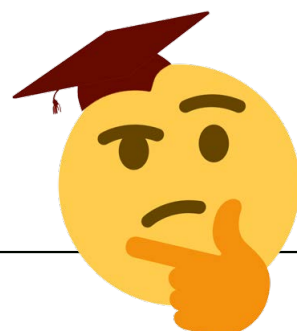
14 - (4MA0-W 2018-Paper 3HR-Q20) - STATISTICS

The histogram gives information about the lengths, in millimetres, of 1875 snails.



Calculate an estimate for the proportion of the snails more than 55 millimetres in length.

(Total for Question 14 is 3 marks)



15 - (4MA0-W 2019-Paper 3HR-Q13) - STATISTICS

The table shows information about the marks gained by 200 students in a music examination.

Mark (m)	Frequency
$0 < m \leq 20$	15
$20 < m \leq 40$	25
$40 < m \leq 60$	80
$60 < m \leq 80$	50
$80 < m \leq 100$	20
$100 < m \leq 120$	10

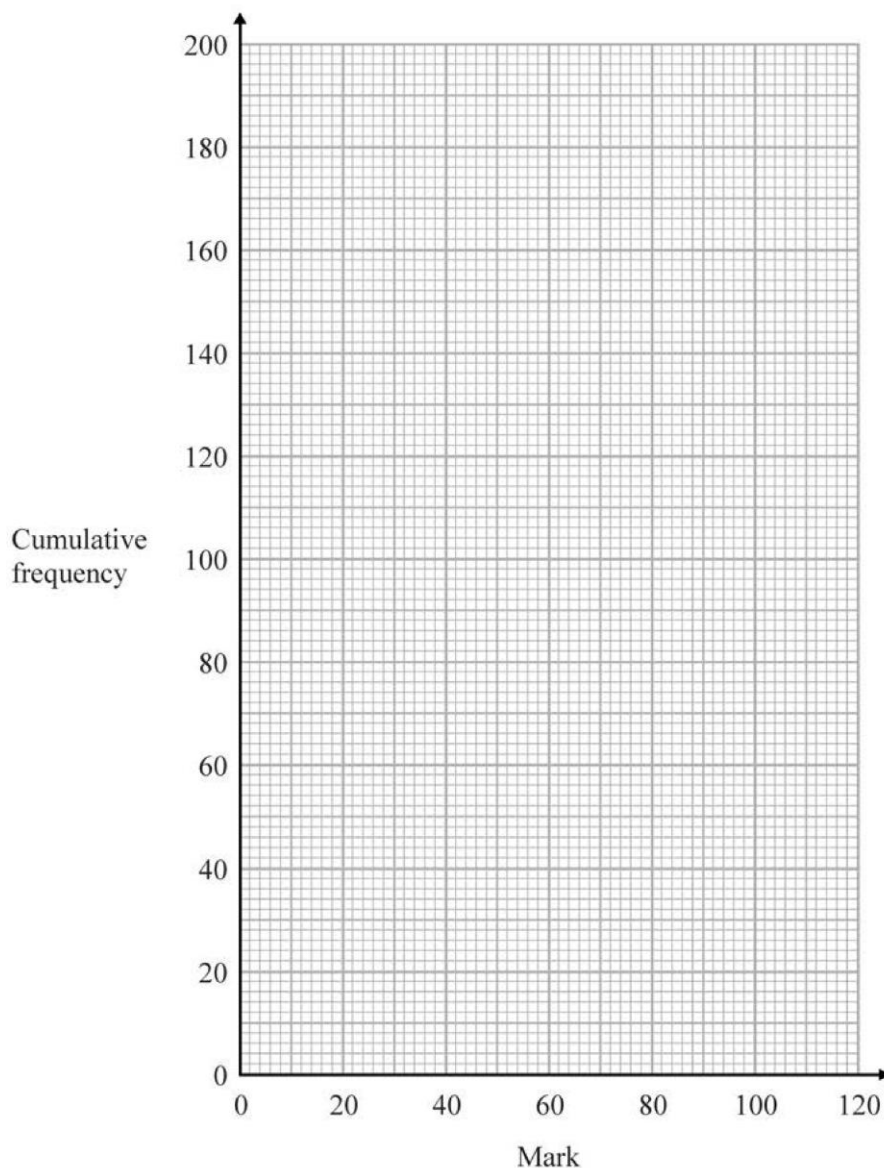
(a) Complete the cumulative frequency table.

Mark (m)	Cumulative frequency
$0 < m \leq 20$	
$0 < m \leq 40$	
$0 < m \leq 60$	
$0 < m \leq 80$	
$0 < m \leq 100$	
$0 < m \leq 120$	

(1)



(b) On the grid, draw a cumulative frequency graph for your table.



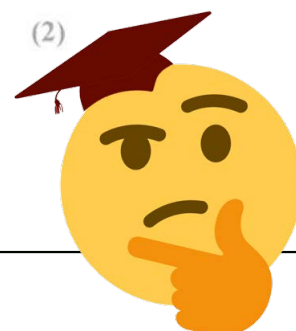
(2)

(c) Use your graph to find an estimate for the median mark.

(1)

(d) Use your graph to find an estimate for the number of students who gained more than 75 marks.

(2)



1 - (4MA0-W 2015-Paper 3HR-Q22) - *PROBABILITY*

Here are 7 cards.

Each card has a number on it.



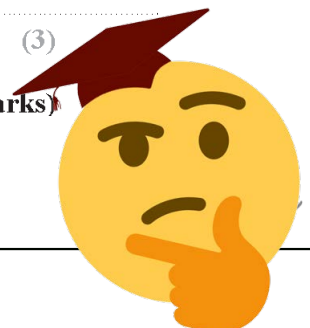
Harry takes at random two cards.

(a) Calculate the probability that the numbers on the two cards are the same.

.....
(3)

(b) Calculate the probability that the sum of the numbers on the two cards is 5

.....
(3)
(Total for Question is 6 marks)



2 - (4MA0-S 2016-Paper 3HR-Q3) - *PROBABILITY*

There are 50 marbles in a bag.
35 of the marbles are brown.

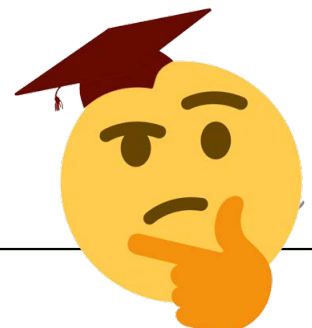
Otti takes at random a marble from the bag.
He records the colour of the marble and puts the marble back in the bag.

He does this 300 times.

Work out an estimate for the number of brown marbles he takes.

.....

2 marks



3 - (4MA0-S 2016-Paper 3HR-Q9) - PROBABILITY

Li throws a 6-sided biased dice once.

The table shows the probability that the dice will land on 1, 2, 3, 5 or 6

Number	1	2	3	4	5	6
Probability	0.15	0.1	0.05		0.2	0.15

(a) Work out the probability that the dice will land on 4

.....
(2)

(b) Work out the probability that the dice will land on an odd number.

.....
(2)

4 marks



4 - (4MA0-S 2016-Paper 3HR-Q14) - PROBABILITY

Linford and Alan race against each other in a competition.

If one of them wins a race, he wins the competition.

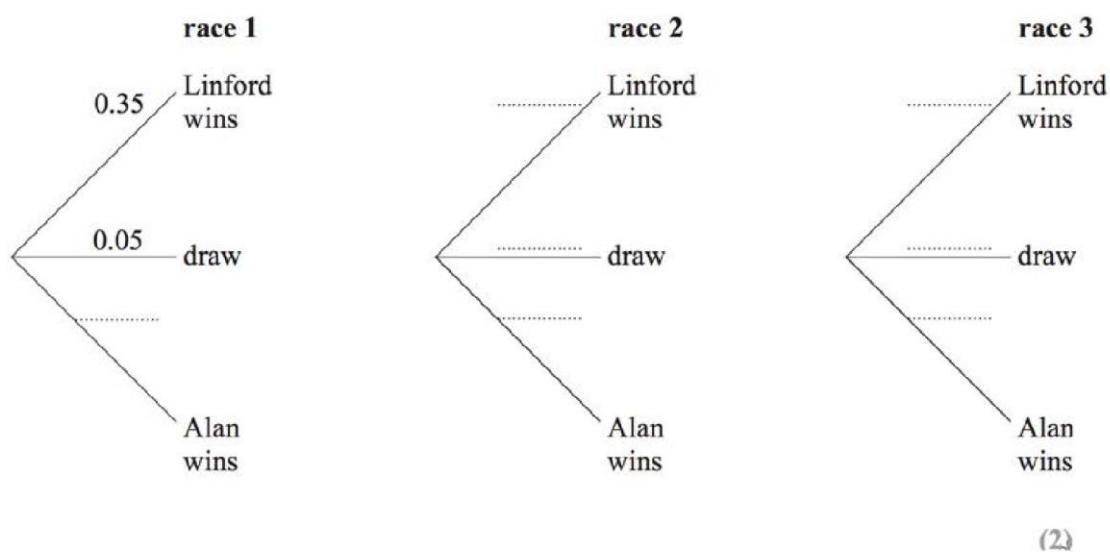
If the race is a draw, they run another race.

They run a maximum of three races.

Each time they race, the probability that Linford wins is 0.35

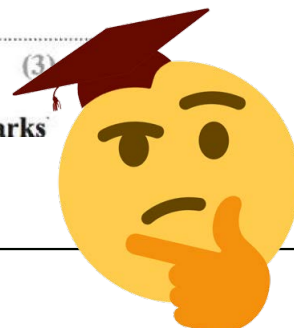
Each time they race, the probability that there is a draw is 0.05

(a) Complete the probability tree diagram.



(b) Calculate the probability that Linford wins the competition.

5 marks



5 - (4MA0-W 2016-Paper 3HR-Q4) - *PROBABILITY*

Maisie plays a game.

Each time she plays, she can win a prize of \$1 or \$5 or \$10

When she does not win one of these prizes, she loses.

The table gives the probability of winning each of the prizes.

Prize	Probability
\$1	0.50
\$5	0.15
\$10	0.05

Maisie plays the game once.

(a) Work out the probability that Maisie loses.

.....
(2)

(b) Maisie plays the game 40 times.

(i) Work out an estimate for the number of \$5 prizes she wins.

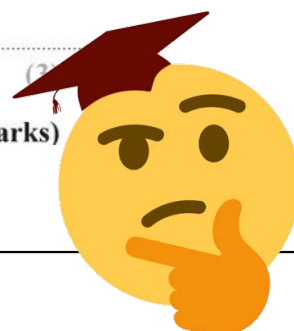
.....
(2)

(ii) Work out an estimate for the total value of the prizes she wins.

\$.....

(2)

(Total for Question 5 is 7 marks)



6 - (4MA0-W 2016-Paper 3HR-Q18) - *PROBABILITY*

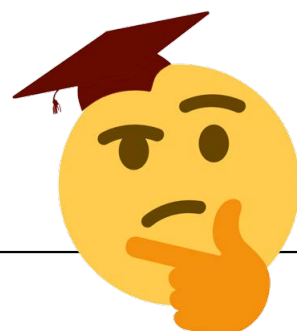
There are 100 tiles in a bag.
Each tile is marked with a number.
The table shows information about the tiles.

Number on tile	Frequency
0	2
1	68
2	7
3	13
4	10

Carmen takes at random a tile from the bag.
She records the number on the tile and then replaces the tile in the bag.
Pablo takes at random a tile from the bag.

- (a) Work out the probability that Carmen takes a tile with the number 0 or the number 1 and Pablo takes a tile with a number greater than 1

.....
(2)



All 100 tiles are in the bag.

Juan takes at random a tile from the bag without replacing it.

He then takes a second tile from the bag.

(b) (i) Work out the probability that the number on each tile is 4

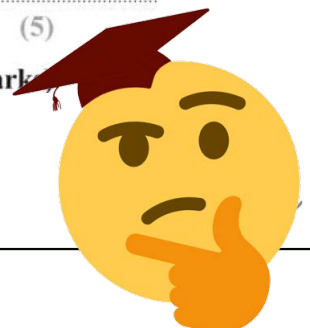
.....

(ii) Work out the probability that the total of the numbers on the two tiles is 2

.....

(5)

(Total for Question ... is 7 marks)



7 - (4MA0-S 2017-Paper 3HR-Q11) - PROBABILITY

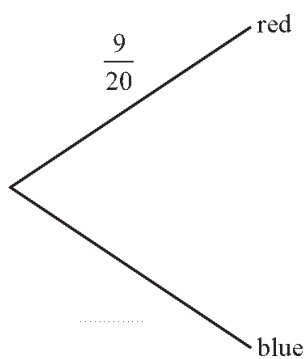
There are 9 red counters and 11 blue counters in a bag.
There are no other counters in the bag.

Emeka takes at random a counter from the bag and writes down the colour of the counter.
He puts the counter back in the bag.
Natasha takes at random a counter from the bag and writes down the colour of the counter.

(a) Complete the probability tree diagram.

Emeka

Natasha



(2)

(b) Work out the probability that Emeka takes a red counter from the bag and Natasha takes a blue counter from the bag.

(2)

(c) Work out the probability that both counters taken from the bag are the same colour.

(3)



8 - (4MA0-W 2017-Paper 3HR-Q22) - PROBABILITY

There are 12 sweets in a bag.

4 of the sweets are lemon flavour.

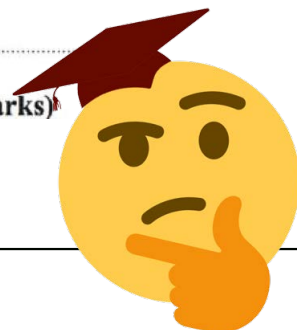
4 of the sweets are strawberry flavour.

4 of the sweets are orange flavour.

Luke takes at random 3 of the sweets.

Work out the probability that exactly 2 of the sweets that Luke takes are the same flavour.

(Total for Question is 5 marks)



9 - (4MA0-S 2018-Paper 3HR-Q18) - PROBABILITY

Two fair 6-sided dice are thrown.

The total is the sum of the numbers that each dice lands on.

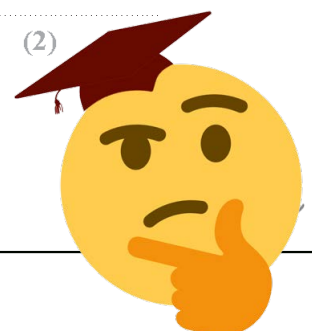
(a) Work out the probability that the total is 4

Three people each throw the two dice.

(b) Work out the probability that none of the three people get a total of 4

(2)

(2)



10 - (4MA0-W 2018-Paper 3HR-Q18) - *PROBABILITY*

There are four white tiles and three grey tiles in a bag.
Each tile has a number on one side.



There are no other tiles in the bag.

Flora takes at random a tile from the bag.
She keeps the tile.

Esther then takes at random a tile from the bag.

(a) Work out the probability that Flora takes a white tile and Esther takes a grey tile.

.....
(2)

The numbers on the tiles taken from the bag are added together to get a total T .

(b) Work out the probability that T is 4

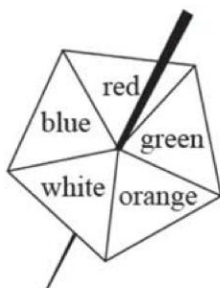
.....
(4)

.....
(Total for Question is 6 marks)



11 - (4MA0-W 2019-Paper 3HR-Q3) - PROBABILITY

Here is a biased five-sided spinner.



When the spinner is spun the probabilities that it lands on blue, red, green and orange are given in the table.

Colour	blue	red	green	orange	white
Probability	0.17	0.1	0.13	0.15	

Gary spins the spinner once.

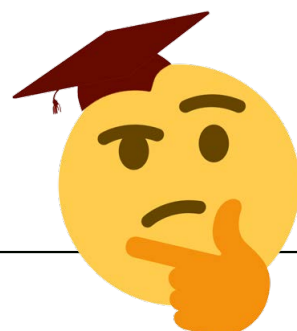
(a) Work out the probability that the spinner lands on white.

(2)

Jasmine is going to spin the spinner 360 times.

(b) Work out an estimate for the number of times the spinner will land on red.

(2)



12 - (4MA0-W 2019-Paper 3HR-Q15) - *PROBABILITY*

Henry puts 8 coins in a bag.

The table gives information about the value of the coins.

Value of coin	5p	2p	1p
Number of coins	5	2	1

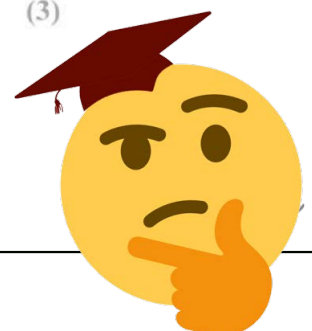
Henry then takes at random two coins from the bag.

(a) Work out the probability that the two coins are both 5p coins.

(2)

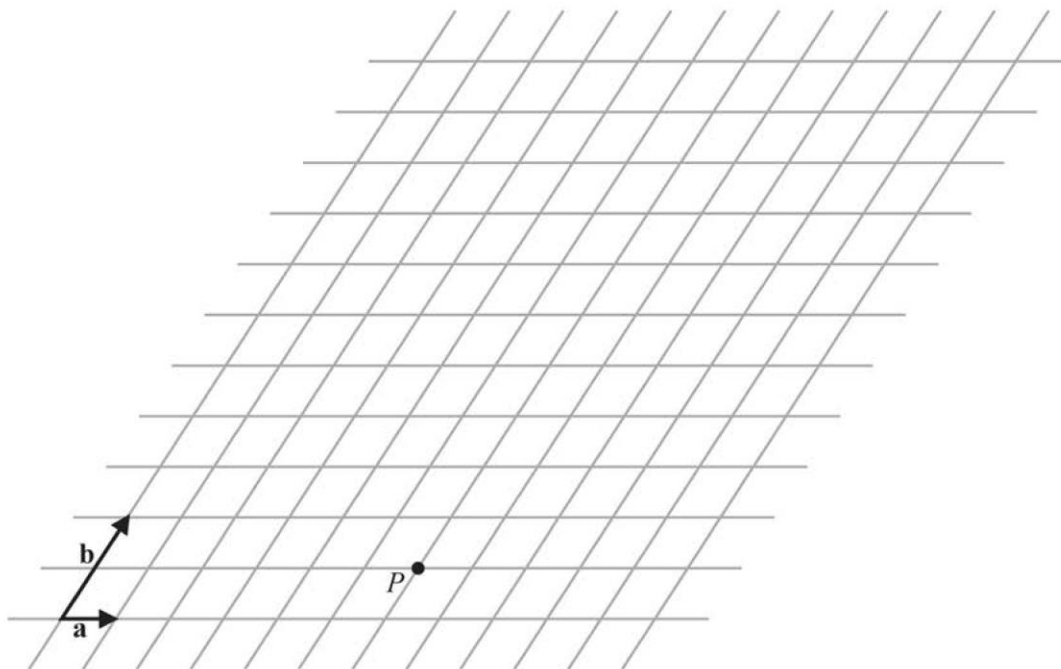
(b) Work out the probability that the total value of the two coins is at least 6p.

(3)



1 - (4MA0-W 2016-Paper 3HR-Q19) - VECTORS

The diagram shows a grid of equally spaced parallel lines.
The point P and the vectors $\mathbf{a}$ and $\mathbf{b}$ are shown on the grid.



$$\overrightarrow{PQ} = 3\mathbf{a} + 4\mathbf{b}$$

(a) On the grid, mark the vector $\overrightarrow{PQ}$

(1)

$$\overrightarrow{PR} = -4\mathbf{a} + 2\mathbf{b}$$

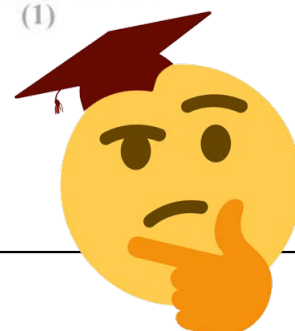
(b) On the grid, mark the vector $\overrightarrow{PR}$

(1)

(c) Find, in terms of $\mathbf{a}$ and $\mathbf{b}$, the vector $\overrightarrow{QR}$

$$\overrightarrow{QR} = \dots\dots\dots$$

(1)



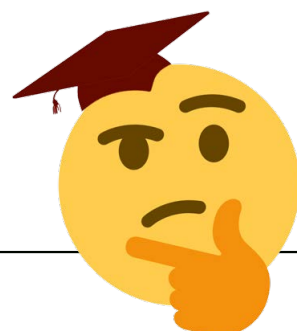
The point M lies on PR such that $PM = \frac{2}{3}PR$

The point N lies on PQ such that $PN = \frac{1}{3}PQ$

- (d) Show that $\vec{MN} = k\mathbf{a}$ where k is a constant.
State the value of k .

$$k = \dots\dots\dots (3)$$

(Total for Question is 6 marks)



2 - (4MA0-W 2017-Paper 3HR-Q23) - VECTORS

The diagram shows trapezium $ABCD$.

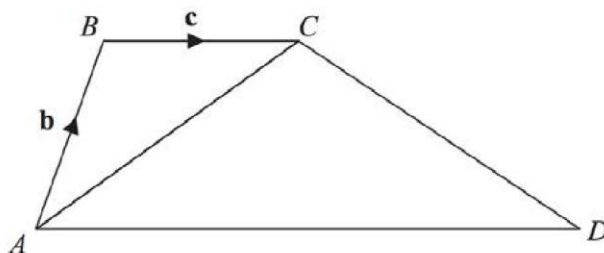


Diagram **NOT**
accurately drawn

BC is parallel to AD

$AD = 3BC$

$\vec{AB} = \mathbf{b}$, $\vec{BC} = \mathbf{c}$

- (a) Find, in terms of $\mathbf{b}$ and $\mathbf{c}$, the vector $\vec{CD}$
Give your answer in its simplest form.

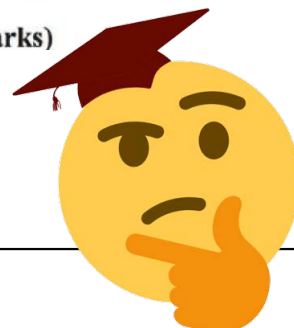
.....
(2)

The point P lies on the line AC such that $AP:PC = 2:1$

- (b) Is BPD a straight line?
Show your working clearly.

(4)

(Total for Question is 6 marks)



3 - (4MA0-W 2019-Paper 3HR-Q20) - VECTORS

OAB is a triangle.

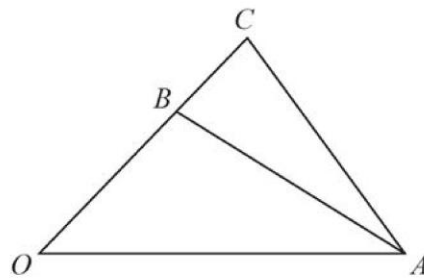


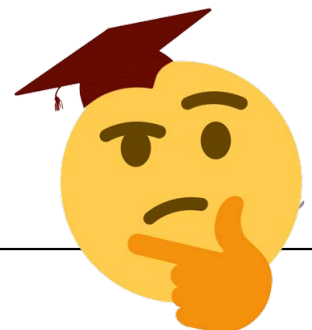
Diagram **NOT**
accurately drawn

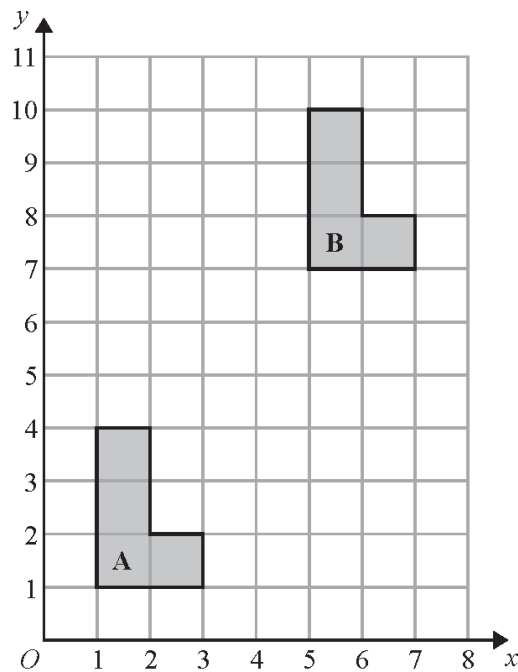
$$\vec{OA} = 3\mathbf{a} \quad \vec{OB} = 3\mathbf{b} \quad \vec{OC} = \frac{4}{3}\vec{OB}$$

Q is the point on AC such that $AQ = \frac{3}{5}AC$

P is the point on BA such that $BP = \frac{1}{3}BA$

Using a vector method, prove that OPQ is a straight line.



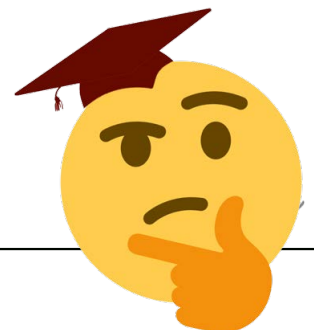
1 - (4MA0-W 2015-Paper 3HR-Q7) - TRANSFORMATION

Describe fully the single transformation that maps shape A onto shape B.

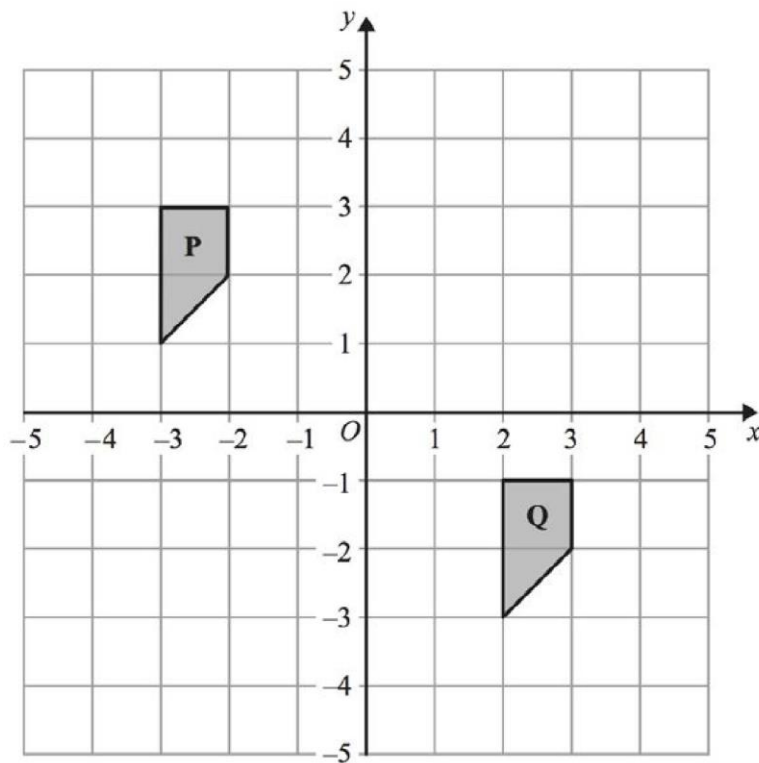
.....

.....

(Total for Question is 2 marks)



2 - (4MA0-S 2016-Paper 3HR-Q8) - TRANSFORMATION

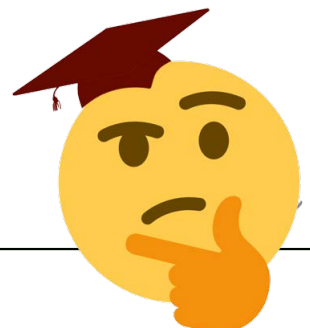


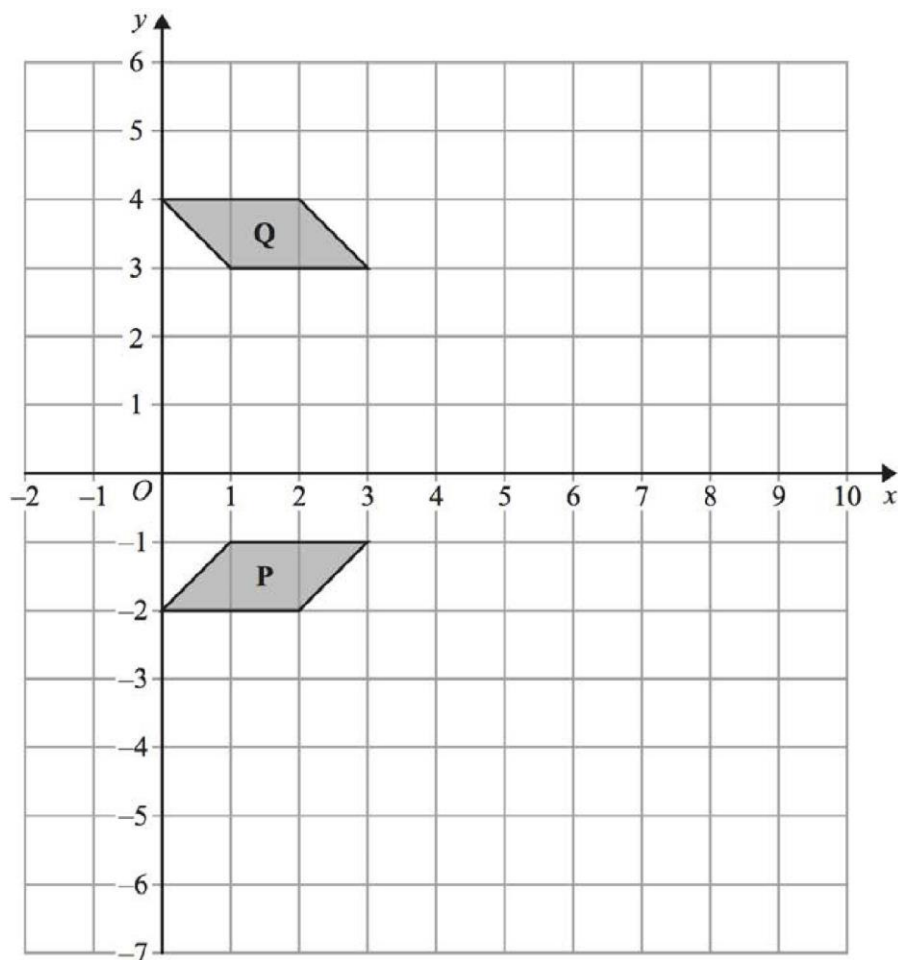
(a) Describe fully the single transformation that maps shape **P** onto shape **Q**.

(2)

(b) Rotate shape **Q** 90° clockwise about (1,0)
Label the new shape **R**.

(2)



3 - (4MA0-W 2016-Paper 3HR-Q3) - TRANSFORMATION

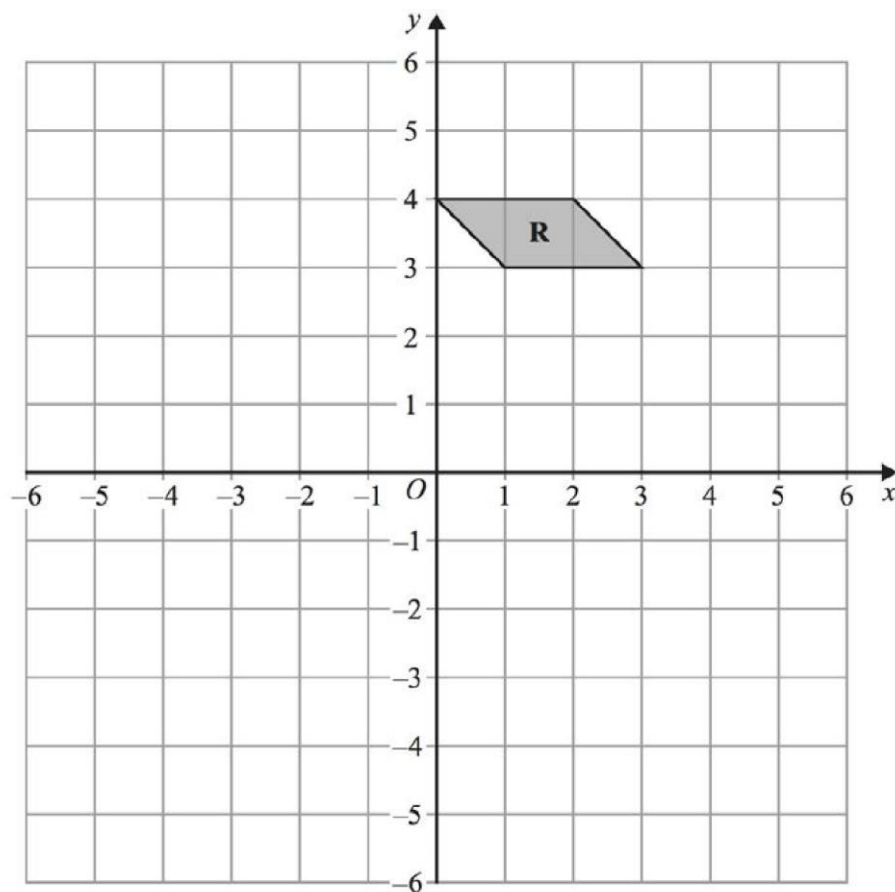
(a) Describe fully the single transformation that maps shape **P** onto shape **Q**.

(2)

(b) On the grid above, enlarge shape **P** with scale factor 3 and centre **O**.

(2)





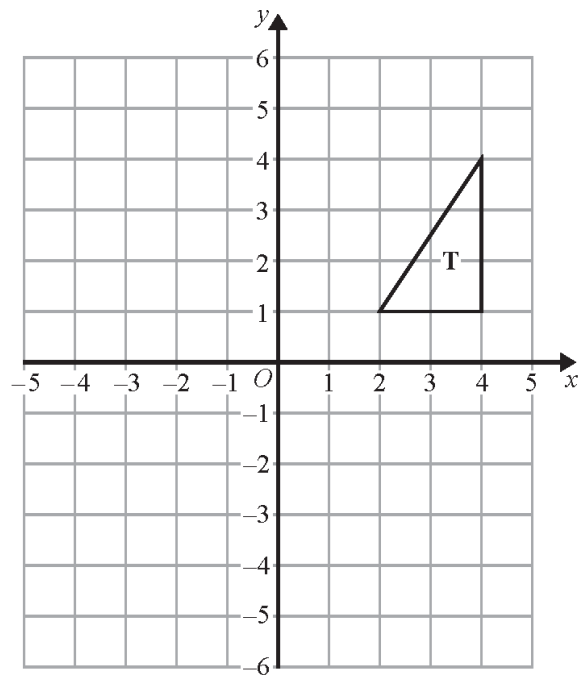
(c) On the grid above, rotate shape **R** 90° anticlockwise with centre (0, 1)

(2)

(Total for Question is 6 marks)

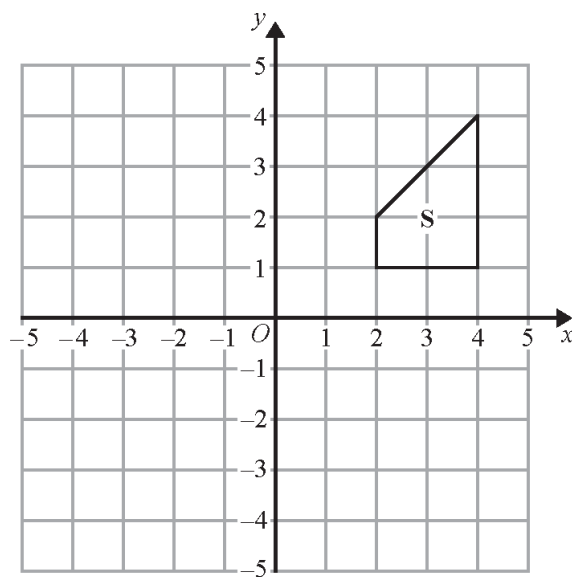


4 - (4MA0-S 2017-Paper 3HR-Q8) - TRANSFORMATION



(a) On the grid above, rotate triangle T 90° clockwise about (0, 2).

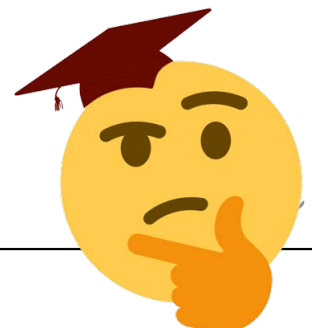
(2)



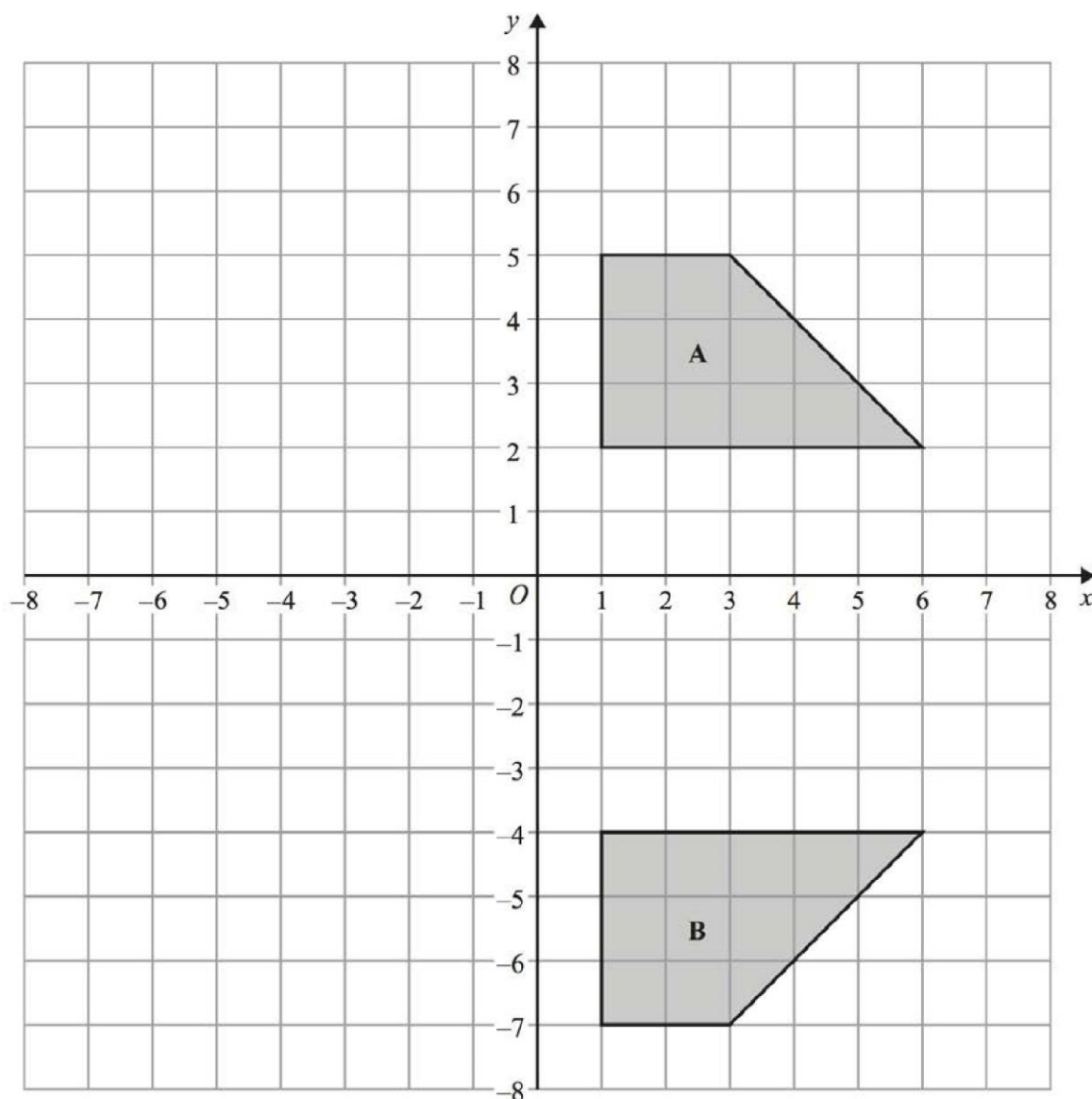
(b) On the grid, translate shape S by the vector $\begin{pmatrix} -1 \\ -3 \end{pmatrix}$.

(1)

3 marks)



5 - (4MA0-W 2017-Paper 3HR-Q6) - TRANSFORMATION



- (a) Describe fully the single transformation that maps shape A onto shape B.

(2)

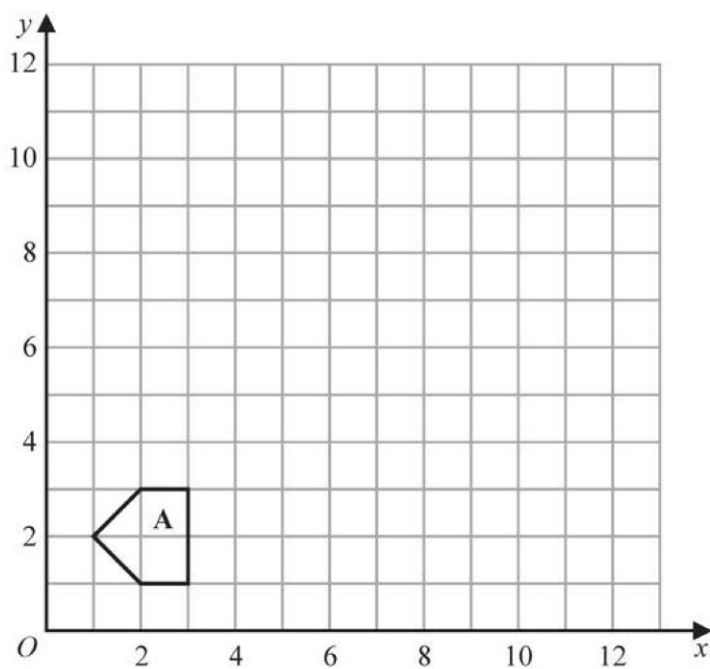
- (b) On the grid, rotate shape A 90° anticlockwise about (0, 0)
Label the new shape C.

(2)

(Total for Question is 4 marks)

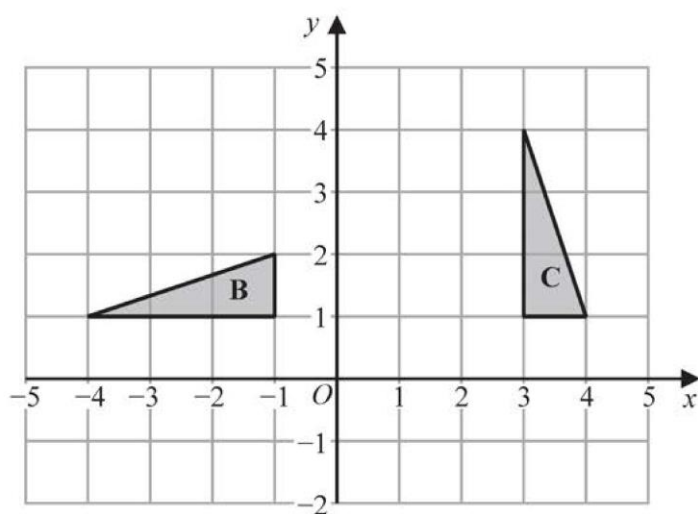


6 - (4MA0-W 2019-Paper 3HR-Q4) - TRANSFORMATION



(a) On the grid, enlarge shape **A** with scale factor 3 and centre O .

(2)



(b) Describe fully the single transformation that maps triangle **B** onto triangle **C**.

(3)



1 - (4MA0-W 2015-Paper 3HR-Q17) - DIFFERENTIATION & KINEMATICS

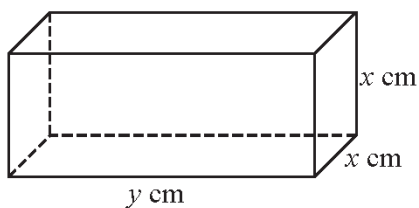


Diagram **NOT**
accurately drawn

The diagram shows a cuboid of volume $V \text{ cm}^3$

The length of the cuboid is $y \text{ cm}$

The width and height of the cuboid are both $x \text{ cm}$

The total length of all the edges of the cuboid is 112 cm

(a) Show that $V = 28x^2 - 2x^3$

(3)

(b) Find $\frac{dV}{dx}$

$$\frac{dV}{dx} = \dots\dots\dots$$

(2)

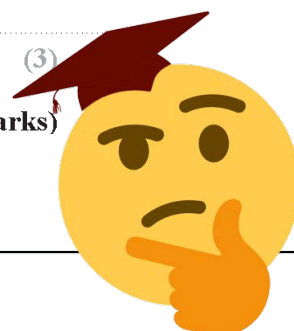
(c) Find the maximum value of V

Give your answer correct to 3 significant figures.

$$V = \dots\dots\dots$$

(3)

(Total for Question is 8 marks)



2 - (4MA0-S 2016-Paper 3HR-Q15) - DIFFERENTIATION & KINEMATICS

$$y = x^3 - \frac{9}{2}x^2 - 54x + 10$$

(a) Find $\frac{dy}{dx}$

.....
(2)

The curve with equation $y = x^3 - \frac{9}{2}x^2 - 54x + 10$ has two turning points.

(b) Find the x coordinate of each of these two points.

.....
(3)



3 - (4MA0-S 2017-Paper 3HR-Q15) - DIFFERENTIATION & KINEMATICS

For the curve **C** with equation

$$y = 2x^3 - 3x^2 - 12x + 9$$

(a) find $\frac{dy}{dx}$

.....
(2)

(b) Find the gradient of **C** at the point with coordinates (2, -11)

.....
(2)

The curve **C** has a gradient of -12 at the point where $x = k$ and at the point where $x = m$.
Given that $k > m$

(c) find the value of k and the value of m .

$k =$

$m =$

(3)



4 - (4MA0-W 2017-Paper 3HR-Q20) - DIFFERENTIATION & KINEMATICS

A curve has equation $y = x^3 - 4x^2 + 5x + 4$

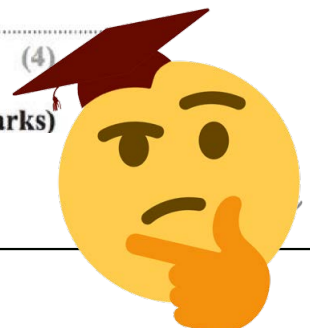
(a) Find $\frac{dy}{dx}$

(2)

(b) Find the x coordinates of the points where the curve with equation $y = x^3 - 4x^2 + 5x + 4$ has a gradient of 1
Show clear algebraic working.

(4)

(Total for Question is 6 marks)



5 - (4MA0-S 2018-Paper 3HR-Q17) - DIFFERENTIATION & KINEMATICS

The curve **C** has equation $y = 2x^3 - 6x$

(a) Find $\frac{dy}{dx}$

$$\frac{dy}{dx} = \dots\dots\dots$$

(2)

(b) Work out the gradient of **C** at the point (2, 4)

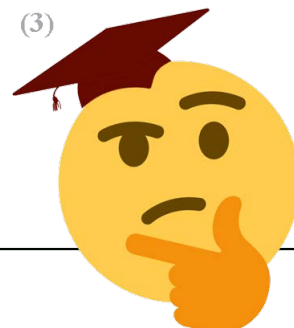
\dots\dots\dots

(1)

(c) Find the x coordinates of the points on **C** where the gradient of the curve is $7\frac{1}{2}$
Show clear algebraic working.

\dots\dots\dots

(3)



ANSWERS



1 - (4MA0-W 2015-Paper 3HR-Q1) - NUMBER

	$640 \div (7 + 9) \times 9$ or 40×9	360
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2 - (4MA0-W 2015-Paper 3HR-Q2) - NUMBER

(a)	$15625 + \frac{173}{2.5}$	15694.2
(b)		15700

3 - (4MA0-W 2015-Paper 3HR-Q8) - NUMBER

(a)	$\frac{12}{100} \times 45 (=5.4)$ $45 - "5.4"$	39.6(0)
(b)	$546 - 525 (=21)$ $\frac{'21'}{525} \times 100$	4



4 - (4MA0-W 2015-Paper 3HR-Q9) - NUMBER

	$\frac{15}{2} - \frac{14}{3} = \frac{45a}{6a} - \frac{28a}{6a}$	
		shown

5 - (4MA0-W 2015-Paper 3HR-Q13) - NUMBER

	$2^3 \times 3^2$	
		72



6 - (4MA0-W 2015-Paper 3HR-Q20) - NUMBER

(a)	$R = \frac{k}{c^2}$ $30 = \frac{k}{4^2} \text{ or } k = 480 \text{ oe}$	$R = \frac{480}{c^2} \text{ oe}$
(b)	$c^2 = \frac{480}{1920} \text{ or } c^2 = \frac{30}{1920} \times 4^2$	0.5oe

7 - (4MA0-S 2016-Paper 3HR-Q1) - NUMBER

(a)	$\frac{7}{10} \times 30 \text{ oe (eg } 30 \div (7 + 3) = 3, 7 \times '3' \text{) or}$ $\frac{3}{10} \times 30 (= 9)$	21	2
(b)	$\frac{75}{3} \times 4 \text{ oe}$	100	2

8 - (4MA0-S 2016-Paper 3HR-Q5) - NUMBER

(a)	$\frac{8}{100} \times 28 \text{ or } 2.24$ $28 - "2.24"$	25.76	3
(b)	$\frac{3}{0.08} \text{ or } \frac{3}{8} \times 100 \text{ oe}$	37.50	3



9 - (4MA0-S 2016-Paper 3HR-Q7) - NUMBER

$792 = 2 \times 396 = 2 \times 2 \times 198$ $= 2 \times 2 \times 2 \times 99 = 2 \times 2 \times 2 \times 3 \times 33$		3
2, 2, 2, 3, 3, 11		
		$2 \times 2 \times 2 \times 3 \times 3 \times 11$

10 - (4MA0-W 2016-Paper 3HR-Q1) - NUMBER

	$\frac{14.14}{3.5}$	
		4.04

11 - (4MA0-W 2016-Paper 3HR-Q6) - NUMBER

(a)	Correct factor tree or repeated division to find factors 2, 2, 2, 3, 5, 5 (condone inclusion of 1's)	$2^3 \times 3 \times 5^2$
(b)	Eg $\frac{5^{12}}{5^3}$ or $\frac{5^{10}}{5}$ or $\frac{5^{11}}{5^2}$	5^9



12 - (4MA0-W 2016-Paper 3HR-Q8) - *NUMBER*

(a)	$\frac{163 \text{ (million)}}{683 \text{ (million)}} \times 100$	23.9
(b)	$\frac{17.6}{100} \times 1028 \text{ (million)}$ or $180.928 \text{ (million)}$ $\frac{17.6}{100} \times 1028 \text{ (million)} + 1028 \text{ (million)}$	1209
(c)	$\frac{1028 \text{ (million)}}{187.6} \times 100$ oe	548

13 - (4MA0-S 2017-Paper 3HR-Q4) - *NUMBER*

a	$3500 \div 119$	29.41	2	M1 A1 for 29.41 – 29.412
b	$8500 \div 52$ or 163.(461...)			M1 M1 for $8500 \times 119 = 1011500$ M1 for $119 \div 52 (=2.28...)$
	"163.461..." $\times 119$			M1 dep M1 for " $1011500 \div 52$ " M1 for $8500 \times "2.28..."$
		19452	3	A1 for 19380 – 19520
c	$24 \div 60 (=0.4)$ or 2.4 or $2\frac{24}{60}$ oe or $2 \times 60 + 24 (=144)$			M1
	$1534 \div 2.4$ oe or $(1534 \div 144) \times 60$ oe			M1 (allow $1534 \div 2.24$ or answer of 684.(82...) or 685)
		639	3	A1 for 639 – 639.17

14 - (4MA0-S 2017-Paper 3HR-Q7) - *NUMBER*

e.g. $2 \times 2 \times 7 \times 12$ or at least 3 divisions in a factor tree			M1 for the start of a correct method e.g. may be a factor tree or consecutive divisions condone 1 error
All 6 correct prime factors, no extras (2,2,2,2,3,7,(1))			M1 e.g. from a factor tree, ignore 1s
	$2 \times 2 \times 2 \times 2 \times 3 \times 7$	3	A1 oe dep on M1, M1



15 - (4MA0-S 2017-Paper 3HR-Q10) - NUMBER

a	$100 - 9.4 (= 90.6)$	$\frac{9.4}{100} \times 607$ oe ($= 57.058$)			M1
	$\frac{"90.6"}{100} \times 607$ oe	$607 - "57.058"$			M1 (dep)
			550	3	A1 for 549.942 or 549.94 or 549.9
b	$\frac{100}{20} \times 1320$ oe				M2 for a complete method If not M2 then award M1 for a correct first step $1320 \div 20 (=66)$ or $0.2x = 1320$ or $1320 \div 2 (=660)$
			6600	3	A1

16 - (4MA0-S 2017-Paper 3HR-Q20) - NUMBER

	$(2^p)^2 - 2^p - 2^p + 1$ or $2^{2p} - 2^p - 2^p + 1$ or $4^p - 2^p - 2^p + 1$			M2 for correct expansion If not M2 then award M1 for 3 terms correct from $(2^p)^2 - 2^p - 2^p + 1$
	$N = 2^{p+1}(2^{p-1} - 1)$	Shown		A1 for correct factorised expression from correct working (dep on M2)
				Total 3 marks
	Alternative method $N = (k-1)(k+1)$			M1 for correct factorisation
	$N = (2^p - 1 - 1)(2^p - 1 + 1)$			M1 for correct factorisation and substitution (implies B1)
	$N = 2^{p+1}(2^{p-1} - 1)$	Shown	3	A1 for correct factorised expression (dep on M2)

17 - (4MA0-W 2017-Paper 3HR-Q1) - NUMBER

100^2 or 10 000		
	120 000	2

18 - (4MA0-W 2017-Paper 3HR-Q4) - NUMBER

$15 \div 60 (=0.25)$ or 13.25 or $13 \times 60 + 15 (=795)$ or $13 \times 3600 + 15 \times 60 (=47700)$		
$8740 \div "13.25"$ or $8740 \div "795" \times 60$ or $8740 \div "47700" \times 3600$		
	660	3



19 - (4MA0-W 2017-Paper 3HR-Q5) - NUMBER

$80 \div (3 + 1) (=20)$ or 20 or 60	67	5
$0.15 \times (3 \times "20") (=9)$		
$"20" \div 5 (=4)$		
$80 - "9" - "4"$		
or		
$\frac{3}{4} \times \frac{15}{100} (= \frac{9}{80} \text{ or } 0.1125)$	67	5
$\frac{1}{4} \times \frac{1}{5} (= \frac{1}{20} \text{ or } 0.05)$		
$"\frac{9}{80}" + "\frac{1}{20}" (= \frac{13}{80})$ or $"0.1125" + "0.05" (=0.1625)$		
$(1 - "\frac{13}{80}") \times 80$ or $(1 - "0.1625") \times 80$ or $\frac{67}{80}$		

20 - (4MA0-W 2017-Paper 3HR-Q8) - NUMBER

a	$224 \div 8$ or	28	2
b	$523 - 411 (=112)$ or $\frac{523}{411} (= 1.273...)$ or $\frac{523}{411} \times 100 (=127.3...)$ $\frac{112}{411} \times 100$ or $100 \times "1.273" - 100$ or $"127.3" - 100$	27.3	3

21 - (4MA0-W 2017-Paper 3HR-Q13) - NUMBER

a		0.00079	1
b		2.015×10^{10}	2



22 - (4MA0-W 2017-Paper 3HR-Q14) - NUMBER

$9000 \times 0.018 (= 162)$ or $9000 \times 1.018 (= 9162)$	9494.8(0)	3
$(9000 + "162") \times 0.018 (= 164.916)$ $("9162" + "164.916") \times 0.018 (= 167.88...)$ $"9162" + "164.916" + "167.88"$		

23 - (4MA0-S 2018-Paper 3HR-Q1) - NUMBER

(a)	$(26.72...)^2$ or $\frac{15775.36}{22.09}$	714.1(40335)	2	M1 for 26.72... or 15775.36 or 22.09 A1
(b)		714	1	B1 ft if at least 4 significant figures in (a)

24 - (4MA0-S 2018-Paper 3HR-Q2) - NUMBER

	$60 \times \frac{5}{6}$	50	2	M1 A1 NB: $\frac{50}{60}$ gains M1 A0
--	-------------------------	----	---	--

25 - (4MA0-S 2018-Paper 3HR-Q4) - NUMBER

	E.g. $\frac{x}{60} = \frac{12}{16}$ oe or $12 : 16 = x : 60$ oe or $\frac{12 \times 60}{16}$ oe or $\frac{24 \times 60}{32}$ oe	45	2	M1 for a correct equation (accept ratios) or a correct calculation A1 cao
--	--	----	---	---

26 - (4MA0-S 2018-Paper 3HR-Q9) - NUMBER

e.g. $\frac{27}{8} \div \frac{9}{4}$, $\frac{27}{8} \div \frac{18}{8}$ $\frac{27}{8} \times \frac{4}{9}$ or $\frac{4 \times 27}{8 \times 9}$ or $\frac{108}{72}$ or $\frac{27}{8} \div \frac{18}{8}$	$1\frac{1}{2}$	3	M1	for two correct improper fractions
			M1	accept division of any two correct fractions with a common denominator which is a multiple of 8
			A1	for correct working leading to $1\frac{1}{2}$ must show correct cancelling of fractions before multiplication or a correct mixed number eg $1\frac{36}{72}$, $1\frac{9}{18}$ or a correct improper fraction eg. $\frac{108}{72}$



27 - (4MA0-S 2018-Paper 3HR-Q16) - NUMBER

(a)	E.g. $13\,300 \div 0.76$	17 500	3	M2	If not M2 then award M1 for $x \times 0.76 = 13\,300$ or $13\,300 \div 76$
				A1	NB: Accept $1 - 0.24$ in place of 0.76
(b)	E.g. $13\,300(1-x)^3 = 6500$ or $13\,300y^3 = 6500$	21.2	3	M1	for a correct equation condone use of $(1-x)^4$ or y^4 accept $x\%$ or $y\%$ in equation
				M1	condone use of 4 th root rather than cube root
				A1	for an answer in the range $21.2 - 21.24$
	$\sqrt[3]{\frac{6500}{13300}} (=0.787\dots)$ or $1 - \sqrt[3]{\frac{6500}{13300}}$ ($=0.212\dots$)			SC:	If no marks scored then award B2 for an answer of $16.38 - 16.4$ (from using 4 years)

28 - (4MA0-W 2018-Paper 3HR-Q3) - NUMBER

ALT	$210 \div 9.72 (= (\text{€})21.60\dots)$ '21.60..' $\times 1.10 (= (\text{\$})23.765)$ $79 - 23.765\dots$	55	4	M1	for $210 \div 9.72$ or $(\$)1 = 9.72 \div 1.10$ ($= 8.836\dots$ (EGP)) oe
				M1	for '21.60..' $\times 1.10$ or $210 \div '8.836\dots'$ ($= 23.765\dots$) oe
				M1	
				A1	(Accept answer in the range $55 - 55.3$)
ALT	$79 \div 1.1 \times 9.72 (= 698.7\dots)$ OR $79 \div 1.1 (= 71.81\dots)$ and $210 \div 9.72 (= 21.60\dots)$	55	4	M1	convert \$79 into pounds OR convert \$79 into euros and 210 pounds into euros
	'698' $- 210 (= 488.7\dots)$ OR '71.8' $- '21.6' (= 50.21\dots)$			M1	(dep) for subtraction '698' $- 210$ or '71.8' $- '21.6'$
	'488' $\div 9.72 \times 1.1$ OR '50.2' $\times 1.1$			M1	for conversion of answer into dollars
				A1	(Accept answer in the range $55 - 55.3$)

29 - (4MA0-W 2018-Paper 3HR-Q7) - NUMBER

	$\frac{3}{4} \times 24 (= 18)$ or $\frac{1}{4} \times 24 (= 6)$ '18' $\times 30 (= 540)$ or '6' $\times 20 (= 120)$ $\frac{'540' + '120' - 400}{400} \times 100 (= 65)$ oe	65%	4	M1	
				M1	
				M1	for a complete method
				A1	
				SC:	B3 for an answer of 165%

30 - (4MA0-W 2018-Paper 3HR-Q8) - NUMBER

	$50\,000 \times 30 (= 1500000)$ or $50\,000 \div (100 \times 1000) (= 0.5)$ or $30 \div (100 \times 1000) (= 0.0003)$	15	3	M1	for a correct first step or an answer with the digits 15 eg 0.0015, 1500
	'1500000' $\div (100 \times 1000)$ or '0.5' $\times 30$ or '0.0003' $\times 50000$			M1	for a complete method
				A1	



31 - (4MA0-W 2018-Paper 3HR-Q9) - NUMBER

$\frac{5}{8} \times \frac{3}{4} \left(= \frac{15}{32} \right)$	$\frac{5}{8} \times 320 (= 200) \text{ or } \left(1 - \frac{5}{8} \right) \times 320 (= 120)$	$\frac{23}{32}$	4	M1
$\left(1 - \frac{5}{8} \right) \times \frac{2}{3} \left(= \frac{6}{24} \right)$	$\frac{3}{4} \times 200' (= 150) \text{ oe and } \frac{2}{3} \times '120' (= 80) \text{ oe}$			M1
$\frac{15}{32} + \frac{6}{24} \text{ oe}$	$\frac{'150'+ '80'}{320} \text{ oe}$			M1 for a complete method
				A1 oe

32 - (4MA0-W 2018-Paper 3HR-Q13) - NUMBER

Total distance = $b + x$ or $v \text{ km/h} = v \times 1000 \div 3600 \text{ m/s}$	$T = \frac{18(b+x)}{5v}$	3	M1 for total distance or conversion from km/h to m/s
$(T =) (b + x) / (v \times 1000 \div 3600)$			M1 for any correct expression for T
			A1 correct and fully simplified (numerator may not be factorised)

33 - (4MA0-W 2018-Paper 3HR-Q14) - NUMBER

$3000 \times (1 + 0.024)^3 (= 3221.22(5...))$ or 3072, 3145.72(8), 3221.22(5...)	3132.74	4	M2 for a complete method to find the amount in the account after 3 years before the 40% deduction
$'3221.22(5...)' - [('3221.22(5...)' - 3000) \times 0.4] \text{ oe}$			If not M2 then M1 for $3000 \times (1 + 0.024) \text{ oe}$ or $3000 \times (1 + 0.024)^2 \text{ oe}$
			M1 (indep) for finding 60% of their interest
			A1 3132 – 3133

34 - (4MA0-W 2019-Paper 3HR-Q1) - NUMBER

(a)	$0.07 \times 560 (= 39.2(0)) \text{ oe}$ $560 + "39.2"$	599.2(0)	3	M1	M2 for 1.07×560
(b)	$42 \div 7 (= 6) \text{ oe or } 42 \div "39.2" (= 1.07(14...))$ $(42 \div 7) \times 100 \text{ oe or } "1.07..." \times 560$	600	3	M1	SC: If no marks awarded, award B1 for an answer of 520.8(0)
				M1	oe e.g. $42 \div 0.07$ or ft from (a)
				A1	

35 - (4MA0-W 2019-Paper 3HR-Q5) - NUMBER

e.g. $630 = 2 \times 315 = 2 \times 3 \times 105 = 2 \times 3 \times 3 \times 35$		2	M1 for at least 2 correct steps in repeated factorisation (may be seen in a tree diagram or 'ladder')
	$2 \times 3 \times 3 \times 5 \times 7$		A1 dep on M1 or for $2 \times 3^2 \times 5 \times 7$



36 - (4MA0-W 2019-Paper 3HR-Q8) - NUMBER

$760 \div (2 + 3 + 5) (=76)$ for at least 2 of: $2 \times "76" (=152), 3 \times "76" (=228), 5 \times "76" (=380)$ $\frac{1}{2} \times "152" \text{ oe } (=76) \text{ or } \frac{2}{3} \times "228" \text{ oe } (=152)$ or $\frac{30}{100} \times "380" \text{ oe } (=114)$ $\frac{1}{2} \times "152" + \frac{2}{3} \times "228" + \frac{30}{100} \times "380" \text{ oe}$ or "76" + "152" + "114"	342	5	M1 or for $\frac{2}{10}, \frac{3}{10}, \frac{5}{10} \text{ oe}$ e.g. 20%, 30%, 50% M1 or for $\frac{1}{2} \times \frac{2}{10} \left(= \frac{1}{10} \right) \text{ oe or } \frac{2}{3} \times \frac{3}{10} \left(= \frac{2}{10} \right) \text{ oe}$ or $0.3 \times \frac{5}{10} \left(= \frac{15}{100} \right) \text{ oe}$ M1 or for $"\frac{1}{10}" + "\frac{2}{10}" + "\frac{15}{100}" \text{ oe } = 10\% + 20\% + 15\% = 45\%$ M1 or for $\frac{45}{100} \times 760 \text{ oe}$ A1 NB: An answer of 418 scores M4 A0
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37 - (4MA0-W 2019-Paper 3HR-Q11) - NUMBER

(a)		5.4×10^{-7}	1	B1 cao
(b)	$0.576 \times 9.92 \times 10^6 \text{ oe}$ or 5713920 (rounded to 2sf or better)	5.7×10^6	2	M1
(c)	$(1.4 \times 10^9) \div (7.4 \times 10^6)$		2	A1 or better but must be in standard form
		189		M1 or for digits 189(189...) or digits 1892
				A1 Allow 1.89×10^2

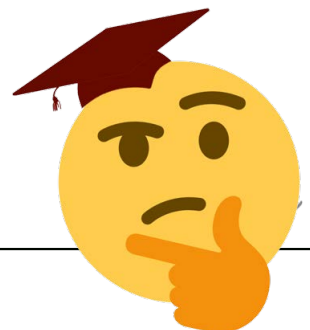


1 - (4MA0-W 2015-Paper 3HR-Q4) - ALGEBRA

(a)		$3(2w + 5)$
(b)	$x^2 + 4x + 7x + 28$	$x^2 + 11x + 28$
(c)	$3(x - 5) = 3x - 15$ $3x - 15 = 7x + 12$ $-15 - 12 = 7x - 3x$ or $3x - 7x = 12 + 15$ oe	-6.75

2 - (4MA0-W 2015-Paper 3HR-Q15) - ALGEBRA

		$16x^6y^4$
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3 - (4MA0-W 2015-Paper 3HR-Q24) - ALGEBRA

	$x^2 + (2x - 3)^2 = 41$	
	$x^2 + 4x^2 - 6x - 6x + 9 = 41$ or $x^2 + 4x^2 - 12x + 9 = 41$	
	$5x^2 - 12x - 32 (= 0)$	
	$(5x + 8)(x - 4) (= 0)$ or $5x(x - 4) + 8(x - 4) (= 0)$ or $x(5x + 8) - 4(5x + 8)$ or $\frac{- -12 \pm \sqrt{(-12)^2 - 4 \times 5 \times -32}}{2 \times 5}$ (may be partially evaluated condone lack of brackets around negative numbers) eg $\frac{12 \pm \sqrt{144 + 640}}{10}$ or $\frac{12 \pm 28}{10}$	
	$x = -\frac{8}{5}$ or $x = 4$	
		$x = -\frac{8}{5}, y = -\frac{31}{5}$ $x = 4, y = 5$

4 - (4MA0-S 2016-Paper 3HR-Q2) - ALGEBRA

(a)		$2x(x - 2)$	2
(b)	$32 = 2p + 3 \times 7$ $2p = 32 - 3 \times 7$ or $2p = 32 - 21$ or $2p = 11$ or $p = \frac{32 - 21}{2}$	$\frac{11}{2}$	3



5 - (4MA0-S 2016-Paper 3HR-Q6) - ALGEBRA

(a)	$-9 < 3x \leq 6$ or $3x > -9$ and $3x \leq 6$ or $-\frac{4}{3} < x + \frac{5}{3} \leq \frac{11}{3}$ or $x + \frac{5}{3} > -\frac{4}{3}$ and $x + \frac{5}{3} \leq \frac{11}{3}$ or $x > -3$ or $x \leq 2$		3
		$-3 < x \leq 2$	
(b)		$-2, -1, 0, 1, 2$	2

6 - (4MA0-S 2016-Paper 3HR-Q12) - ALGEBRA

(a)	e.g. $\frac{a^{11}}{a^7}$ or $\frac{a^6}{a^2}$ or $\frac{a^9}{a^5}$ oe	a^4	2
(b)	$4q - 5 = 3p - p$ oe eg $-2p = 5 - 4q$	$p = \frac{4q-5}{2}$	2
(c)	$8y^2 - 2y + 12y - 3$	$8y^2 + 10y - 3$	2
(d)		$2a^2b$	2



7 - (4MA0-S 2016-Paper 3HR-Q20) - ALGEBRA

(a)	$\frac{2(5x+2)(5x-2)}{2(5x-2)}$ or $\frac{(5x+2)(5x-2)}{5x-2}$ or $\frac{(5x-2)(10x+4)}{2(5x-2)}$ or $\frac{(10x-4)(5x+2)}{2(5x-2)}$ oe	$5x+2$	3
(b)	$\sqrt{12a \times 3a} + a\sqrt{3a \times 3a}$ or better		3
	$6a + 3a^2$		
	eg $3(2a + a^2)$ or $3a(2 + a)$ or $\frac{6a+3a^2}{3} = 2a + a^2$ or explanation that $6a$ and $3a^2$ are multiples of 3 so overall expression is a multiple of 3	Show	

8 - (4MA0-S 2016-Paper 3HR-Q21) - ALGEBRA

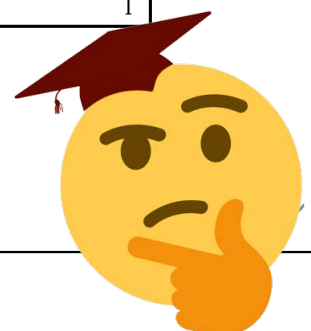
$(2^2)^{2k+8} = 2^3$ or $4^{\frac{3}{2}} = 8$ or $2^{4k+16} = 2^3$ or $4^{\frac{3}{2}} = 4^{2k+8}$		4
$4k + 16 = 3$ or $2k + 8 = 1.5$ oe		
	$-\frac{13}{4}$	

9 - (4MA0-W 2016-Paper 3HR-Q2) - ALGEBRA

(a)		$9(2c - 3)$
(b)	$t^2 - 4t + 5t - 20$	$t^2 + t - 20$

10 - (4MA0-W 2016-Paper 3HR-Q7) - ALGEBRA

(a)		$e < 2$
(b)	$5 - 4 < 3e$ or $-3e < 4 - 5$	$e > \frac{1}{3}$
(c)		1



11 - (4MA0-W 2016-Paper 3HR-Q11) - ALGEBRA

	Eg $5c = 35$ or $25d = -100$ or $4(-13 - 5d) - 5d = 48$ oe	
		$c = 7$ $d = -4$

12 - (4MA0-W 2016-Paper 3HR-Q12) - ALGEBRA

	$17t - 5t^2 = 12$ $5t^2 - 17t + 12 (= 0)$ Eg $(5t - 12)(t - 1) (= 0)$ or $(t =) \frac{-(-17) \pm \sqrt{(-17)^2 - 4 \times 5 \times 12}}{2 \times 5}$ or $\frac{17 \pm \sqrt{49}}{10}$ or $\frac{17 \pm 7}{10}$	
		$t = 1$ $t = 2.4$ oe

13 - (4MA0-W 2016-Paper 3HR-Q13) - ALGEBRA

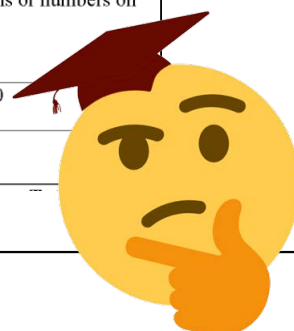
(a)		$64h^2$
(b)	$\frac{a \times a^{\frac{1}{2}}}{a^{\frac{2}{3}}}$ or $\frac{a^{\frac{3}{2}}}{a^{\frac{2}{3}}}$ $a^{(1 + \frac{1}{2} - \frac{2}{3})}$ or $k = (1 + \frac{1}{2} - \frac{2}{3})$ oe or $1 + \frac{1}{2} = k + \frac{2}{3}$ oe	$\frac{5}{6}$

14 - (4MA0-S 2017-Paper 3HR-Q1) - ALGEBRA

	$\frac{6 - 2.84}{(\sqrt{5})^2}$ or $\frac{6 - 2.84}{5}$ oe			M1 or for 0.63 NB: Accept 2.23(6...) in place of $\sqrt{5}$
		0.632	2	A1 for 0.632 or $\frac{79}{125}$ SC : B1 for an answer of 1.41(31...)

15 - (4MA0-S 2017-Paper 3HR-Q2) - ALGEBRA

	$5x - x = 8 - 10$			M1 for correct rearrangement with x terms on one side and numbers on the other in a correct equation or the correct simplification of either x terms or numbers on one side in a correct equation eg. $4x - 8 = -10$; $5x = x - 2$
	$4x = -2$			M1 or $-4x = 2$ or $4x + 2 = 0$ or $-4x - 2 = 0$ NB: This mark implies the previous M1
		-0.5	3	A1 oe e.g. $-\frac{2}{4}$ dep on M1



16 - (4MA0-S 2017-Paper 3HR-Q9) - ALGEBRA

a		$10e^5 f^2$	2	B2	If not B2 then award B1 for $ke^5 f^2, k \neq 10$ or $10e^5 f^2$ or $10e^b f^2$ $a, b \neq 0$
b		$(x-6)(x+1)$	2	B2	If not B2 then award B1 for $(x-1)(x+6)$ or $(x-3)(x-2)$ or $(x+3)(x-2)$ or $(x-3)(x+2)$

17 - (4MA0-S 2017-Paper 3HR-Q16) - ALGEBRA

	$cxy + dy = ax + b$			M1	both terms in original denominator multiplied by y
	e.g. $cxy - ax = b - dy$ or $dy - b = ax - cxy$			M1	for isolating terms in x and non x terms correctly ft from $cxy + d = ax + b$ or $cx + dy = ax + b$
	$x(cy - a) = b - dy$			M1	for taking out a factor of x correctly provided there are two terms in x
		$x = \frac{b - dy}{cy - a}$	4	A1	for $x = \frac{b - dy}{cy - a}$ or e.g. $x = \frac{dy - b}{a - cy}$

18 - (4MA0-S 2017-Paper 3HR-Q18) - ALGEBRA

	$y^2 + 4x = 12$ $4x + 6y = 20$ with subtraction or $\left(\frac{10-2x}{3}\right)^2 + 4x = 12$ or $2 \times \left(\frac{12-y^2}{4}\right) + 3y = 10$ or			M1	for eliminating one variable multiplication of equation(s) to get same multiple of y with subtraction (condone one arithmetic error) or either rearrangement of one equation and then correct substitution into second equation (condone algebraic error in rearrangement)
	E.g. $y^2 - 6y = -8$ or $4x^2 - 4x - 8 = 0$			A1	reduction to a correct 3 term quadratic; terms may not all be 'on the same side'
	E.g. $(y-2)(y-4) = 0$ or $4(x-2)(x+1) = 0$			M1	ft if first M1 awarded and equation is quadratic for correct factorisation or correct substitution into formula
				A1	for $y = 2, y = 4$ or $x = 2, x = -1$ correct x or y values implies previous M1
	$(x =) \frac{10-3 \times 2}{2}$ or $\frac{10-3 \times 4}{2}$ $(y =) \frac{10-2 \times 2}{3}$ or $\frac{10-2 \times (-1)}{3}$			M1	(dep on the previous M1) for correct substitution to find both values
		$x = 2, y = 2$ or $x = -1, y = 4$	6	A1	values for x and y must be correctly paired dep on M1 awarded



19 - (4MA0-W 2017-Paper 3HR-Q11) - ALGEBRA

a	e.g. $12x = 36$ or $24y = -60$	$x = 3$ oe, $y = -2.5$	3
	e.g. $7 \times "3" + 2y = 16$ or $7x + 2 \times -2.5 = 16$		
b	$k^2 + 9k - 5k - 45$	$k^2 + 4k - 45$	2
c	eg $\left(\frac{1}{8x^6y^3}\right)^{\frac{1}{3}}$ or $\left(\frac{8x^6y^8}{y^5}\right)^{\frac{1}{3}}$ or $\left(\frac{y^{\frac{-5}{3}}}{0.5x^{-2}y^{\frac{-8}{3}}}\right)$ oe	$2x^2y$	3
	eg $(8x^6y^3)^{\frac{1}{3}}$ or $\left(\frac{1}{8^{\frac{-1}{3}}x^{-2}y^{-1}}\right)$ or $\left(\frac{2x^2y^{\frac{8}{3}}}{y^{\frac{5}{3}}}\right)$ oe		



20 - (4MA0-W 2017-Paper 3HR-Q16) - ALGEBRA

a	e.g. $3(3x + 1) - 5(x - 4) = 2 \times 15$ or $\frac{3(3x+1)}{15} - \frac{5(x-4)}{15} = 2$ or $\frac{3(3x+1)-5(x-4)}{15} = 2$	1.75 oe	3
	e.g. $9x + 3 - 5x + 20 = 30$		
b	$t(3p + 1) = 7 - 2p$	$p = \frac{7-t}{3t+2}$	4
	$3pt + 2p = 7 - t$		
	$p(3t + 2) = 7 - t$		

21 - (4MA0-W 2017-Paper 3HR-Q18) - ALGEBRA

$\frac{7\sqrt{p}-p^2}{p\sqrt{p}}$ or $\frac{7\sqrt{p}-p^2}{\sqrt{p^3}} \times \frac{\sqrt{p^3}}{\sqrt{p^3}}$ oe	$\frac{7-p\sqrt{p}}{p}$	3
$\frac{7\sqrt{p}-p^2}{p\sqrt{p}} \times \frac{\sqrt{p}}{\sqrt{p}}$ or $\frac{7\sqrt{p}-p\sqrt{p}\sqrt{p}}{p\sqrt{p}}$		
$\frac{7\sqrt{p}\sqrt{p^3}-p^2\sqrt{p^3}}{p^3}$ oe		



22 - (4MA0-S 2018-Paper 3HR-Q7) - ALGEBRA

(a) (i)	$(4x+1)+(4x+1)+(2x+2)+(2x+2) (=12x+6)$	1	B1	for a correct expression, may not be simplified, but if simplified it must be correct
(ii)	$(x+3)+(x+3)+2x (=4x+6)$	1	B1	for a correct expression, may not be simplified, but if simplified it must be correct
(b)	$(4x+1)+(4x+1)+(2x+2)+(2x+2) =$ $2[(x+3)+(x+3)+2x]$ oe	$1\frac{1}{2}$ oe	4	M1 ft from (a) if at least B1 awarded OR one perimeter correct and $2 \times$ (perimeter of triangle)
	E.g. $6 = 4x$			M2 (dep on M1) ft for an equation in the form $ax = b$
	E.g. $4x + 6 = 12$ oe or $12x - 6 = 8x$ oe			If not M2 then award M1 (dep on M1) for correct simplification of all x terms OR correct simplification of all number terms
			A1	for 1.5 or $\frac{6}{4}$ or $\frac{3}{2}$ or $1\frac{1}{2}$ from correct algebraic working

23 - (4MA0-S 2018-Paper 3HR-Q14) - ALGEBRA

(a)		$p < 28$	1	B1
(b)	$q^2 > \frac{9}{16}$ oe or $q > \sqrt{\frac{9}{16}}$ or $(\pm) 4q > 3$ or $\frac{3}{4}$ oe	$q < -\frac{3}{4}$ or $q > \frac{3}{4}$	3	M1 Allow as equations or incorrect inequality sign
	or $(4q-3)(4q+3) > 0$ or $\frac{0 \pm \sqrt{0-4 \times 16 \times (-9)}}{2 \times 16}$			
	$\frac{3}{4}$ and $-\frac{3}{4}$ oe or $\pm \frac{3}{4}$ oe or $\pm \sqrt{\frac{9}{16}}$			M1 for finding both values. A1 for both correct inequalities

24 - (4MA0-S 2018-Paper 3HR-Q19) - ALGEBRA

$5x^2 - 3x - 4 (=0)$ or $5x^2 - 4 = 3x$ oe	$5y^2 - 49y + 80 (=0)$ or $5y^2 - 49y = -80$ oe	$x = 1.24$ $y = 7.73$	4	M1 Correct quadratic (condone = 0 missing).
$\frac{-(-3) \pm \sqrt{(-3)^2 - 4 \times 5 \times (-4)}}{2 \times (5)}$	$\frac{-(-49) \pm \sqrt{(-49)^2 - 4 \times 5 \times 80}}{2 \times 5}$	$x = -0.64$ $y = 2.07$		M1 Correct substitution into quadratic formula, which may be partially evaluated. Accept 3^2 or -3^2 Accept 49^2 or -49^2
or $\frac{3 \pm \sqrt{89}}{10}$	or $\frac{49 \pm \sqrt{801}}{10}$			A1 (dep on first M1) for both values of x or both values of y correct to at least 2 dp
$(x =) -0.64339...$ or $(x =) 1.24339...$	$(y =) 2.06980...$ or $(y =) 7.73019...$			A1 (dep on first M1) for correct x and y values, correctly paired.



25 - (4MA0-S 2018-Paper 3HR-Q20) - ALGEBRA

$\frac{5\sqrt{2}-3\sqrt{2}}{4}$ E.g. $\frac{2\sqrt{2}}{4}$ or $\frac{5\sqrt{2}-3\sqrt{2}}{4} \times \frac{\sqrt{2}}{\sqrt{2}}$	$\frac{1}{\sqrt{2}}$	3	M1 for $5\sqrt{2}$ and $3\sqrt{2}$ M1 dep on first M1 for method to rationalise the denominator A1 (dep on M2) for correct steps to correct answer
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26 - (4MA0-S 2018-Paper 3HR-Q22) - ALGEBRA

$\frac{3(2x+1)(2x-1)}{(3x+4)(2x-1)}$	$\frac{3(2x+1)}{3x+4}$	3	M1 for $(2x+1)(2x-1)$ or $(6x+3)(2x-1)$ or $(2x+1)(6x-3)$
			M1 for $(3x+4)(2x-1)$ or $(-3x-4)(1-2x)$
			A1 for $\frac{3(2x+1)}{3x+4}$, accept $\frac{6x+3}{3x+4}$

27 - (4MA0-W 2018-Paper 3HR-Q1) - ALGEBRA

(a)	$5x+5y-3x+3y$	$2x+8y$	2	M1 A1
(b)		t^{10}	1	B1
(c)		m^{12}	1	B1

28 - (4MA0-W 2018-Paper 3HR-Q15) - ALGEBRA

eg $3x-4y=8$ $10x-4y=22$ $7x=14$ eg $3 \times '2' - 4y=8$ $3x-4 \times '-0.5' = 8$	eg $15x-20y=40$ $15x-6y=33$ $-14y=7$	$2, -\frac{1}{2}$	3	M1 for a complete method to eliminate one variable (condone one arithmetic error) M1 (Dep on M1) for substituting the found variable or starting again to eliminate the other variable A1 dep on M1 NB: candidates showing no correct algebraic working score 0 marks.
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29 - (4MA0-W 2018-Paper 3HR-Q17) - ALGEBRA

(a)	$\text{eg } \frac{(x+1)^2}{(2x+1)(x+1)} - \frac{1}{(2x+1)(x+1)} \text{ OR } \frac{(x+1)^2 - 1}{(2x+1)(x+1)} \text{ OR } \frac{x^2 + 2x + 1 - 1}{(2x+1)(x+1)}$	Shown	2	M1 for correctly writing both fractions over a common denominator A1 shown with fully correct working
(b)	$x^2 + 2x = 1$ $\frac{-2 \pm \sqrt{2^2 - 4 \times 1 \times -1}}{2}$ $\frac{-2 \pm \sqrt{8}}{2}$ OR $\frac{-2 \pm \sqrt{2^2 + 4}}{2}$ OR $\frac{-2 \pm 2\sqrt{2}}{2}$ $(x+1)^2 - 1 = 1$ $(x+1) = \pm\sqrt{2}$	0.414, -2.41	4	M1 for $x^2 + 2x = 1$ oe M1 for substituting values from their quadratic equation into the formula (condone one sign error in substitution) OR a correct first step for completing the square M1 for method to solve their equation A1 awrt dep on the second M mark (accept 0.41)

30 - (4MA0-W 2018-Paper 3HR-Q21) - ALGEBRA

(a) (i)	$4a^k(a^2x^3)^w (= 4ax^2)$	$\frac{2}{3}$	4	M1 for substitution A1
(ii)	compare powers of a eg $1 = k + "2w"$	$-\frac{1}{3}$		M1 forming and equation for k A1
<u>ALT</u> (a) (i)	$x = \left(\frac{z}{a^2}\right)^{\frac{1}{3}}$	$\frac{2}{3}$		M1 for making x the subject A1
(a) (ii)	$y = 4a\left(\left(\frac{z}{a^2}\right)^{\frac{1}{3}}\right)^2$	$-\frac{1}{3}$		M1 (may be seen in a(i)) A1
(b)	$m = 1000$, so $m \times m^m = 1000 \times 1000^{1000} (= 1000^{1001})$	10^{3003}	3	M1 oe eg $(10^3)^{10^3+1}$ M1 for method which is 1 step away from the correct answer eg $(10^3)^{1001}$ A1

31 - (4MA0-W 2019-Paper 3HR-Q9) - ALGEBRA

(a)		c^8	1	B1
(b)		5	1	B1
(c)	$8x - 12y - 6x - 2y$	$2x - 14y$ oe	2	M1 for 3 correct terms A1



32 - (4MA0-W 2019-Paper 3HR-Q12) - ALGEBRA

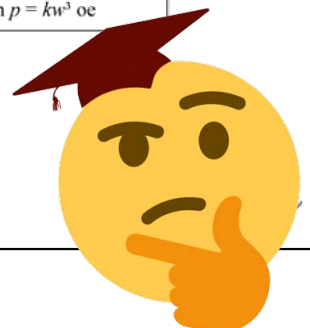
$\begin{array}{rcl} \text{e.g. } 9x + 6y = 16.5 & \text{or} & 15x + 10y = 27.5 \\ + 10x - 6y = -26 & & - 15x - 9y = -39 \\ \hline 19x & = & -9.5 \end{array}$ $\frac{15x + 10y = 27.5}{19x = -9.5} \quad \frac{15x - 9y = -39}{19y = 66.5}$ $x = -0.5$ or $y = 3.5$ e.g. $3 \times -0.5 + 2y = 5.5$ or $3x + 2 \times 3.5 = 5.5$		$x = -0.5$ oe, $y = 3.5$ oe	4 M1 for coefficients of x or y the same with the correct operation to eliminate one variable (allow one arithmetic error in multiplication) or for correct rearrangement of one equation followed by substitution in the other. A1 dep on M1 M1 (dep on M1) for substituting for the other variable or starting again to eliminate the other variable A1 dep on first M1 NB: correct solution with no working scores no marks
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33 - (4MA0-W 2019-Paper 3HR-Q14) - ALGEBRA

(a)	e.g. $\frac{3(2w-3)}{21} + \frac{7(2w-5)}{21} (=2)$ or $\frac{3(2w-3) + 7(2w-5)}{21} (=2)$ or $3(2w-3) + 7(2w-5) = 2 \times 21$ e.g. $6w - 9 + 14w - 35 = 42$	4.3 oe	3 M1 for a method to deal with fractions eg. finds common denominator (21 or a multiple of 21) or multiplies by a common multiple in a correct equation. M1 for method to expand brackets and multiply by common denominator NB: condone one one error in expansion of brackets A1 dep on M1
(b)	$t^2 = \frac{3e+7}{e-3}$ $et^2 - 3t^2 = 3e + 7$ oe $t^2e - 3e = 7 + 3t^2$ or $-3t^2 - 7 = 3e - et^2$ oe	$e = \frac{3t^2 + 7}{t^2 - 3}$	4 M1 for squaring both sides M1 for multiplying by $(e-3)$ and removing bracket in a correct equation M1 for isolating terms in e on one side of a correct equation A1 or for $e = \frac{-3t^2 - 7}{3 - t^2}$ oe

34 - (4MA0-W 2019-Paper 3HR-Q16) - ALGEBRA

(a)	$p = kw^3$ oe $37.5 = k \times 5^3$ or $k = 0.3$	$p = 0.3w^3$ oe	3 M1 allow $w^3 = mp$ Do not allow $p = w^3$ M1 for a correct substitution into a correct equation; implies first M1 Award M2 if $k = 0.3$ oe is stated unambiguously (or $m = \frac{10}{3}$ oe) Condone use of proportional sign in place of equals sign A1 if $p = kw^3$ on answer line and $k=0.3$ seen elsewhere then award M1M1A1 B1ft If formula is in form $p = kw^3$ oe
(b)		19.2	



35 - (4MA0-W 2019-Paper 3HR-Q17) - ALGEBRA

		$125h^4g^6$	3	B2	If not B2 then award B1 for $ah^m g^n$ where 2 of a , m and n are correct. Condone inclusion of $\times$ signs
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36 - (4MA0-W 2019-Paper 3HR-Q21) - ALGEBRA

$(x+2)^2 + (2x+7)^2 = (x+14)^2$ oe $x^2 + 4x + 4 + 4x^2 + 28x + 49 = x^2 + 28x + 196$ $4x^2 + 4x - 143 (=0)$ oe $(2x+13)(2x-11) (=0)$ $x = 5.5$ (must be selected as the only solution)	67.5	6	M1 for a correct equation M1 independent mark for correct expansions A1 Correct 3 term quadratic M1 fit a 3 term quadratic (dep on first M1) for correct factorisation or use of formula or completing the square A1 dep on M3 A1 dep on M3
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1 - (4MA0-W 2015-Paper 3HR-Q5) - *FUNCTIONS & GRAPHS*

	$(-2, -4)(-1, -1)(0, 2)(1, 5)(2, 8)$ $(3, 11)(4, 14)$	Correct line between $x = -2$ and $x = 4$
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2 - (4MA0-W 2015-Paper 3HR-Q21) - *FUNCTIONS & GRAPHS*

(a)		$-\frac{1}{3}$
(b)		2.5 oe
(c)	$\frac{x+4}{2(x+4)-5}$	$\frac{x+4}{2x+3}$
(d)	$y(2x-5) = x$ $2xy - x = 5y$	$\frac{5x}{2x-1}$



3 - (4MA0-S 2016-Paper 3HR-Q18) - FUNCTIONS & GRAPHS

(a)		$\frac{1}{5}$	1
(b)		$\frac{1}{5}$	2
(c)		$-\frac{1}{3}$	1
(d)	$x = \frac{y}{3y+1}$ $x(3y+1) = y$ or $3xy + x = y$	$y = \frac{x}{3x+1}$ $y(3x+1) = x$ or $3xy + y = x$	3
	$3xy - y = -x$ or $y(3x - 1) = -x$ oe	$3xy - x = -y$ or $x(3y - 1) = -y$ oe	
		$\frac{x}{1-3x}$ or $\frac{-x}{3x-1}$	

4 - (4MA0-W 2016-Paper 3HR-Q9) - FUNCTIONS & GRAPHS

(a)	$(\frac{1}{2}(0-4), \frac{1}{2}(2-1))$	$(-2, \frac{1}{2})$
(b)	$\frac{2-(-1)}{0-(-4)}$ or $\frac{-1-2}{-4-0}$ oe	$\frac{3}{4}$
(c)	$y = \frac{3}{4}x + c$ or $y = mx + 2$ oe	$y = \frac{3}{4}x + 2$ oe

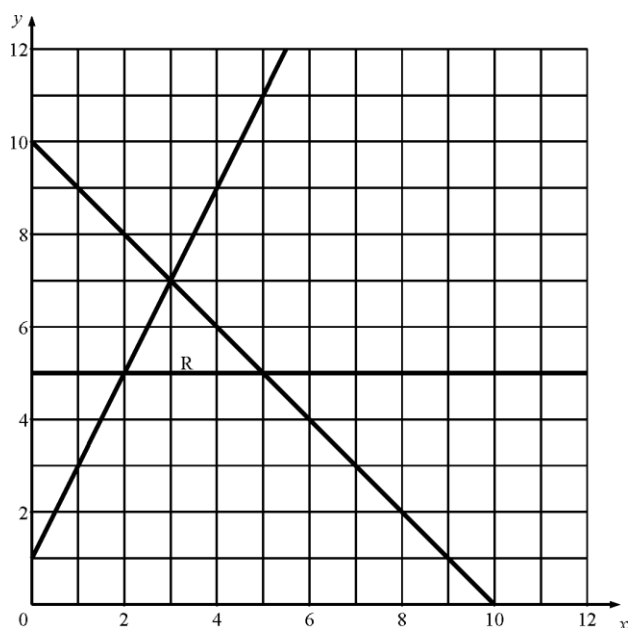


5 - (4MA0-W 2016-Paper 3HR-Q16) - FUNCTIONS & GRAPHS

(a)		2.2
(b)		1
(c)	$y(x-1) = 2x$ or $yx - y = 2x$ or $x(y-1) = 2y$ or $xy - x = 2y$ $x(y-2) = y$ or $y(x-2) = x$	$\frac{x}{x-2}$
(d)		2

6 - (4MA0-S 2017-Paper 3HR-Q13) - FUNCTIONS & GRAPHS

				M1	for either $y = 2x + 1$ or $x + y = 10$ drawn correctly
				M1	for all lines drawn correctly
		Correct region	3	A1	for all 3 lines correct and the region identified Lines may be full lines or broken lines



7 - (4MA0-W 2017-Paper 3HR-Q7) - FUNCTIONS & GRAPHS

<table><tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>y</td><td>10</td><td>8</td><td>6</td><td>4</td><td>2</td><td>0</td><td>-2</td></tr></table>	x	-2	-1	0	1	2	3	4	y	10	8	6	4	2	0	-2	$y = 6 - 2x$ drawn from $x = -2$ to $x = 4$	4
x	-2	-1	0	1	2	3	4											
y	10	8	6	4	2	0	-2											



8 - (4MA0-W 2017-Paper 3HR-Q19) - FUNCTIONS & GRAPHS

a		2	1
b		0.5 oe	1
c	$y(2-x) = 3$ or $x(2-y) = 3$ oe	$\frac{2x-3}{x}$	2
d	$\frac{3}{2 - \frac{2x+1}{3}}$ oe	$\frac{9}{5-2x}$	2

9 - (4MA0-S 2018-Paper 3HR-Q3) - FUNCTIONS & GRAPHS

(a)	$(-1, 6), (0, 4), (1, 2), (2, 0), (3, -2)$	correct line between $x = -1$ and $x = 3$	3	B3 for a correct line between $x = -1$ and $x = 3$ If not B3 then award B2 for a straight line segment through at least 3 of $(-1, 6), (0, 4), (1, 2), (2, 0), (3, -2)$ OR for all of $(-1, 6), (0, 4), (1, 2), (2, 0), (3, -2)$ plotted and not joined OR for a line drawn through $(0, 4)$ with a clear attempt at a gradient of -2 (eg a line through $(0, 4)$ and $(0.5, 2)$) If not B2 then award B1 for at least 2 correct points stated or plotted (may be in a table); ignore any incorrect points either plotted or evaluated OR for a line drawn with negative gradient through $(0, 4)$ OR for a straight line with gradient -2
(b)		$(1.5, 1)$ oe	1	B1 for $(1.5, 1)$ or ft from (a)

10 - (4MA0-S 2018-Paper 3HR-Q23) - FUNCTIONS & GRAPHS

(a)		$x > 4$	1	B1
(b)	$y^2 = 4 - x$ or $x^2 = 4 - y$	$4 - x^2$ oe	2	M1
				A1
(c)	$\sqrt{4 - (5 - x)(x - 1)}$	$x - 3$	4	M1
	$\sqrt{4 - (5x - 5 - x^2 + x)}$ or $\sqrt{4 - 5x + 5 + x^2 - x}$			M1
	$\sqrt{x^2 - 6x + 9}$			M1
	Alternative scheme	$x - 3$	4	A1 Allow $(3 - x)$ but not $\pm(x - 3)$
	$(5 - x)(x - 1) = 5x - 5 - x^2 + x (= 6x - 5 - x^2)$			M1 if simplified, must be correct
	$\sqrt{4 - (5x - 5 - x^2 + x)}$ or $\sqrt{4 - 5x + 5 + x^2 - x}$			M1 ft from their expansion (must be a quadratic)
	$\sqrt{x^2 - 6x + 9}$			M1
				A1 accept $(3 - x)$ but not $\pm(x - 3)$



11 - (4MA0-W 2018-Paper 3HR-Q4) - FUNCTIONS & GRAPHS

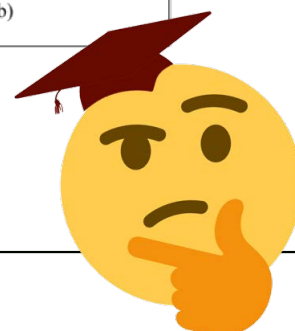
(a)	<table><tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>y</td><td>-6</td><td>-2</td><td>2</td><td>6</td><td>10</td><td>14</td></tr></table>	x	-2	-1	0	1	2	3	y	-6	-2	2	6	10	14	Correct line	3	B3	for a correct line between $x = -2$ and $x = 3$
	x	-2	-1	0	1	2	3												
y	-6	-2	2	6	10	14													
	If not B3 then award B2 for a correct line through at least 3 of $(-2, -6)$ $(-1, -2)$ $(0, 2)$ $(1, 6)$ $(2, 10)$ $(3, 14)$ OR for all of $(-2, -6)$ $(-1, -2)$ $(0, 2)$ $(1, 6)$ $(2, 10)$ $(3, 14)$ plotted, not joined OR line through $(0, 2)$ and clear attempt to use a gradient of 4 eg line through $(0, 2)$ and $(1, 10)$ If not B2 then award B1 for at least 2 correct points stated or plotted (may be in a table) OR for a line drawn with a positive gradient through $(0, 2)$ OR for a line with a gradient of 4																		
(b)	$4p + 2 = 50$	12	2	M1 A1	$4p + 2 = 50$														

12 - (4MA0-W 2018-Paper 3HR-Q23) - FUNCTIONS & GRAPHS

(a)	$(a+1)^2 = \frac{25}{9}$ $a+1 = (\pm)\frac{5}{3}$	$\frac{2}{3}$	3	M1 M1 or $a+1 = \frac{5}{3}$ or solving a correct quadratic equation of the form $ax^2 + bx + c = 0$ e.g. $a^2 + 2a - \frac{16}{9} = 0$ followed by $\left(a - \frac{2}{3}\right)\left(a + \frac{8}{3}\right) (= 0)$ $-2 \pm \sqrt{2^2 - 4 \times 1 \times -\frac{16}{9}}$ or $a = \frac{-2 \pm \sqrt{2^2 - 4 \times 1 \times -\frac{16}{9}}}{2}$ (allow 1 sign error) A1 (DEP on at least M1) for $\frac{2}{3}$ as the only value
(b)	$fg(x) = f\left(\frac{1}{x}\right) = \left(\frac{1}{x} + 1\right)^2$ $x^2\left(\frac{1}{x} + 1\right)^2 = \text{etc.}$	Shown	2	M1 A1
(c)	$y = (x+1)^2 \therefore \sqrt{y} = x+1$ or $x = (y+1)^2 \therefore \sqrt{x} = y+1$	$\sqrt{x} - 1$	2	M1 (accept $\pm\sqrt{y} = x+1$ or $\pm\sqrt{x} = y+1$) A1

13 - (4MA0-W 2019-Paper 3HR-Q6) - FUNCTIONS & GRAPHS

(a)	2, -1, $\frac{1}{2}$, $\frac{1}{3}$, 2, 7	Correct table	2	B2 If not B2 then award B1 for 2 or 3 correct y values
(b)		Correct graph	2	M1 for plotting at least 4 points correctly for their table (dep on B1 earned in (a)) A1 for a fully correct curve
(c)		-0.7, 2.7	2	B1 for -0.6 to -0.8 or ft graph B1 for 2.6 to 2.8 or ft graph NB: solutions must come from the candidate's graph Can fit from an incorrect graph dep on M1 scored in (b)



14 - (4MA0-W 2019-Paper 3HR-Q10) - *FUNCTIONS & GRAPHS*

$m = -3$ e.g. $y = -3x + c$ where $c \neq 5$ e.g. $-4 = "-3" \times 6 + c$ or $y - 4 = "-3"(x - 6)$ oe or $c = 14$	$y = -3x + 14$	3	M1 M1 allow 3 or $\frac{1}{3}$ only for "-3" for substitution of (6, -4) into $y = -3x + c$ or a correct equation or $L = 14 - 3x$ oe A1 oe NB: The equation can be in any form
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15 - (4MA0-W 2019-Paper 3HR-Q18) - *FUNCTIONS & GRAPHS*

(a)	$f(7) = \frac{3 \times 7}{4 - 7}$ oe $(=-7)$ or for $(gf(x)) = \frac{2\left(\frac{3x}{4-x}\right) + 1}{3}$	$-4\frac{1}{3}$ $\frac{3x-1}{2}$ oe $\frac{3(2x+1)}{11-2x}$	2 M1 A1 $-\frac{13}{3}$ or $-4.\dot{3}$ (not -4.3) 2 M1 A1 or for $\frac{3x}{2} - \frac{1}{2}$ NB an answer of $\frac{3y-1}{2}$ oe scores M1A0 2 M1 A1 numerator may not be factorised
(b)	$3y = 2x + 1$ or $3x = 2y + 1$ oe		
(c)	$\frac{3\left(\frac{2x+1}{3}\right)}{4 - \left(\frac{2x+1}{3}\right)}$ oe		



1 - (4MA0-W 2015-Paper 3HR-Q10) - MENSURATION

(a)	$\pi \times 11^2 (121\pi)(=380.1\dots)$ or $2 \times \pi \times 11^2 (242\pi)(=760.2\dots)$ or $2 \times \pi \times 11 \times 30 (660\pi) (=2073.4\dots)$	
	$2 \times "380" + "2073" \text{ or } "760.2" + "2073"$ $(242\pi + 660\pi \text{ or } 902\pi)$	
		2800
(b) (i)		29.5
(b) (ii)		30.5 or 30.49 rec

2 - (4MA0-W 2015-Paper 3HR-Q18) - MENSURATION

	$\frac{4}{3} \times \pi \times \left(\frac{18.6}{2}\right)^3 \text{ or } 3369(.282\dots)$ "3369(.282...)" $\div 2$	1680
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3 - (4MA0-W 2016-Paper 3HR-Q15) - MENSURATION

(a)	$l^2 = 12^2 + 4^2$ $\pi \times 4 \times \sqrt{12^2 + 4^2} \text{ or } \pi \times 4 \times \sqrt{160} \text{ or } \pi \times 4 \times 12.6 (4911064\dots) \text{ or } 50.56\pi \text{ or } \frac{1264}{25}\pi$	159
(b)	$\frac{12-h}{r} = \frac{12}{4} \text{ or } 4(12-h) = 12r \text{ or } \frac{h}{12} = \frac{4-r}{4} \text{ or } 4:12 = r:12-h \text{ oe}$ $h = \frac{12(4-r)}{4} \text{ or } h = 3(4-r) \text{ or } h = 12 - 3r$	$V = 12\pi r^2 - 3\pi r^3$
(c)	$\frac{dV}{dr} = 24\pi r - 9\pi r^2$ $24\pi r - 9\pi r^2 = 0$	$2\frac{2}{3}$



4 - (4MA0-S 2017-Paper 3HR-Q5) - MENSURATION

a	$\pi \times 2.5$ oe or $2 \times \pi \times \left(\frac{2.5}{2}\right)$			M1
		7.85	2	A1 7.85 – 7.86
b	$10 \times \frac{4.7}{2.5}$ oe or $10 \times \frac{470}{250}$ oe			M1 or for digits 188
		18.8	2	A1 accept 19 if 18.8 seen

5 - (4MA0-S 2017-Paper 3HR-Q19) - MENSURATION

$(V_c =) \frac{\pi}{3} \times 36^2 \times 53 (=22896\pi = 71930)$			M1	for volume of cone
$(V_H =) \frac{2\pi}{3} \times 36^3 (=31104\pi = 97716)$			M1	for volume of hemi-sphere
				NB : 54000π or 169646 implies first two method marks
$\pi \times r^2 \times 2r = \frac{2\pi}{3} \times 36^3 + \frac{\pi}{3} \times 36^2 \times 53$ oe			M1	(dep on at least M1) for forming an equation with correct volume expression for cylinder
$r = \sqrt[3]{\frac{54000\pi}{2\pi}} = 30$			M1	
$2 \times "30"$			M1	(dep previous M1)
	60	6	A1	

6 - (4MA0-W 2017-Paper 3HR-Q10) - MENSURATION

$18^2 - (14 \div 2)^2 (=275)$		4
$\sqrt{18^2 - (14 \div 2)^2}$ or $\sqrt{275}$ or $5\sqrt{11}$ or 16.5... or 16.6		
$0.5 \times 14 \times "16.5..."$ or $35\sqrt{11}$		
	116	
Alternative scheme		
$25(25 - 18)(25 - 18)(25 - 14)(= 13475)$ oe		4
$\sqrt{13475}$ oe		
	116	



7 - (4MA0-S 2018-Paper 3HR-Q15) - MENSURATION

(a)	$\pi \times 4^2 \times 12$	603	2	M1	Accept 3.14 or better for π
				A1	for answer in range 603 – 603.3
(b)	$\frac{21}{12}$ oe (=1.75) or $\frac{12}{21}$ oe (=0.571..) or $\frac{12}{8}$ oe (=1.5) or $\frac{8}{12}$ oe (=0.666...) or $\frac{d}{21} = \frac{8}{12}$	14	2	M1	for the correct linear scale factor or a correct equation (may be seen in ratio form)
				A1	
(c)	E.g. $\left(\frac{h}{12}\right)^3 = \frac{64V}{V}$ or $\left(\frac{h}{12}\right)^3 = 64$ or $\sqrt[3]{64}$ (= 4)	48	3	M1	Correct equation for height or correct expression for scale factor. ft from (a) if a value is used for the volume.
				M1	for a correct expression for height.
				A1	

8 - (4MA0-W 2018-Paper 3HR-Q5) - MENSURATION

$\frac{(24+30)}{2} \times 12 (= 324)$ $\sqrt{324}$ (= 18) 4 × '18'	72	4	M1	for a complete method for the area
			M1	
			M1	
			A1	

9 - (4MA0-W 2018-Paper 3HR-Q6) - MENSURATION

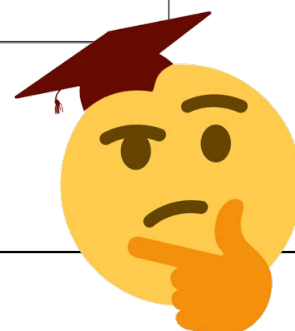
$\pi \times 80$ (= 251.327....) $\pi \times 80 - 2 \times 80$ (= 91.327...)	91.3	3	M1	oe
			M1	for a complete method
			A1	91.2 – 91.43

10 - (4MA0-W 2018-Paper 3HR-Q22) - MENSURATION

eg $\frac{1}{3} \times \pi \times (3r)^2 \times 4r$ (= $12\pi r^3$) or $\frac{1}{2} \times \frac{4}{3} \times \pi \times (3r)^3$ (= $18\pi r^3$) eg $\frac{1}{3} \times \pi \times (3r)^2 \times 4r + \frac{1}{2} \times \frac{4}{3} \times \pi \times (3r)^3$ eg $\frac{1}{3} \times \pi \times (3r)^2 \times 4r + \frac{1}{2} \times \frac{4}{3} \times \pi \times (3r)^3 = 330\pi$ $30\pi r^3 = 330\pi$	$\sqrt[3]{11}$	5	M1	for a method to find the volume of the cone or the hemisphere (condone missing brackets)
			M1	for a method to find the total volume of the cone and the hemisphere (condone missing brackets)
			M1	for a correct equation
			M1	for a correct simplified equation
			A1	

11 - (4MA0-W 2019-Paper 3HR-Q2) - MENSURATION

$\pi \times 15^2$ (= $225\pi = 706(.858...)$) or 707 or $2 \times \pi \times 15^2$ (= $450\pi = 1413(.7...)$) or 1414 110 × 55 (= 6050) "6050" – 2 × "706..."	4640	4	M1	for area of one or two circles
			M1	
			M1	both values must come from a correct method
			A1	for 4635 - 4640



12 - (4MA0-W 2019-Paper 3HR-Q22) - MENSURATION

	$\frac{x}{360} \times \pi \times 30 = 3\pi \quad \text{or} \quad 3\pi = 15x$ $\frac{36}{360} \times \pi \times 15^2 \text{ oe } (=70.6(85\dots)) \text{ or } 70.7$ or $\frac{1}{2} \times 15 \times 15 \times \sin 36 \text{ oe } (= 66.1258\dots)$ $\frac{36}{360} \times \pi \times 15^2 \text{ and } \frac{1}{2} \times 15 \times 15 \times \sin (36) \text{ oe}$	4.6	5	M1 for a correct first stage to find angle AOC A1 for (angle $AOC =$) 36° or $\frac{3\pi}{15}$ use of 0.1 oe as fraction of circle in area of sector calculation M1 for a correct method to find area of sector $OABC$ or area of triangle OAC (NB: $AC = 9.27\dots$, $OD = 14.2\dots$ where D is midpoint of AC) ft candidate's angle if first M1 awarded or an angle of 72° M1 for a correct method to find area of sector $OABC$ and area of triangle OAC ft candidate's angle if first M1 awarded or an angle of 72° A1 for 4.5 – 4.6
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1 - (4MA0-W 2015-Paper 3HR-Q6) - GEOMETRY

	$\frac{4+1}{2}$ or $\frac{1+9}{2}$	(2.5, 5)
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2 - (4MA0-W 2015-Paper 3HR-Q14) - GEOMETRY

	$180 - 140$ or 40	
	$360 \div "40"$	
	$n = 9$	
	$180 - 360 \div (2 \times "9")$	
		160
	Alternative scheme	
	$180 - 140$ or 40	
	$"40" \div 2$	
	20	
	$180 - "20"$	
		160

3 - (4MA0-W 2015-Paper 3HR-Q19) - GEOMETRY

	$8x = 6 \times 6.5$	4.875
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4 - (4MA0-S 2016-Paper 3HR-Q4) - GEOMETRY

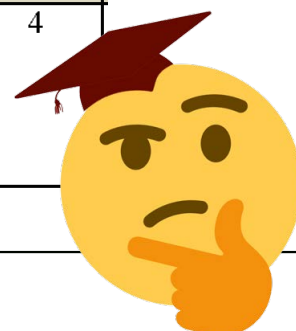
$\frac{360}{8}$ or $180 - \frac{(8-2) \times 180}{8}$		2
	45	

5 - (4MA0-S 2016-Paper 3HR-Q11) - GEOMETRY

gradient = -2		3
$1 = 3 \times '(-2)' + c$ or $y - 1 = '-2'(x - 3)$ oe		
	$y = -2x + 7$	

6 - (4MA0-S 2016-Paper 3HR-Q13) - GEOMETRY

$3.6^2 + 9.8^2$ or 109		4
$\sqrt{"3.6^2 + 9.8^2"}$ or $\sqrt{109}$ (=10.4...)		
$\sqrt{"109" - 8.4^2}$	6.2	



7 - (4MA0-S 2016-Paper 3HR-Q17) - GEOMETRY

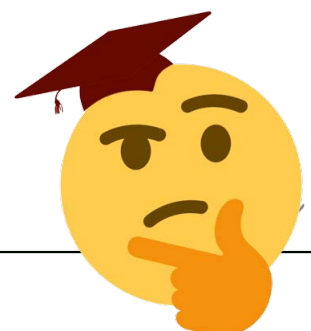
(a)	$\frac{9}{4}$ or $\frac{4}{9}$ oe	11.25	2
(b)	Eg $\frac{5}{\text{"11.25"}} = \frac{x}{x+4.5}$ or $\frac{4}{9} = \frac{x}{x+4.5}$ or $\frac{5}{4} = \frac{4.5}{x}$ or $4.5 \div \frac{\text{"11.25"}-5}{5}$ or $2.25x = x + 4.5$ oe	3.6	2
(c)	2.25^2 or 5.0625 or $\frac{16}{81}$ or $\frac{81}{16}$ or $81 : 16$ or $16 : 81$ or $\frac{16}{65}$ or $\frac{65}{16}$ or $65 : 16$ or $16 : 65$ $5.0625y - y = x$ or $\frac{65}{16} = \frac{x}{y}$ oe	$\frac{16x}{65}$	3

8 - (4MA0-S 2016-Paper 3HR-Q19) - GEOMETRY

100×2 $360 - \text{"100} \times 2" (=160)$	20	3
$360 - (90 + 90 + \text{"160"})$		

9 - (4MA0-W 2016-Paper 3HR-Q5) - GEOMETRY

(a)	$\pi \times 6.5^2$	133
(b)	$10.5^2 - 6.5^2$ or $110.25 - 42.25$ or 68 $\sqrt{10.5^2 - 6.5^2}$ or $\sqrt{110.25 - 42.25}$ or $\sqrt{68}$ oe	8.25



10 - (4MA0-W 2016-Paper 3HR-Q10) - GEOMETRY

(a)		48
(b)	angle $AOM = 48^\circ$ and $AM = 8$ (where M is the midpoint of AB) or angle $OAB = 42^\circ$ (may be shown on diagram) $\sin 48 = \frac{8}{r}$ or $\frac{16}{\sin 96} = \frac{r}{\sin 42}$ or $16^2 = r^2 + r^2 - 2r^2 \cos 96$ oe $r = \frac{8}{\sin 48}$ or $r = \frac{16 \sin 42}{\sin 96}$ or $r = \sqrt{\frac{16^2}{2(1 - \cos 96)}}$ oe	10.8

11 - (4MA0-S 2017-Paper 3HR-Q3) - GEOMETRY

Angle $BCD = 142^\circ$ or Angle $BCF = 180 - 62 (=118^\circ)$ or Angle $ABC = 180 - 142 (=38)$ 360 - 142 - "118" or "38" + 62			M1 for angle $BCD = 142^\circ$ or angle $BCF = (180 - 62)^\circ$
			M1 for a complete method to find x
	100	3	A1

12 - (4MA0-S 2017-Paper 3HR-Q17) - GEOMETRY

$12 \times (12 + 6) = 9 \times (9 + BC)$ oe or $12 \times (12 + 6) = 9 \times AC$ oe or $AC = 24$			M1
$(BC =) \frac{12 \times (12 + 6)}{9} - 9$ oe or $24 - 9$			M1 for a complete method
	15	3	A1

13 - (4MA0-W 2017-Paper 3HR-Q2) - GEOMETRY

$360 \div 18$ or $\frac{(2n-4)90}{n} = 162$ or $\frac{(n-2)180}{n} = 162$		
	20	2

14 - (4MA0-W 2017-Paper 3HR-Q3) - GEOMETRY

$\left(\frac{4+8}{2}, \frac{11+3}{2} \right)$		
	(6, 7)	2



15 - (4MA0-W 2017-Paper 3HR-Q15) - GEOMETRY

$-4y = 5 - 3x$	No with correct figures	4
$y = 0.75x (+c)$ or gradient of A = 0.75 oe		
gradient of B = $\frac{3-7}{-1-4} \left(= \frac{4}{5} \right)$ oe		

16 - (4MA0-W 2017-Paper 3HR-Q17) - GEOMETRY

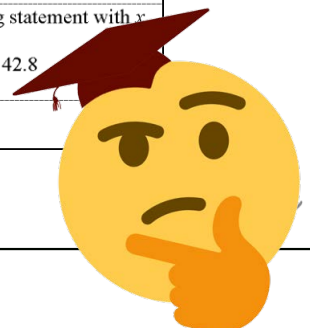
e.g. $\frac{12}{3} = \frac{RX}{4}$ or $12 \times 4 = XR \times 3$ or $3x = 48$	9.5	3
$(XR =) 12 \times 4 \div 3 (=16)$		

17 - (4MA0-S 2018-Paper 3HR-Q5) - GEOMETRY

(a) $\frac{360}{n} = 24$ oe or $\frac{360}{24}$ or $180 - \frac{180(n-2)}{n} = 24$ oe or $\frac{180(n-2)}{n} = 156$ oe	15	2	M1 for a correct equation or a correct calculation A1 cao
(b) $(2 \times 5 - 4) \times 90 (=540)$ or $(5 - 2) \times 180 (=540)$ $540 - (90 + 137 + 90 + 128)$ or $540 - 445$	95	3	M1 Complete method to find sum of interior angles. M1 dep A1 cao SC : If no marks awarded then award B1 for $137 + 128 + 90 + 90 + t = m$ oe or $m - (137 + 128 + 90 + 90)$ or $m - 445$ where $m > 360$
Alternative scheme – using exterior angles $2 \times (180 - 90) + (180 - 137) + (180 - 128) + (180 - t) = 360$ or $90 + 43 + 90 + 52 + 180 - t = 360$ oe $455 - 360 (=t)$ or $90 + 43 + 90 + 52 + 180 - 360 (=t)$ oe	95	3	M1 for a correct equation using exterior angles M1 (dep) for isolating t on one side of the equation A1 cao

18 - (4MA0-S 2018-Paper 3HR-Q10) - GEOMETRY

$x^2 + 11^2 = 15^2$ or $15^2 - 11^2$ oe	10.2	3	M1 for a correct use of Pythagoras's theorem M1 for an angle found from a correct method (42.8... , 47.1...) and used with a correct trig statement with x eg. $\sin 42.8 = \frac{x}{15}$
$\sqrt{15^2 - 11^2}$ or $\sqrt{104}$ or $2\sqrt{26}$			M1 dep on M1 M1 for correct trig statement with x the subject eg. $(x =) 15 \times \sin 42.8$
			A1 for answer in range 10.19 – 10.2



19 - (4MA0-S 2018-Paper 3HR-Q11) - GEOMETRY

(a)	$y = \frac{20-4x}{5}$ or $y = \frac{20}{5} - \frac{4}{5}x$	$-\frac{4}{5}$ oe	2	M1 for correct rearrangement of equation for term in x (condone any errors in constant term) A1
(b)	$y = mx + 4$ or $y = 2x + c$	$y = 2x + 4$	2	M1 fit “4” from (a) m and c may be left as letters or shown as any values (c may be 0) OR for an answer of $2x + 4$ or $M = 2x + 4$
				A1 for $y = 2x + 4$ oe

20 - (4MA0-S 2018-Paper 3HR-Q12) - GEOMETRY

(a) (i)		102	1	B1
(ii)			1	B1 (dep on B1 in (i)) for <u>opposite angles</u> of a <u>cyclic quadrilateral</u> add up to 180°
(b)	angle $RSQ = 62$ or angle $PRQ = (180 - 62 - 78) (=40)$	40	2	M1 fit from (a) for “102” – 62 may be marked on the diagram A1

21 - (4MA0-W 2018-Paper 3HR-Q2) - GEOMETRY

	$\angle ADE = 180 - 124 (=56)$ or $\angle ADE = \frac{360 - 2 \times 124}{2} (=56)$ $\angle DAE = \angle ADE = '56'$ $\angle AEC = 2 \times '56'$	112	4	M1 M1 M1 for $2 \times '56'$ or for $\angle AED = 180 - 2 \times '56' (=68)$ and $\angle AEC = 180 - '68'$ A1
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22 - (4MA0-W 2018-Paper 3HR-Q11) - GEOMETRY

	$20^2 - 10^2 (=300)$ $BD = \frac{\sqrt{300}}{2} (=8.66\dots)$ $AD^2 = 10^2 + (0.5 \times \text{their } BC)^2$	13.2	4	M1 M1 M1 (indep) A1 for answer in the range 13.2 – 13.25
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23 - (4MA0-W 2018-Paper 3HR-Q12) - GEOMETRY

(a)	$\frac{12}{8}$ oe or $\frac{8}{12}$ oe or $\frac{5}{8}$ oe or $\frac{8}{5}$ oe	7.5	2	M1 A1 oe
(b)	$13.5 - \frac{8}{12} \times 13.5$ oe	4.5	2	M1 for a complete method A1 oe



24 - (4MA0-W 2018-Paper 3HR-Q19) - GEOMETRY

$\angle TOB = 2 \times 78 (= 156)$ Reflex $\angle TOB = 360 - '156' (= 204)$ and $\angle OTP = 90$ $\angle OBT = \angle OTB = (180 - 56) \div 2 (= 12)$ and $\angle OTP = 90$ $\angle OBP = 360 - '204' - 90 - 34$ or $\angle OBP = 180 - 90 - '12' \times 2 - 34$ NOTE: Values could be marked on the diagram	32	4	M1 M1 for method to find reflex $\angle TOB$ and $\angle OTP$ M1 for method to find $\angle OBT$, $\angle OTB$ and $\angle OTP$ M1 for a complete method A1
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25 - (4MA0-W 2019-Paper 3HR-Q7) - GEOMETRY

540 or $5 \times \left(180 - \frac{360}{5}\right)$ or 3×180 oe e.g. $2x + 37 + 3x + 90 + 130 + 3x - 5 = n$ or $8x = "540" - 252 (= 288)$	36	3	M1 for use of 540 or a correct calculation for angles in a pentagon M1ft for an equation or correct calculation for x NB: n can be any value provided $n > 360$ A1 cao
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1 - (4MA0-W 2015-Paper 3HR-Q11) - TRIGONOMETRY

	$\tan A = \frac{80}{35} \text{ or } \tan B = \frac{35}{80}$	
	$(A =) \tan^{-1}\left(\frac{80}{35}\right) \text{ or } (B =) \tan^{-1}\left(\frac{35}{80}\right)$	
	$(A =) 66.37... \text{ or } (B =) 23.62...$	
		204

2 - (4MA0-W 2015-Paper 3HR-Q23) - TRIGONOMETRY

	$\frac{\sin 47}{13.8} = \frac{\sin MLN}{8.5}$	
	$MLN = \sin^{-1}\left(\frac{\sin 47 \times 8.5}{13.8}\right)$	
	$MLN = 26.7(73...)$	
	$LMN = 180 - 47 - "26.7..." \text{ or } 106(.2260622...)$	
	$\frac{1}{2} \times 8.5 \times 13.8 \times \sin("106")$	
		56.3



3 - (4MA0-S 2016-Paper 3HR-Q22) - TRIGONOMETRY

$\frac{30}{360} \times \pi r^2 - 0.5r^2 \sin 30 = 100 \text{ oe}$ $r^2 \left(\frac{30\pi}{360} - 0.5 \sin 30 \right) = 100$ $r^2 \left(\frac{\pi - 3}{12} \right) = 100$		6
$r^2 = \frac{1200}{\pi - 3}$		
$r = \sqrt{\frac{1200}{\pi - 3}}$		
$2\pi \times \sqrt{\frac{1200}{\pi - 3}} \times \frac{30}{360} \text{ oe eg } 2\pi \times 92 \dots \times \frac{1}{12}$		
	48.2	

4 - (4MA0-S 2017-Paper 3HR-Q14) - TRIGONOMETRY

Scheme 1 (interior angle and angle ADC and an angle in triangle ADC)		Let X be midpoint of DC	
(Angle DEA) = $\frac{(5-2) \times 180}{5} = 108$		M1	or for 108 seen as an interior angle
Angle EDA or $EAD = (180 - 108) \div 2 = 36$		M1	
Angle ADC or $ACD = 108 - 36 = 72$ or Angle $DAC = 108 - 2 \times 36 (=36)$ or Angle $DAC = \cos^{-1} \left(\frac{16.18^2 + 16.18^2 - 10^2}{2 \times 16.18 \times 16.18} \right)$ Angle DAX or $CAX = (108 - 2 \times 36) \div 2 (=18)$		M1	Angles may be seen on diagram
E.g. $AX = 5 \times \tan 72 (=15.38\dots)$ or $AX = 5 \div \tan 18 (=15.38\dots)$ or $AX = 5 \times \tan ADC$ or $AX = 5 \div \tan DAX$ or $AD^2 = 10^2 + 10^2 - 2 \times 10 \times 10 \cos 108 (=261.8)$ or $AD = \sqrt{10^2 + 10^2 - 2 \times 10 \times 10 \times \cos 108} (=16.18)$ or $AD = \frac{10 \times \sin 72}{\sin 36} (=16.18)$		M1	or for $AD = \frac{10}{\sin 36} \times \sin 108 (=16.18\dots)$ or $AD = \frac{10}{\sin 36} \times \sin 72$ Allow 16 or 16.2 for AD throughout NB: Allow the value on the diagram for angle ADC or DAX if used in an otherwise correct trig statement
E.g. Area = $\frac{1}{2} \times 10 \times "15.38\dots"$ oe or $0.5 \times 10 \times "16.18" \times \sin 72$ or $0.5 \times "16.18" \times "16.18" \times \sin 36$ or $0.5 \times 10 \times "16.18" \times \sin ADC$ or $0.5 \times "16.18" \times "16.18" \times \sin DAX$		M1	dep on previous M1 NB: Allow the value on the diagram for angle ADC or DAX if used in an otherwise correct area statement
	76.9	6	A1 for answer in the range 76.5 – 77 SC: B4 for an answer in the range 53 – 53.5



Scheme 2 (only interior angle needed)			Let X be midpoint of DC
$(\text{Angle } DEA) = \frac{(5-2) \times 180}{5} = 108$			M1 or for 108 seen as an interior angle
$AD^2 = 10^2 + 10^2 - 2 \times 10 \times 10 \cos 108 (=261.8)$ or $AD = \sqrt{10^2 + 10^2 - 2 \times 10 \times 10 \cos 108} (=16.18)$			M1 Allow 16 or 16.2 for AD throughout
$AX^2 = "261.8" - 5^2 (=236.8)$ or $AX^2 = "16.18^2 - 5^2 (=236.8)$			M1
$\sqrt{"236.8"} (=15.38..)$			M1
$0.5 \times 10 \times "15.38"$			M1
	76.9	6	A1 for answer in the range 76.5 – 77
SC: B4 for an answer in the range 53 – 53.5			

5 - (4MA0-S 2017-Paper 3HR-Q21) - TRIGONOMETRY

$((BD)^2 =) (x-2)^2 + (x-3)^2 - 2(x-2)(x-3)\cos(120)$			M1
$(x-2)^2 = x^2 - 2x - 2x + 4$ oe $(x-3)^2 = x^2 - 3x - 3x + 9$ oe			M1 (independent) correct expansion of $(x-2)^2$ or $(x-3)^2$
$x^2 - 4x + 4 + x^2 - 6x + 9 + x^2 - 5x + 6 (=3x^2 - 15x + 19)$			A1 correct quadratic for BD^2 with all terms expanded may not be simplified
Area = $2BD^2$ oe or Area = $2 \times ("3x^2 - 15x + 19")$			M1 (independent)
	$6x^2 - 30x + 38$	5	A1

6 - (4MA0-W 2017-Paper 3HR-Q21) - TRIGONOMETRY

$(OB^2 =) 12^2 + 16^2 - 2 \times 12 \times 16 \times \cos(60^\circ)$		5
$(OB =) \sqrt{208}$ or $4\sqrt{13}$ or 14.4.... or $(OB^2) = 208$		
$0.5 \times 12 \times 16 \times \sin(60^\circ) (=83.1... \text{ or } 48\sqrt{3})$ or $\frac{38}{360} \times \pi \times "14.4" \times "14.4" (=68.9...)$ or $\frac{38}{360} \times \pi \times "208" (=68.9...)$		
$0.5 \times 12 \times 16 \times \sin(60^\circ) + \frac{38}{360} \times \pi \times "14.4" \times "14.4"$ $(68.9.... + 83.1...)$		
	152	

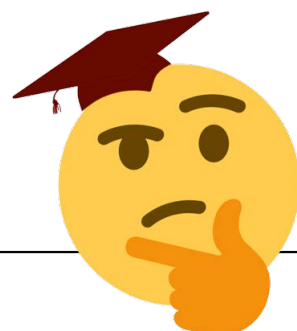


7 - (4MA0-S 2018-Paper 3HR-Q21) - TRIGONOMETRY

(a)	$\frac{1}{2} \times 7 \times 10 \times \sin 105$	33.8	2	M1 A1 for answer in range 33.8 – 33.81
(b)	$(AB^2 =) 7^2 + 10^2 - 2 \times 7 \times 10 \times \cos(105)$	45.2	5	M1
	$(AB =) \sqrt{100 + 49 - 36.2(346)}$ $(= \sqrt{185.2(346)} = 13.6...)$			M1 for correct order of operations and square root
	$\frac{10}{\sin A} = \frac{13.6}{\sin 105}$ oe or $10^2 = 7^2 + 13.6^2 - 2 \times 7 \times 13.6 \times \cos A$ or $\frac{1}{2} \times 7 \times 13.6 \times \sin A (= 33.8(074...))$ or E.g. $\frac{\sin B}{7} = \frac{\sin 105}{13.6...}$ or angle $B = 29.7...$			M1 (dep on 1 st M1) ft 13.6 ft 33.8 dep on M1 in (a) or for a start to a method to find angle B
	E.g. $\sin A = \frac{10 \sin 105}{13.6} (= \frac{9.65(925)}{13.6} = 0.7(09712))$ or $\sin A = \frac{33.8}{\frac{1}{2} \times 7 \times 13.6} (= \frac{33.8}{47.6(353)} = 0.7(09712))$ or $\cos A = \frac{7^2 + 13.6^2 - 10^2}{2 \times 7 \times 13.6} (= 0.7(03...))$ or $180 - 105 - \sin^{-1}\left(\frac{\sin 105}{13.6...} \times 7\right)$			M1 for a correct expression or value for $\sin A$ or $\cos A$ or A
				A1 for answer in range 45.2 to 45.3

8 - (4MA0-W 2019-Paper 3HR-Q19) - TRIGONOMETRY

$CA = \sqrt{15^2 + 10^2} (= \sqrt{325} = 18(0...))$ oe or $C \text{ to } X = \sqrt{7.5^2 + 5^2} (= 9(0...))$ oe		4	M1 Where X is the midpoint of the rectangle
$\cos CEA = \frac{12^2 + 12^2 - 18.01^2}{2 \times 12 \times 12} (= -\frac{37}{288} = 0.128(4...))$ oe or $\sin CEX = \frac{9.01}{12}$ oe $CEA = \cos^{-1}\left(\frac{12^2 + 12^2 - 18.01^2}{2 \times 12 \times 12}\right)$ oe or $CEA = 2 \times \sin^{-1}\left(\frac{9.01}{12}\right)$ oe			M1 or for a fully correct method to find angle CEA or CAE ($= 41.2...$) it must be clear that this is the angle that the candidate is intending to find M1 or for $180 - 2 \times 41.2$ oe
	97.4		A1 for 97.3 – 97.4



1 - (4MA0-W 2016-Paper 3HR-Q17) - SETS

(a)		
(b)		{2, 5, 7, 8}
(c)		{9, 12}
(d)		6

2 - (4MA0-S 2018-Paper 3HR-Q6) - SETS

(a)		B	1	B1	cao
(b)		Description	2	M1	for reference to both - length greater than 20cm - weigh more than 1 kg or for identifying $\cup$ as 'or'
				A1	for a complete correct statement eg 'fish that have length greater than 20cm OR weigh more than 1 kg (or both)' (accept and/or)
(c)		Explanation	1	B1	for a complete correct statement eg ' no fish that are less than 1 year old and weigh more than 1 kg', 'all the fish that weigh more than 1 kg are older than 1 year'

3 - (4MA0-W 2018-Paper 3HR-Q10) - SETS

(a)		2, 3, 4, 6, 8, 9, 10, 12	1	B1	
(b)		5, 7, 11, 13	2	B2	(B1 any set of 4 elements which satisfies exactly one of $A \cap C = \emptyset$, $B \cap C = \emptyset$ or just 2 or 3 of 5, 7, 11, 13 or all four correct values and one incorrect value eg 1, 5, 7, 11, 13)



1 - (4MA0-W 2015-Paper 3HR-Q3) - STATISTICS

	$0 \times 5 + 1 \times 8 + 2 \times 2 + 3 \times 3 + 4 \times 2$ or $0 + 8 + 4 + 9 + 8$	29
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2 - (4MA0-W 2015-Paper 3HR-Q12) - STATISTICS

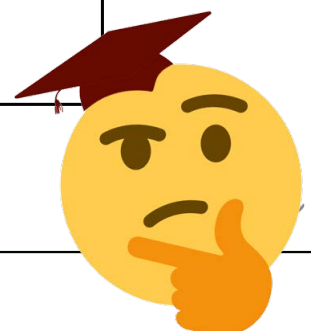
(a)	$18 - 10$	8
(b)		

3 - (4MA0-W 2015-Paper 3HR-Q16) - STATISTICS

(a)		8, 25, 50, 90, 112, 120
(b)	Plotting points from table at ends of interval Points joined with curve or line segments	
(c)	60 (or 60.5) indicated on cf graph or stated	approx 33

4 - (4MA0-S 2016-Paper 3HR-Q10) - STATISTICS

$3 \times 13 + 10 \times 10 + 17 \times 16 + 24 \times 7 + 31 \times 4$ Or $39 + 100 + 272 + 168 + 124$		3
	703	



5 - (4MA0-S 2016-Paper 3HR-Q16) - STATISTICS

(a)	1 Square = 0.5 or 2 squares = 1 oe Or fd $\left(\frac{10}{5} = 2\right)$ calculated or marked at correct place on vertical axis with no contradictions $1 \times 10 + 2 \times 5 + 3 \times 5 (=10 + 10 + 15)$ oe	35	3
(b)		Correct block	1

6 - (4MA0-W 2016-Paper 3HR-Q14) - STATISTICS

(a)		Correct points Curve or line segments through points
(b)	74 (approx) corresponding to $t = 230$ $92 - 74 = 18$ (approx)	18 (approx)

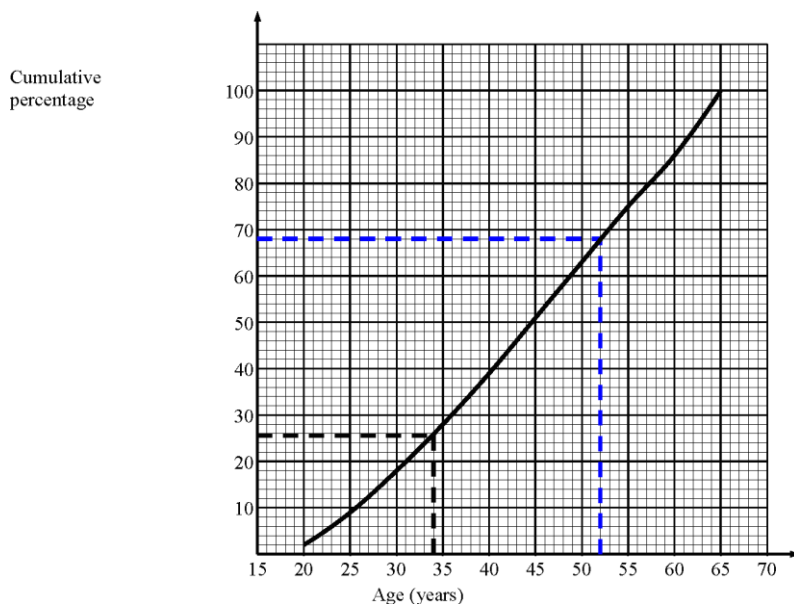
7 - (4MA0-S 2017-Paper 3HR-Q6) - STATISTICS

a	$\frac{a+b+c}{3} = 21$ or $\frac{a+b}{2} = 19$ or $3 \times 21 (=63)$ or $2 \times 19 (=38)$ $3 \times 21 - 2 \times 19$	25	3	M1 M1 for a complete method A1
b	$2 \times 19 - 20 (=18)$ or $21 \times 3 - 20 - "25" (=18)$ "25" – "18"	7	3	M1 fit from (a) for a complete method to find age of 3 rd person M1 dep or for $18 - 25$ A1 fit from answer in (a)



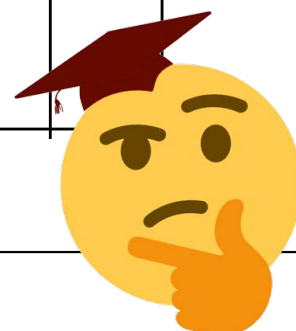
8 - (4MA0-S 2017-Paper 3HR-Q12) - STATISTICS

a	2, 9, 18, 28, 39, 51, 63, 75, 86, 100	Correct table	1	B1
b				M1 (ft from sensible table i.e. clear attempt at addition) for at least 8 points plotted correctly at end of interval or for all 10 points plotted consistently within each interval in the freq table at the correct height
		Correct cf graph	2	A1 accept curve or line segments accept graph that is not joined to (0,15)
c	E.g. for a mark drawn at 25 on their cumulative frequency diagram			M1 for intention to use 25 on cf axis ft from a cumulative frequency graph provided method is shown
		33 – 35	2	A1 33 - 35 ft from a cumulative frequency graph provided method is shown
d	E.g. reading of 66 – 68 (%) or reading from graph at $A = 52$ or mark on cf axis from using $A = 52$			M1 for a reading taken from 52 on age axis ft from a cumulative frequency graph provided method is shown
	$\frac{68}{100} \times 1200(000)$			M1 (dep)
		792000 – 816000	3	A1 for answer in the range 792000 – 816000



9 - (4MA0-W 2017-Paper 3HR-Q9) - STATISTICS

a		$100 < w \leq 110$	1
b	$85 \times 3 + 95 \times 5 + 105 \times 7 + 115 \times 4 + 125$ $255 + 475 + 735 + 460 + 125$		3
		2050	



10 - (4MA0-W 2017-Paper 3HR-Q12) - STATISTICS

a		correct graph	2
b		57 – 59	2
c		8	2

11 - (4MA0-S 2018-Paper 3HR-Q8) - STATISTICS

(a)		4 – 6	1	B1
(b)	$2 \times 5 + 5 \times 12 + 8 \times 10 + 11 \times 4 + 14 \times 1$ or $10 + 60 + 80 + 44 + 14 (= 208)$	6.5	4	M2 for at least 4 correct products added (need not be evaluated) If not M2 then award M1 for consistent use of value within interval (including end points) for at least 4 products which must be added OR correct mid-points used for at least 4 products and not added
	$\frac{2 \times 5 + 5 \times 12 + 8 \times 10 + 11 \times 4 + 14 \times 1}{5 + 12 + 10 + 4 + 1} \left(= \frac{208}{32} \right)$			M1 dep on at least M1 Allow division by their $\sum f$ provided addition or total under column seen
				A1 for 6.5 or $6\frac{1}{2}$ allow 6 or 7 if 6.5 oe seen or $208 \div 32$ seen

12 - (4MA0-S 2018-Paper 3HR-Q13) - STATISTICS

(a)	(CF =) 44	350	2	M1 Stated or marked on graph, or corresponding vertical line marked. Also allow 44.5
				A1 Allow 345 – 355
(b)	80 (may be seen on graph)	8	2	M1 for use of the graph at 500 calories (can be indicated by a vertical line from 500 to the curve)
				A1



13 - (4MA0-W 2018-Paper 3HR-Q16) - STATISTICS

(a)		700	1	B1	Answer in the range 700 - 720
(b)	eg $Q_1 = 510$, eg $Q_3 = 870$	360	2	M1	for a correct method to identify lower and upper quartiles eg readings from 30 and 90 from the vertical axis
				A1	Answer in the range 330 - 380
(c)	$\frac{85}{100} \times 120 (= 102)$ or $\frac{15}{100} \times 120 (= 18)$	940	3	M1	for using the graph to find the value of N
				A1	930 - 950

14 - (4MA0-W 2018-Paper 3HR-Q20) - STATISTICS

	e.g. $5 \times 25 (= 125)$ $10 \times 10 \times 3 (= 300)$ Area from 55 to 90 is $5 \times '25' + 10 \times 10 \times 3 (= 425)$	$\frac{425}{1875}$	3	M1	for frequency found for any bar between 10 and 55 or between 55 and 90
				M1	for a complete method to find the number of snails with lengths more than 55 mm
				A1	oe

15 - (4MA0-W 2019-Paper 3HR-Q13) - STATISTICS

(a)	15, 40, 120, 170, 190, 200	Correct table	1	B1	For correct cumulative frequencies
(b)			2	M1	ft from (a) if only one addition error for at least 4 points plotted correctly at end of interval or for all 6 points plotted consistently within each interval in the frequency table at the correct height (Eg. using values of 20, 40, 60 etc on x axis)
		Correct cumulative frequency graph		A1	accept curve or line segments accept curve which is not joined to (0,0)
(c)		54 – 58	1	B1	ft from their cf graph
(d)	e.g. a reading of 162		2	M1	for reading from the cf axis using a mark of 75
		38 – 44		M1	for 38 – 44 or ft from their cf graph provided method is shown



1 - (4MA0-W 2015-Paper 3HR-Q22) - PROBABILITY

(a)	$\frac{2}{7} \times \frac{1}{6}$ or $\frac{3}{7} \times \frac{2}{6}$ $\frac{2}{7} \times \frac{1}{6} + \frac{3}{7} \times \frac{2}{6}$	$\frac{8}{42}$
(b)	$\frac{2}{7} \times \frac{3}{6}$ or $\frac{3}{7} \times \frac{2}{6}$ or $\frac{1}{7} \times \frac{1}{6}$ $\frac{2}{7} \times \frac{3}{6} + \frac{3}{7} \times \frac{2}{6} + \frac{1}{7} \times \frac{1}{6} + \frac{1}{7} \times \frac{1}{6}$	$\frac{14}{42}$

2 - (4MA0-S 2016-Paper 3HR-Q3) - PROBABILITY

$\frac{35}{50} \times 300$ oe, eg 35×6 , 0.7×300 , etc	210	2
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3 - (4MA0-S 2016-Paper 3HR-Q9) - PROBABILITY

(a)	$1 - (0.15 + 0.1 + 0.05 + 0.2 + 0.15)$	0.35	2
(b)	$0.15 + 0.05 + 0.2$	0.4	2

4 - (4MA0-S 2016-Paper 3HR-Q14) - PROBABILITY

(a)		Correct probabilities	2
(b)	$0.35 + 0.05 \times 0.35 + 0.05 \times 0.05 \times 0.35$ oe $(=0.35 + 0.0175 + 0.000875)$	0.368375	3



5 - (4MA0-W 2016-Paper 3HR-Q4) - PROBABILITY

(a)	$1 - 0.5 - 0.15 - 0.05$	0.3
(b) (i)	40×0.15	6
(ii)	40×0.5 or 20 and 40×0.05 or 2 "20" $\times$ 1 + "6" $\times$ 5 + "2" $\times$ 10	70
	Alternative Method $1 \times 0.50 + 5 \times 0.15 + 10 \times 0.05$ or 1.75 "1.75" $\times$ 40	70

6 - (4MA0-W 2016-Paper 3HR-Q18) - PROBABILITY

(a)	$\frac{70}{100} \times \frac{30}{100}$ oe	$\frac{21}{100}$ oe
(b) (i)	$\frac{10}{100} \times \frac{9}{99}$ oe	$\frac{1}{110}$
(b) (ii)	$\frac{2}{100} \times \frac{7}{99}$ or $\frac{7}{100} \times \frac{2}{99}$ or $\frac{14}{9900}$ or $\frac{68}{100} \times \frac{67}{99}$ or $\frac{4556}{9900}$ oe $\frac{2}{100} \times \frac{7}{99} + \frac{7}{100} \times \frac{2}{99} + \frac{68}{100} \times \frac{67}{99}$ oe	$\frac{382}{825}$
	<u>With replacement method</u> $\frac{2}{100} \times \frac{7}{100}$ or $\frac{14}{10000}$ or $\frac{68}{100} \times \frac{68}{100}$ or $\frac{4624}{10000}$ oe $\frac{2}{100} \times \frac{7}{100} + \frac{7}{100} \times \frac{2}{100} + \frac{68}{100} \times \frac{68}{100}$ or $\frac{1163}{2500}$ or 0.4652 oe	



7 - (4MA0-S 2017-Paper 3HR-Q11) - PROBABILITY

a	Complete correct binary structure for selection of two counters OR At least one additional red branch labelled $\frac{9}{20}$ and at least two blue branches labelled $\frac{11}{20}$			M1	
		Correct probability tree diagram	2	A1	
b	$\frac{9}{20} \times \frac{11}{20}$			M1	for $\frac{9}{20} \times \frac{11}{20}$,
		$\frac{99}{400}$	2	A1	(ft diagram) for $\frac{99}{400}$ or 0.2475 or 24.75%
c	$\frac{9}{20} \times \frac{9}{20}$ or $\frac{11}{20} \times \frac{11}{20}$			M1	for one correct product ft from diagram
					M1 for $2 \times \frac{9}{20} \times \frac{11}{20}$, oe (ft from (a))
	$\frac{9}{20} \times \frac{9}{20} + \frac{11}{20} \times \frac{11}{20}$			M1	for the complete method ft from diagram
		$\frac{202}{400}$	3	A1	$\frac{202}{400}$ oe or 0.505 or 50.5%



8 - (4MA0-W 2017-Paper 3HR-Q22) - PROBABILITY

$\frac{4}{12} \times \frac{3}{11} \times \frac{4}{10} (= \frac{48}{1320} = \frac{2}{55})$ oe	$\frac{36}{55}$	5
$3 \times \frac{4}{12} \times \frac{3}{11} \times \frac{4}{10}$ or $2 \times \frac{4}{12} \times \frac{3}{11} \times \frac{4}{10}$		
$3 \times 2 \times \frac{4}{12} \times \frac{3}{11} \times \frac{4}{10}$ oe or $3 \times 3 \times \frac{4}{12} \times \frac{3}{11} \times \frac{4}{10}$		
$3 \times 3 \times 2 \times \frac{4}{12} \times \frac{3}{11} \times \frac{4}{10}$ oe		
Alternative using 1 – (all different + all the same)		
$\frac{4}{12} \times \frac{4}{11} \times \frac{4}{10}$ or $\frac{4}{12} \times \frac{3}{11} \times \frac{2}{10}$	$\frac{36}{55}$	5
$\frac{4}{12} \times \frac{4}{11} \times \frac{4}{10} \times 6$ or $\frac{4}{12} \times \frac{3}{11} \times \frac{2}{10} \times 3$		
$\frac{4}{12} \times \frac{4}{11} \times \frac{4}{10} \times 6$ and $\frac{4}{12} \times \frac{3}{11} \times \frac{2}{10} \times 3$		
$1 - [(\frac{4}{12} \times \frac{4}{11} \times \frac{4}{10} \times 6) + (\frac{4}{12} \times \frac{3}{11} \times \frac{2}{10} \times 3)]$		

SC: With replacement (maximum marks M3)		
$3 \times \frac{4}{12} \times \frac{4}{12} \times \frac{4}{12} (= \frac{192}{1728} = \frac{1}{9})$ or $2 \times \frac{4}{12} \times \frac{4}{12} \times \frac{4}{12} (= \frac{128}{1728} = \frac{2}{27})$		3
$3 \times 2 \times \frac{4}{12} \times \frac{4}{12} \times \frac{4}{12}$ oe or $3 \times 3 \times \frac{4}{12} \times \frac{4}{12} \times \frac{4}{12}$ oe		
$3 \times 3 \times 2 \times \frac{4}{12} \times \frac{4}{12} \times \frac{4}{12}$ oe		



9 - (4MA0-S 2018-Paper 3HR-Q18) - PROBABILITY

(a)	$\frac{1}{6} \times \frac{1}{6} \left(= \frac{1}{36} \right)$	$\frac{3}{36}$ oe	2	M1 or for a fully correct sample space with (3,1) (1,3) (2,2) selected or $\frac{x}{36}$ where $x < 36$
				A1 for $\frac{3}{36}$ oe or 0.083(3...) or 8.3(3...)%
(b)	$\left(1 - \frac{3}{36}\right)^3$ or $\left(\frac{33}{36}\right)^3$ or $\left(\frac{11}{12}\right)^3$	$\frac{1331}{1728}$ oe	2	M1 ft $\frac{3}{36}$ from (a) for $(1 - (a))^3$ provided answer to (a) < 1
				A1 for $\frac{1331}{1728}$ oe accept 0.77 to 0.771

10 - (4MA0-W 2018-Paper 3HR-Q18) - PROBABILITY

(a)	$\frac{4}{7} \times \frac{3}{6}$	$\frac{12}{42}$	2	M1 A1 oe
(b)	$P(1, 3) = \frac{1}{7} \times \frac{1}{6} \times 4 \left(= \frac{4}{42} \right)$ OR $P(3, 1) = \frac{1}{7} \times \frac{1}{6} \times 4 \left(= \frac{4}{42} \right)$ OR $P(2, 2) = \frac{3}{7} \times \frac{2}{6} = \left(\frac{6}{42} \right)$ Two of $P(1, 3) = \frac{1}{7} \times \frac{1}{6} \times 4 \left(= \frac{4}{42} \right)$ $P(3, 1) = \frac{1}{7} \times \frac{1}{6} \times 4 \left(= \frac{4}{42} \right)$ $P(2, 2) = \frac{3}{7} \times \frac{2}{6} = \left(\frac{6}{42} \right)$ eg $\frac{1}{7} \times \frac{1}{6} \times 4 + \frac{1}{7} \times \frac{1}{6} \times 4 + \frac{3}{7} \times \frac{2}{6}$	$\frac{14}{42}$	4	M1 for method to find $P(1, 3)$ OR $P(3, 1)$ OR $P(2, 2)$ M1 for method to find two of $P(1, 3)$, $P(3, 1)$, $P(2, 2)$ M1 for a complete method A1 oe SC With replacement B2 for an answer of $\frac{14}{49}$ (B1 for $\frac{1}{7} \times \frac{1}{7} \times 8$ or $\frac{3}{7} \times \frac{2}{7}$)

11 - (4MA0-W 2019-Paper 3HR-Q3) - PROBABILITY

(a)	$1 - (0.17 + 0.1 + 0.13 + 0.15)$ oe	0.45 oe	2	M1 A1
(b)	0.1×360	36	2	M1 A1



12 - (4MA0-W 2019-Paper 3HR-Q15) - *PROBABILITY*

(a)	$\frac{5}{8} \times \frac{4}{7}$	$\frac{20}{56}$ oe	2	M1	
(b)	$\frac{5}{8} \times \frac{4}{7}$ or $\frac{5}{8} \times \frac{2}{7}$ or $\frac{5}{8} \times \frac{1}{7}$ or $\frac{5}{8} \times 1$ or $\frac{5}{8} \times \frac{3}{7}$ or $\frac{3}{8} \times \frac{2}{7} (= \frac{6}{56})$ or $\frac{2}{8} \times \frac{1}{7} (= \frac{2}{56})$ oe $2 \times \frac{5}{8} \times \frac{2}{7} + 2 \times \frac{5}{8} \times \frac{1}{7} + \frac{5}{8} \times \frac{4}{7}$ or $\frac{5}{8} + \frac{5}{8} \times \frac{3}{7}$ oe or $1 - \frac{3}{8} \times \frac{2}{7}$ or $1 - \left(\frac{2}{8} \times \frac{1}{7} \times 3 \right)$	$\frac{50}{56}$ oe	3	M1	for any one correct probability for a total of 6p or 7p or 10p or 2p or 3p or 4p
				M1	for a complete method
				A1	for $\frac{50}{56}$ oe eg. $\frac{25}{28}$, 0.892(85...)
					SC: Non-replacement award B2 for an answer of $\frac{55}{64}$ oe eg. 0.859(3...)



1 - (4MA0-W 2016-Paper 3HR-Q19) - VECTORS

(a)	Vector, with arrow, marked from P to point 3 to the right and 8 up.	
(b)	Vector, with arrow, marked from P to point 4 to the left and 4 up.	
(c)		$-7\mathbf{a} - 2\mathbf{b}$
(d)	Eg $(\overrightarrow{MP}) = \frac{2}{3}(4\mathbf{a} - 2\mathbf{b})$ or $(\overrightarrow{PN}) = \frac{1}{3}(3\mathbf{a} + 4\mathbf{b})$ Eg $(\overrightarrow{MN}) = \frac{2}{3}(4\mathbf{a} - 2\mathbf{b}) + \frac{1}{3}(3\mathbf{a} + 4\mathbf{b})$ or $\frac{1}{3}(3\mathbf{a} + 4\mathbf{b}) - \frac{2}{3}(-4\mathbf{a} + 2\mathbf{b})$ or $\frac{8}{3}\mathbf{a} - \frac{4}{3}\mathbf{b} + \mathbf{a} + \frac{4}{3}\mathbf{b}$	$\frac{11}{3}$

2 - (4MA0-W 2017-Paper 3HR-Q23) - VECTORS

a	$\overrightarrow{CD} = \overrightarrow{CB} + \overrightarrow{BA} + \overrightarrow{AD}$ or $-\mathbf{c} - \mathbf{b} + 3\mathbf{c}$		2
		$2\mathbf{c} - \mathbf{b}$	
b	$\overrightarrow{BP} = \overrightarrow{BA} + \frac{2}{3}\overrightarrow{AC}$ or $\overrightarrow{PD} = \frac{1}{3}\overrightarrow{AC} + \overrightarrow{CD}$		4
	$\overrightarrow{BP} = -\mathbf{b} + \frac{2}{3}(\mathbf{b} + \mathbf{c}) (= \frac{2}{3}\mathbf{c} - \frac{1}{3}\mathbf{b})$ or $\overrightarrow{PD} = \frac{1}{3}(\mathbf{b} + \mathbf{c}) + 2\mathbf{c} - \mathbf{b} (= \frac{7}{3}\mathbf{c} - \frac{2}{3}\mathbf{b})$		
	$\overrightarrow{BP} = -\mathbf{b} + \frac{2}{3}(\mathbf{b} + \mathbf{c}) (= \frac{2}{3}\mathbf{c} - \frac{1}{3}\mathbf{b})$ AND $\overrightarrow{PD} = \frac{1}{3}(\mathbf{b} + \mathbf{c}) + 2\mathbf{c} - \mathbf{b} (= \frac{7}{3}\mathbf{c} - \frac{2}{3}\mathbf{b})$ OR $\overrightarrow{BP} = -\mathbf{b} + \frac{2}{3}(\mathbf{b} + \mathbf{c}) (= \frac{2}{3}\mathbf{c} - \frac{1}{3}\mathbf{b})$ AND $\overrightarrow{BD} = -\mathbf{b} + 3\mathbf{c}$ OR $\overrightarrow{PD} = \frac{1}{3}(\mathbf{b} + \mathbf{c}) + 2\mathbf{c} - \mathbf{b} (= \frac{7}{3}\mathbf{c} - \frac{2}{3}\mathbf{b})$ AND $\overrightarrow{BD} = -\mathbf{b} + 3\mathbf{c}$		



3 - (4MA0-W 2019-Paper 3HR-Q20) - VECTORS

$\overrightarrow{AC} = 4\mathbf{b} - 3\mathbf{a}$ or $\overrightarrow{CA} = 3\mathbf{a} - 4\mathbf{b}$ $\overrightarrow{BP} = \frac{1}{3}(3\mathbf{a} - 3\mathbf{b}) (= \mathbf{a} - \mathbf{b})$ or $\overrightarrow{AP} = \frac{2}{3}(3\mathbf{b} - 3\mathbf{a}) (= 2\mathbf{b} - 2\mathbf{a})$ $\overrightarrow{OP} = \mathbf{a} + 2\mathbf{b}$ oe $\overrightarrow{PQ} = \frac{1}{5}\mathbf{a} + \frac{2}{5}\mathbf{b}$ oe $\overrightarrow{OQ} = \frac{6}{5}\mathbf{a} + \frac{12}{5}\mathbf{b}$ oe	Correct vectors and correct statement	4	M1 can be implied by $\overrightarrow{OQ}$ or $\overrightarrow{PQ}$ correct M1 Correct vector for $\overrightarrow{BP}$ or $\overrightarrow{PB}$ or $\overrightarrow{AP}$ or $\overrightarrow{PA}$ can be implied by $\overrightarrow{OP}$ or $\overrightarrow{PQ}$ correct A1 for any two appropriate vectors that could be used for the proof NB: for this mark vectors may not be simplified A1 Correct pair of simplified vectors from $\overrightarrow{OP}$ & $\overrightarrow{PQ}$ or $\overrightarrow{OP}$ & $\overrightarrow{OQ}$ or $\overrightarrow{OQ}$ & $\overrightarrow{PQ}$ oe with conclusion E.g. $\overrightarrow{OP} = 5 \overrightarrow{PQ}$ so OPQ is a straight line
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1 - (4MA0-W 2015-Paper 3HR-Q7) - TRANSFORMATION

		Translation 4 right and 6 up
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2 - (4MA0-S 2016-Paper 3HR-Q8) - TRANSFORMATION

(a)		Translation 5 to the right and 4 down	2
(b)		R correct	2

3 - (4MA0-W 2016-Paper 3HR-Q3) - TRANSFORMATION

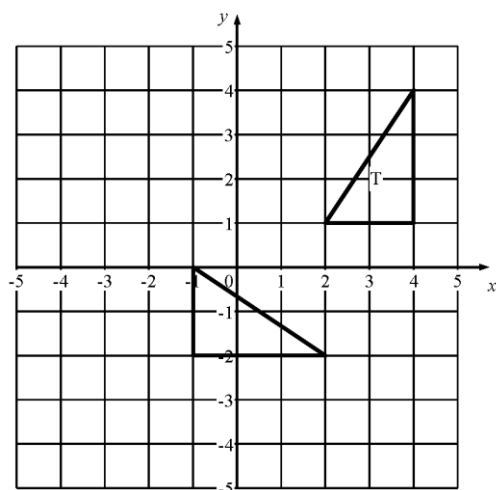
(a)		Reflection in $y = 1$
(b)	Parallelogram with vertices (3, -3), (9, -3), (6, -6) and (0, -6)	
(c)	Parallelogram with vertices (-3, 1), (-3, 3), (-2, 4), (-2, 2)	

4 - (4MA0-S 2017-Paper 3HR-Q8) - TRANSFORMATION

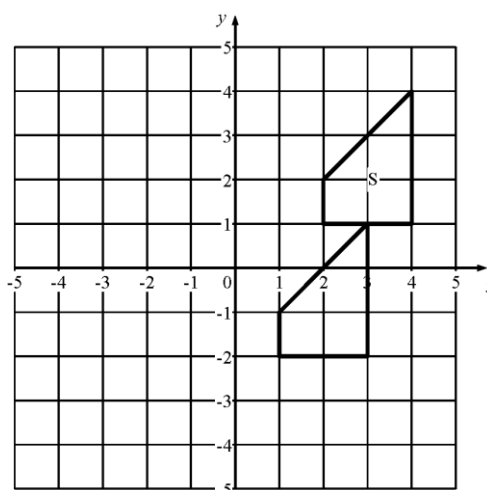
a		Correct triangle (-1, -2) (-1, 0) (2, -2)	2	B2 (B1 for a rotation of 90° clockwise about a different centre i.e. a triangle in the same orientation as the correct triangle or rotation by 90° anticlockwise about (0, 2))
b		Correct trapezium (1, -1) (1, -2) (3, 1) (3, -2)	1	B1



a



b



5 - (4MA0-W 2017-Paper 3HR-Q6) - TRANSFORMATION

a		Reflection in $y = -1$	2
b		Vertices at $(-2, 1)$ $(-2, 6)$ $(-5, 1)$ $(-5, 3)$	2

6 - (4MA0-W 2019-Paper 3HR-Q4) - TRANSFORMATION

(a)		$(3, 6)(6, 9)(9, 9)(9, 3)(6, 3)$	2	B2 for a fully correct enlargement If not B2 then award B1 for an enlargement SF 3 with shape in correct orientation but incorrect position or for a correct enlargement of SF 2 or SF 4 with centre O or for 4 out of 5 vertices correct
(b)		Rotation centre $(1, -1)$ 90° clockwise	3	B1 for rotation B1 for (centre) $(1, -1)$ B1 90° clockwise or -90° or 270° anticlockwise NB: no marks if more than one type of transformation mentioned



1 - (4MA0-W 2015-Paper 3HR-Q17) - DIFFERENTIATION & KINEMATICS

(a)	$8x + 4y = 112$	
	$y = \frac{112-8x}{4}$ oe $V = x^2 \times \frac{112-8x}{4}$	proof
(b)	$56x - 6x^2$	
(c)	$56x - 6x^2 = 0$ $x = \frac{28}{3}$ oe	

2 - (4MA0-S 2016-Paper 3HR-Q15) - DIFFERENTIATION & KINEMATICS

(a)		$3x^2 - 9x - 54$	2
(b)	$3x^2 - 9x - 54 = 0$ Eg $3(x-6)(x+3) (=0)$ or $(x =) \frac{-(-9) \pm \sqrt{(-9)^2 - 4 \times 3 \times -54}}{2 \times 3}$	$x = -3$ and $x = 6$	3

3 - (4MA0-S 2017-Paper 3HR-Q15) - DIFFERENTIATION & KINEMATICS

a	$3 \times 2 \times x^2 - 3 \times 2x - 12$	$6x^2 - 6x - 12$	2	M1	for one of $3 \times 2 \times x^2 (=6x^2)$ or $-3 \times 2x (=6x)$ or -12
b	$6 \times 2^2 - 6 \times 2 - 12$	0	2	A1	
c	$6x^2 - 6x - 12 = -12$			M1	ft from answer to (a) (must be a quadratic expression)
	$x = 1, 0$	1, 0	3	A1	for both correct solutions
				A1	for $k = 1$ and $m = 0$



4 - (4MA0-W 2017-Paper 3HR-Q20) - DIFFERENTIATION & KINEMATICS

a		$3x^2 - 8x + 5$	2
b	$3x^2 - 8x + 5 = 1$		4
	$3x^2 - 8x + 4 = 0$		
	eg $(3x - 2)(x - 2) = 0$		
		$\frac{2}{3}, 2$	

5 - (4MA0-S 2018-Paper 3HR-Q17) - DIFFERENTIATION & KINEMATICS

(a)		$6x^2 - 6$	2	B2	If not B2 then award B1 for $6x^2$ or $3 \times 2x^2$ or -6
(b)		18	1	B1	ft from (a)
(c)	$6x^2 - 6 = 7.5$ oe	1.5, -1.5 oe	3	M1	ft from (a)
	$x^2 = \frac{13.5}{6} \left(= \frac{27}{12} = \frac{9}{4} \right)$			M1	correct expression for x^2
				A1	dep on at least M1 scored

