

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Time 1 hour 30 minutes

Paper
reference

1MA1/3H

Mathematics PAPER 3 (Calculator) Higher Tier

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You must **show all your working**.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- **Calculators may be used.**
- If your calculator does not have a π button, take the value of π to be 3.142 unless the question instructs otherwise.



Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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.CG Maths.

Hints



Pearson

Please note that these worked solutions have neither been provided nor approved by Pearson Education and may not necessarily constitute the only possible solutions. Please refer to the original mark schemes for full guidance.

Any writing in blue indicates what must be written in order to answer the questions and get the marks. The worked solutions have been designed to show the smallest amount of work which needs to be done to answer the question.

Anything written in green in a cloud doesn't have to be written in the exam.

Anything written in orange in a rectangle doesn't have to be written in the exam and is there to show what should be put into a calculator or measured using a ruler or protractor.

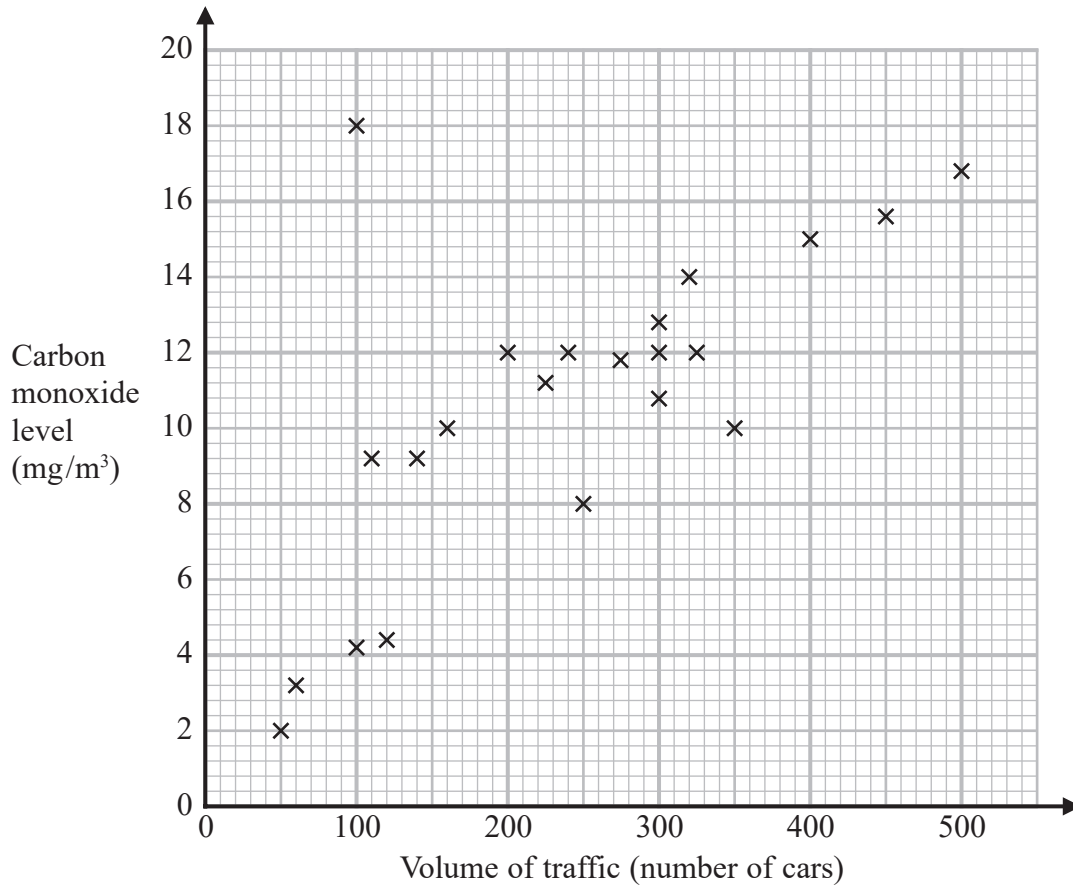
If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1 The scatter graph shows information about the volume of traffic and the carbon monoxide level at a point on a road each day for 22 days.



One point is an outlier.

- (a) Write down the coordinates of this point.

The data all mostly follow a trend. There is one plotted point which is relatively far away from the other points and doesn't follow the trend

(.....,)
(1)

For another day, 370 cars pass the point on the road.

- (b) Estimate the carbon monoxide level for this day.

Read up to a point on the graph which is about in the middle of the surrounding data then read across. There is no need to draw a line of best fit and this can actually make it more difficult to make an estimate

..... mg/m³
(2)

DO NOT WRITE IN THIS AREA

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DO NOT WRITE IN THIS AREA

Alfie says,

“Because there is an outlier, there is no correlation.”

(c) Is Alfie correct?

You must give a reason for your answer.

No...

(1)

(Total for Question 1 is 4 marks)



2 Natalie makes potato cakes in a restaurant.

She mixes potato, cheese and onion so that

$$\text{weight of potato} : \text{weight of cheese} : \text{weight of onion} = 9 : 2 : 1$$

Natalie needs to make 6000 g of potato cakes.

Cheese costs £2.25 for 175 g.

Work out the cost of the cheese needed to make 6000 g of potato cakes.

9 + 2 + 1 works out how many parts there are in total. This number of parts represents the total 6000g. So dividing the 6000 by this many parts works out what 1 part of the ratio is worth. Multiplying this by 2 works out what the 2 parts representing the cheese is worth. Dividing this by 175 works out how many lots of 175g the cheese is. Multiplying this by £2.25 works out the cost of this many lots of the cheese

£.....

(Total for Question 2 is 4 marks)

- 3 (a) Write 4.5×10^5 as an ordinary number.

Type into calculator

.....
(1)

- (b) Write 0.007 in standard form.

Type into calculator

.....
(1)

- (c) Work out $4.2 \times 10^3 + 5.3 \times 10^2$
Give your answer in standard form.

Type into calculator

Standard form is $a \times 10^n$, where $1 \leq a < 10$ and n is an integer. Keep dividing the answer by 10 until it is a number between 1 and 10 then multiply it by a power of 10 which multiplies by 10 that many times. $\times 10^y$ multiplies by 10 y times

.....
(2)

(Total for Question 3 is 4 marks)

- 4 A water tank is empty.
Anil needs to fill the tank with 2400 litres of water.

Company **A** supplies water at a rate of 8 litres in 1 minute 40 seconds.
Company **B** supplies water at a rate of 2.2 gallons per minute.

1 gallon = 4.54 litres

Company **A** would take more time to fill the tank than Company **B** would take to fill the tank.

How much more time?

Give your answer in minutes correct to the nearest minute.

Subtracting the time for Company B from the time for Company A works out how many more minutes it takes. For Company A, $2400/8$ works out how many lots of the 8 litres are needed. Then multiplying this by the time taken per lot of 8 litres works out the total time taken. For Company B, convert the gallons into litres then divide the 2400 by this to work out how many minutes it takes

1°40°

Time can be entered into the calculator using the  button

..... minutes

(Total for Question 4 is 4 marks)

5 The first four terms of a Fibonacci sequence are

$$a \quad 2a \quad 3a \quad 5a$$

The sum of the first five terms of this sequence is 228

Work out the value of a .

In a Fibonacci sequence, the two previous terms are added to get the next term. Work out the fifth term then add together the first five terms. Set this equal to 228 and solve the equation

.....
(Total for Question 5 is 3 marks)

- 6 In a bag there are only red counters, blue counters, green counters and pink counters. A counter is going to be taken at random from the bag.

The table shows the probabilities of taking a red counter or a blue counter.

Colour	red	blue	green	pink
Probability	0.05	0.15

The probability of taking a green counter is 0.2 more than the probability of taking a pink counter.

- (a) Complete the table.

Let p be the probability for pink. $p + 0.2$ must be the probability for green. Subtracting the probabilities for red and blue from 1 leaves the total probability for green and pink added together. Add together the expressions for the probability of pink and green and set it equal to the total probability for green and pink. Solve the equation to find p then add 0.2 to get the probability of green

(2)

There are 18 blue counters in the bag.

- (b) Work out the total number of counters in the bag.

Let x be the total number of counters. Multiplying this by the probability of blue expresses the number of blue counters, which is 18. Make an equation then rearrange it to solve for x

.....
(2)

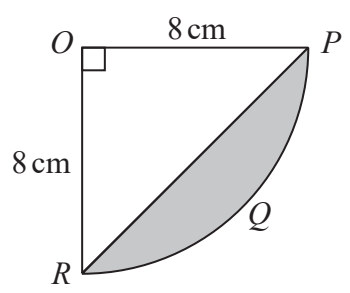
(Total for Question 6 is 4 marks)

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7 The diagram shows a sector $OPQR$ of a circle, centre O and radius 8 cm.



OPR is a triangle.

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

Subtracting the area of the triangle OPR from the sector $OPQR$ leaves the shaded segment PQR . The sector is a quarter of a whole circle.
Area of circle = $\pi \times \text{radius}^2$. Area of triangle = $1/2 \times \text{base} \times \text{height}$

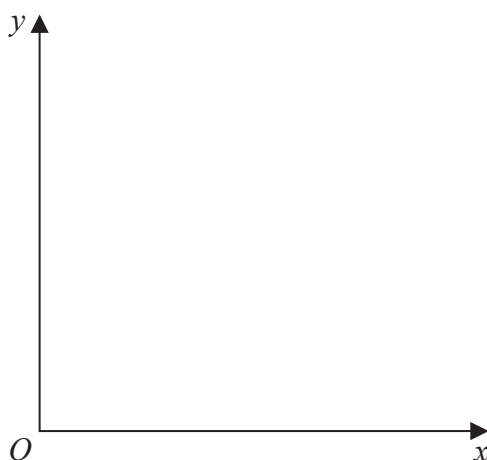
..... cm²

(Total for Question 7 is 4 marks)



8 (a) Using the axes below, sketch a graph to represent the statement

y is directly proportional to x

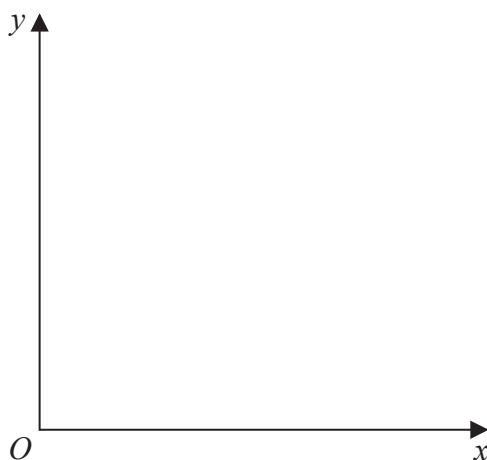


A straight line with a positive gradient going through the origin

(1)

(b) Using the axes below, sketch a graph to represent the statement

y is inversely proportional to x



Using table mode, set $f(x) = 1/x$. Table range, Start: 0, End: 5, Step: 1

(1)

(Total for Question 8 is 2 marks)

The graph of $y = 1/x$ is a graph in which y is inversely proportional to x

9 On Monday, 12 people took 5 hours to clean a number of cars.
 On Tuesday, 15 people cleaned the same number of cars.

Assuming that all the people worked at the same rate,

(a) work out how many hours the 15 people took to clean the cars.

Multiplying the 12 by the 5 works out how many hours worth of work need to be done. Dividing this by the 15 works out how long it will take for each of the 15 people

..... hours
 (2)

The assumption is wrong.

(b) How might this affect the time taken for the 15 people to clean the cars?

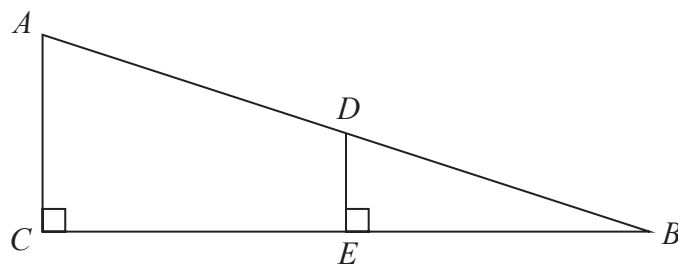
It would be impossible to work out an exact time if each person works at a different rate

(1)

(Total for Question 9 is 3 marks)



10 The diagram shows two right-angled triangles ACB and DEB .



$$AD = 9 \text{ cm}$$

$$DE = 2 \text{ cm}$$

$$DB = 6 \text{ cm}$$

Calculate the length of CB .

Give your answer correct to 2 decimal places.

Triangles ACB and DEB are similar as the angles in both triangles are the same. Work out the scale factor by dividing one of the sides on the larger triangle by the same side on the smaller triangle. Use the scale factor to work out another side on the larger triangle. Use Pythagoras' Theorem to work out the missing side CB in the triangle ACB . $a^2 + b^2 = c^2$, where c is the longest side and a and b are the two shorter sides

..... cm

(Total for Question 10 is 4 marks)

11 Freya writes down the value of x , correct to 1 decimal place.

She writes $x = 6.4$

Complete the error interval for x .

Subtracting half of the resolution works out the lower bound.
 Adding half of the resolution works out the upper bound.
 The resolution is 0.1 as it is correct to 1 decimal place

Lower bound

Upper bound

..... $\leq x <$

(Total for Question 11 is 2 marks)

12 $(ax^6)^{\frac{1}{n}} = 7x^3$

Work out the value of a and the value of n .

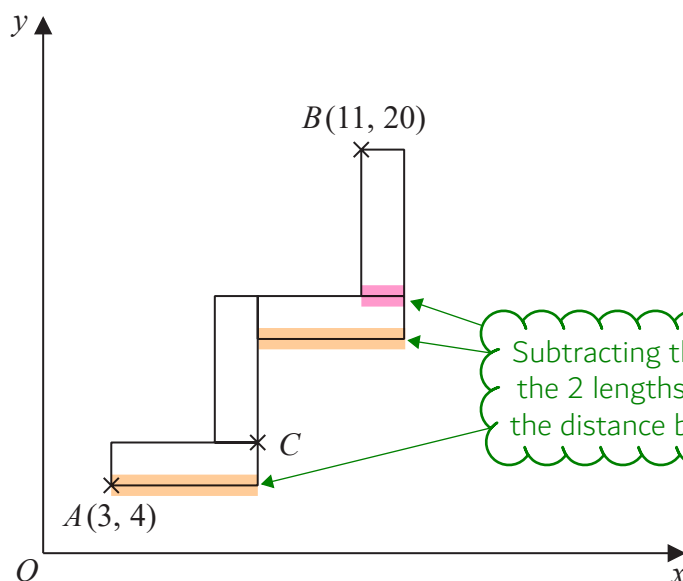
Both parts of ax^6 can be raised to the power separately. $(b^w)^y = b^{wy}$.
 The power of x on both sides must be equal. First work out n . The
 power of $1/n$ means the n th root e.g. power of $1/4$ is 4th root

$a =$

$n =$

(Total for Question 12 is 2 marks)

- 13 A pattern is made from four identical rectangles.
The sides of the rectangles are parallel to the axes.



Point A has coordinates $(3, 4)$
Point B has coordinates $(11, 20)$
Point C is marked on the diagram.

Work out the coordinates of C .
You must show all your working.

The x -coordinate of C can be worked out by adding 1 length of a rectangle to the x -coordinate of A .
The y -coordinate of C can be worked out by adding 1 width of a rectangle to the y -coordinate of A .
Let L be the length of a rectangle and W be the width of a rectangle. Express the distance in the x direction between A and B in terms of L and W and set this equal to the actual distance. Express the distance in the y direction between A and B in terms of L and W and set this equal to the actual distance.
Coordinates are in the form (x, y) and the distance between them in each direction can be worked out by doing the difference between the x -coordinates and the y -coordinates. There should now be two equations which can be solved simultaneously. Both equations should have the same number of L so these can be cancelled out to leave an equation just in terms of W by subtracting them. Then W can be found. Substituting the value of W back into one of the original equations allows L to be found

(.....,))

(Total for Question 13 is 5 marks)

14 Olivia and Jessica have in total half as many sweets as Fran and Gary have in total.

Fran and Gary share their sweets in the ratio 2:3

Olivia and Jessica share their sweets in the ratio 9:1

Fran got w sweets.

Gary got x sweets.

Olivia got y sweets.

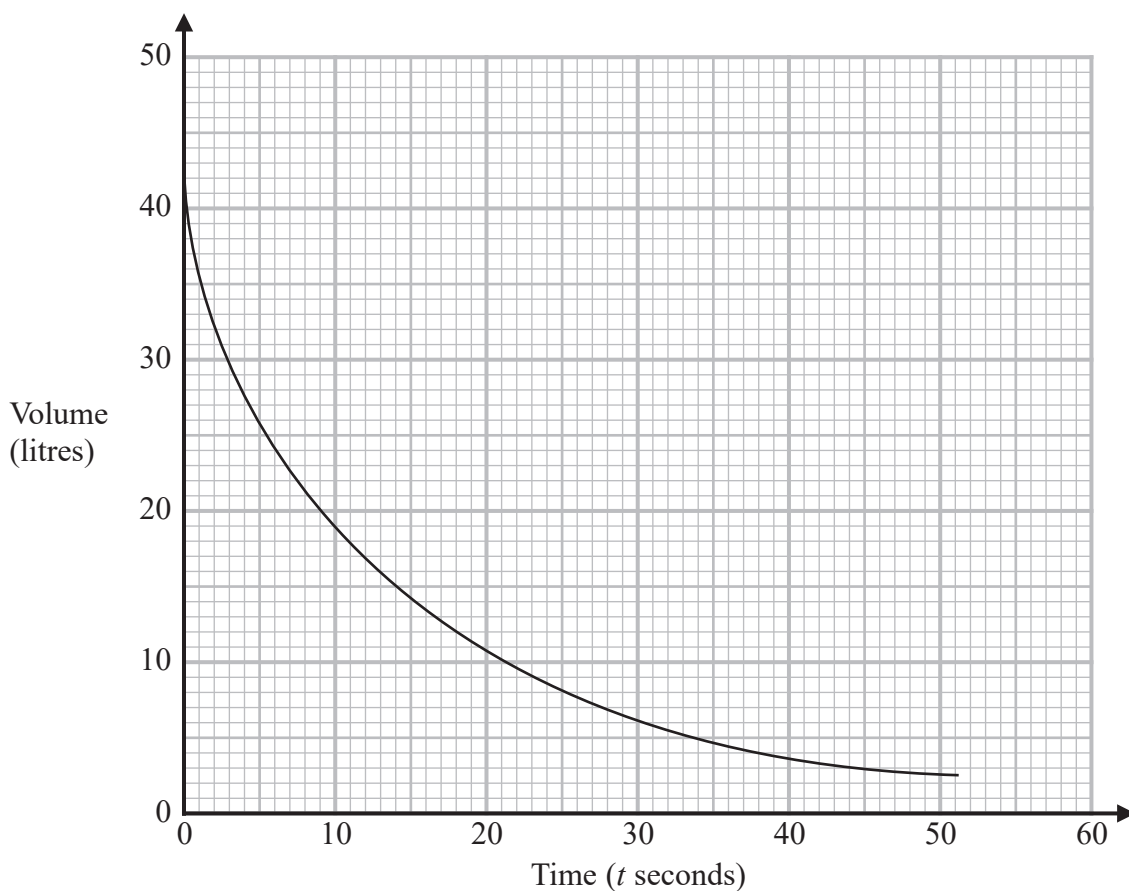
Jessica got z sweets.

Find, in its simplest form, $w:x:y:z$

The ratio for Fran and Gary has 5 parts in total. The ratio for Olivia and Jessica has 10 parts in total. As Fran and Gary have twice as many sweets in total, there needs to be twice as many parts in total in their ratio so multiply both sides of the ratio by 2. Then make the number of parts in both ratios the same so that 1 part is worth the same in each ratio

(Total for Question 14 is 4 marks)

- 15 The graph gives the volume of water, in litres, in a container at time t seconds after the water started to flow out of the container.



Using the graph, work out an estimate for the rate at which the water is flowing out of the container when $t = 12$

You must show your working.

Draw a tangent to the curve at the point where $t = 12$. The gradient of the tangent is an estimate of the gradient of the curve at that point, which is the rate at which the water is flowing. Gradient = (change in y)/(change in x)

..... litres per second

(Total for Question 15 is 3 marks)

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

The line **L** has equation $y - 5x + 4 = 0$

Show, algebraically, that **C** and **L** have exactly one point in common.

Substitute y for $x^2 + 3x - 3$ in the second equation to eliminate the y terms and leave an equation in terms of x which can be solved. Simplify into the form $ax^2 + bx + c = 0$ then solve using the quadratic formula. Make a statement about there only being one x value and therefore only one point in common

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

(Total for Question 16 is 4 marks)

- 17 x is directly proportional to the square of y .
 y is directly proportional to the cube of z .

$$z = 2 \text{ when } x = 32$$

Find a formula for x in terms of z .

$$x = ky^2$$

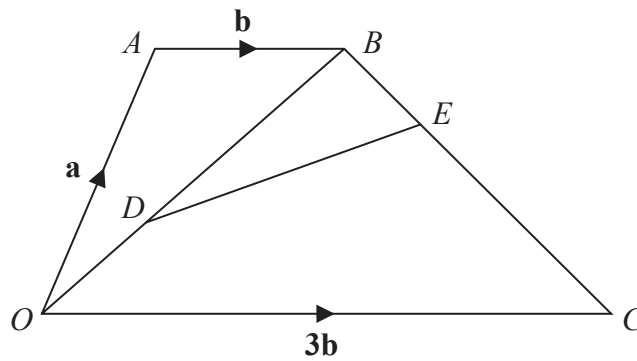
$$y = cz^3$$

Converting both proportions into equations by multiplying the right sides by different letters which represent constants

Substituting y for cz^3 in the first equation eliminates y . Simplify, rearrange and substitute in the values of x and z to find the constants. Both k and c are constants therefore multiplying them together is still constant.

(Total for Question 17 is 4 marks)

18 $OABC$ is a trapezium.



$$\vec{OA} = \mathbf{a}$$

$$\vec{AB} = \mathbf{b}$$

$$\vec{OC} = 3\mathbf{b}$$

D is the point on OB such that $OD:DB = 2:3$

E is the point on BC such that $BE:EC = 1:4$

Work out the vector \vec{DE} in terms of \mathbf{a} and \mathbf{b} .
Give your answer in its simplest form.

$\vec{DE} = \vec{DB} + \vec{BE}$. $\vec{DB} = 3/5 \vec{OB}$ as there are 5 parts in total in the ratio from O to B and 3 of these are for DB . $\vec{OB} = \vec{OA} + \vec{AB} = \mathbf{a} + \mathbf{b}$.
Use the ratio and find \vec{BE} in a similar way. Expand any brackets and collect like terms to simplify

(Total for Question 18 is 4 marks)

19 At the start of year n , the number of animals in a population is P_n

At the start of the following year, the number of animals in the population is P_{n+1} where

$$P_{n+1} = kP_n$$

At the start of 2017 the number of animals in the population was 4000

At the start of 2019 the number of animals in the population was 3610

Find the value of the constant k .

If n is 2017, $n + 1$ is 2018. So to work out the population of the next year, k must be multiplied by the population of the current year. Multiplying the population in 2017 by k once expresses the population in 2018. Multiplying by k again expresses the population in 2019. The 3610 must be equal to this. Create an equation then rearrange to find k

(Total for Question 19 is 3 marks)

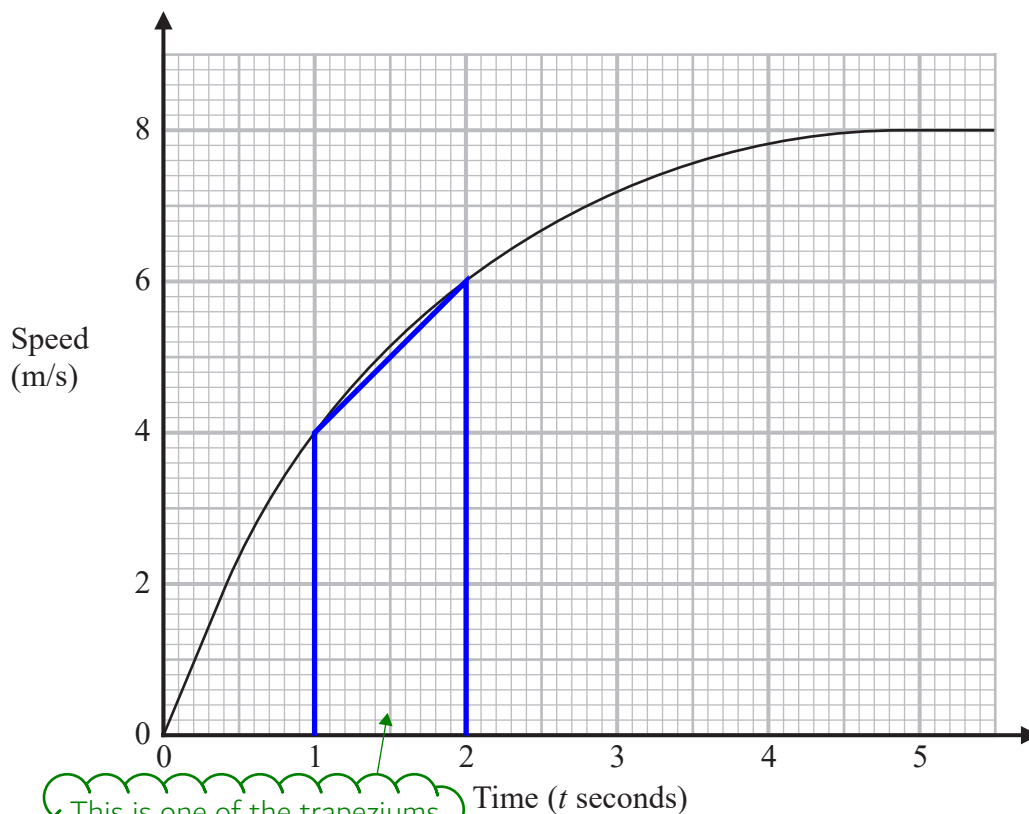
20 Pat throws a fair coin n times.

Find an expression, in terms of n , for the probability that Pat gets at least 1 head and at least 1 tail.

The opposite of getting at least 1 head and at least 1 tail is getting all heads or all tails. Express the probability of getting all heads or all tails then subtract this from 1

(Total for Question 20 is 2 marks)

- 21 Here is a speed-time graph showing the speed, in metres per second, of an object t seconds after it started to move from rest.



- (a) Using 3 trapeziums of equal width, work out an estimate for the area under the graph between $t = 1$ and $t = 4$

Area of trapezium = $\frac{1}{2} (a + b) \times h$, where a and b are the parallel sides and h is the distance between them. Adding the area of each trapezium works out the total area of the trapeziums

.....
(3)

- (b) What does this area represent?

$\frac{1}{2} (a + b)$ basically works out average speed. This is multiplied by h , which is time. Speed \times time = ...

.....
(1)

(Total for Question 21 is 4 marks)

- 22 Show that $\frac{6x^3}{(9x^2 - 144)} \div \frac{2x^4}{3(x - 4)}$ can be written in the form $\frac{1}{x(x + r)}$ where r is an integer.

To divide by a fraction, keep the first part, change the sign and flip the second fraction. Multiply fractions by multiplying the numerators and the denominators. Do not expand any brackets. Instead, factorise fully and leave in this form. Then simplify the fraction by dividing both the numerator and denominator by any factors which are in common to both. Difference of two squares: $A^2 - B^2 = (A + B)(A - B)$

(Total for Question 22 is 3 marks)

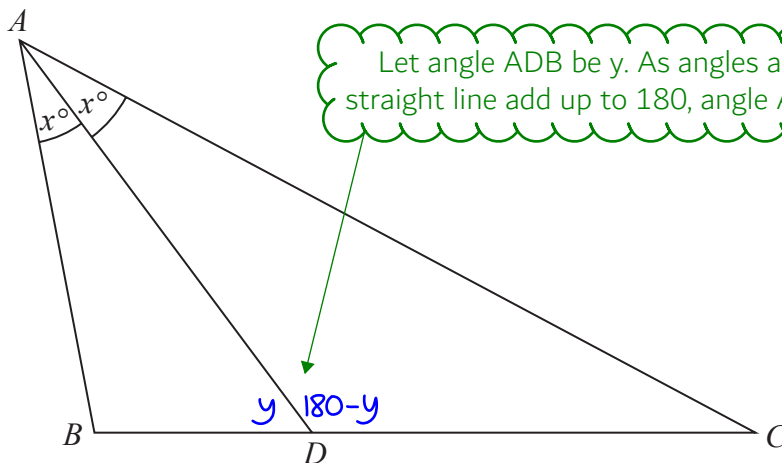
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23 ABC is a triangle.



D is the point on BC such that angle $BAD =$ angle $DAC = x^\circ$

Prove that $\frac{AB}{BD} = \frac{AC}{DC}$

Use the sine rule in both triangles ABD and ADC . Rearrange both equations to find what AB/BD and AC/DC are equal to. One will involve $\sin y$ and the other will involve $\sin(180 - y)$ but these are equivalent as the sin graph is symmetrical from 1 to 180. It is possible to show that both AB/BD and AC/DC are equal to the same thing and therefore must be equal

(Total for Question 23 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS