

Write your name here

Surname

Other names

Centre Number

Candidate Number

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

Mathematics

Paper 2 (Calculator)

Higher Tier

Monday 6 November 2017 – Morning

Time: 1 hour 30 minutes

Paper Reference

1MA1/2H

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.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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.CG Maths.
Worked Solutions



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 Solve $5x - 6 = 3(x - 1)$

$$5x - 6 = 3x - 3$$

Expand the brackets

$$2x = 3$$

Subtract $3x$ from both sides to bring all the x terms to one side. Then add 6 to both sides to get the x terms on their own

Divide both sides by 2 to get x on its own

$$x = \frac{3}{2}$$

(Total for Question 1 is 3 marks)

- 2 Emily buys a pack of 12 bottles of water.
The pack costs £5.64

Emily sells all 12 bottles for 50p each.

Work out Emily's percentage profit.
Give your answer correct to 1 decimal place.

$$\frac{12 \times 0.50 - 5.64}{5.64} \times 100$$

Percentage profit = percentage change
= (new - original)/original x 100. The new amount is what she sells them for, which is $12 \times \text{£}0.50$

6.382978723... is rounded to 1 decimal place

$$\dots\dots\dots 6.4 \dots\dots\dots \%$$

(Total for Question 2 is 3 marks)

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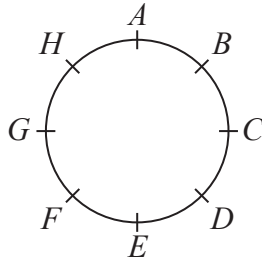
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3 Hasmeet walks once round a circle with diameter 80 metres.



There are 8 points equally spaced on the circumference of the circle.

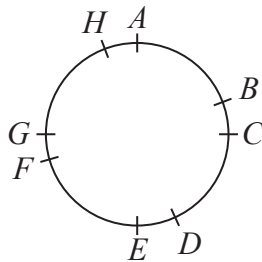
(a) Find the distance Hasmeet walks between one point and the next point.

$$\frac{80\pi}{8}$$

Circumference = $\pi \times$ diameter. Dividing this by 8 as there are 8 equally spaced points

..... 10π m
(2)

Four of the points are moved, as shown in the diagram below.



Hasmeet walks once round the circle again.

(b) Has the mean distance that Hasmeet walks between one point and the next point changed? You must give a reason for your answer.

No as the total distance is still 80π and will still be divided by 8

Mean = total/number where total is the total distance and the number is the number of points

(1)

(Total for Question 3 is 3 marks)

- 4 There are only blue cubes, yellow cubes and green cubes in a bag.

There are

twice as many blue cubes as yellow cubes
and four times as many green cubes as blue cubes.

Hannah takes at random a cube from the bag.

Work out the probability that Hannah takes a yellow cube.

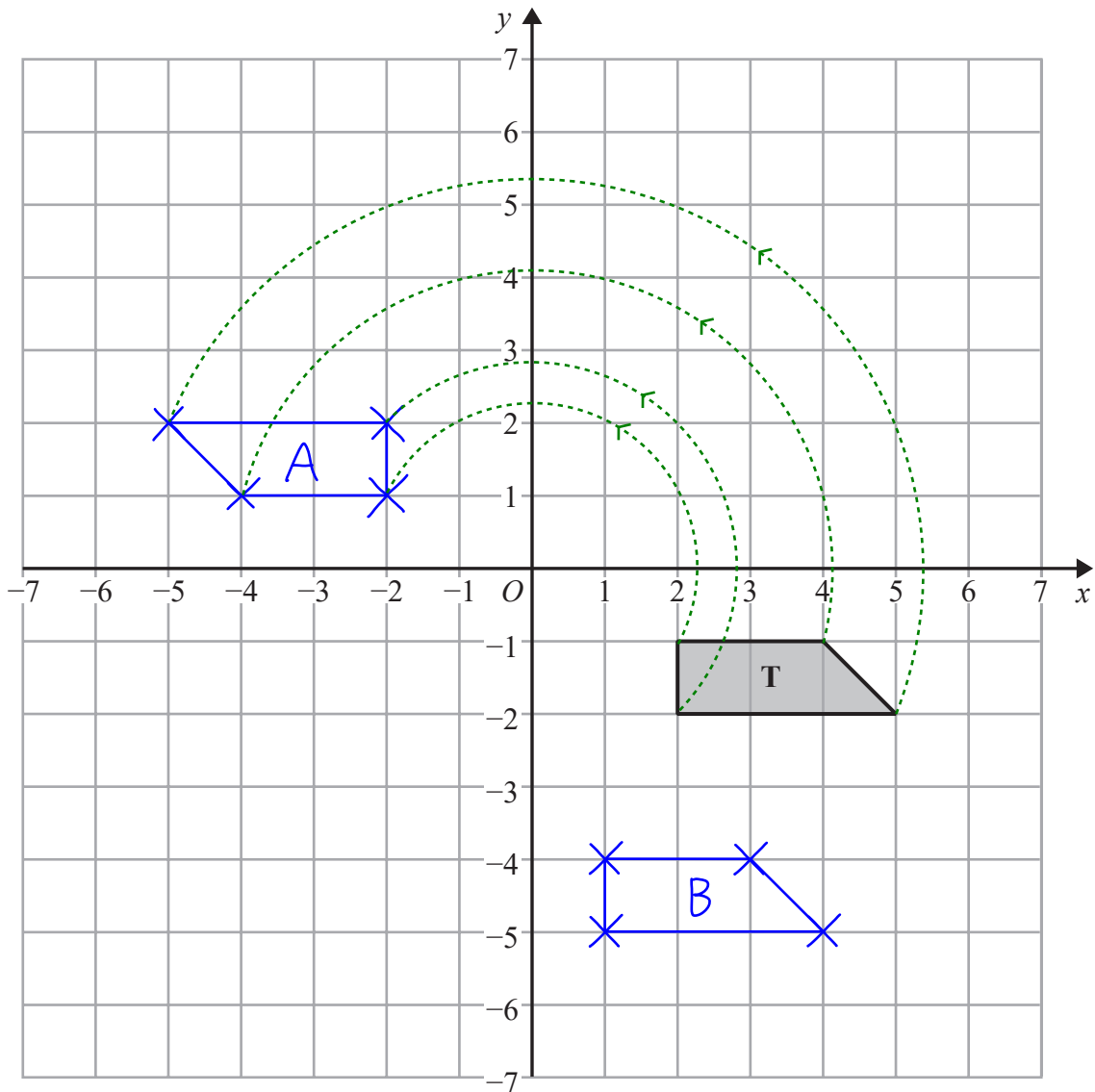
1 : 2 : 8

This is the ratio of yellow : blue : green. Let there be 1 part for yellow. There are twice as many blue so there are 2 parts for blue. There are four times as many green so there are 8 parts for green

There are 11 parts in total. Out of these, there is 1 part for yellow

$\frac{1}{11}$

(Total for Question 4 is 3 marks)



- (a) Rotate trapezium **T** 180° about the origin.
Label the new trapezium **A**.

Use tracing paper to sketch around **T** then rotate the paper 180° about the origin $(0, 0)$

(1)

- (b) Translate trapezium **T** by the vector $\begin{pmatrix} -1 \\ -3 \end{pmatrix}$
Label the new trapezium **B**.

-1 in the x direction (1 left) and
-3 in the y direction (3 down)

(1)

(Total for Question 5 is 2 marks)

6 $p^3 \times p^x = p^9$

(a) Find the value of x .

$$a^x \times a^y = a^{x+y} \text{ so } 3 + x = 9$$

$$x = \frac{6}{(1)}$$

$(7^2)^y = 7^{10}$

(b) Find the value of y .

$$(a^x)^y = a^{xy} \text{ so } 2 \times y = 10$$

$$y = \frac{5}{(1)}$$

$10^a \times 1000^b$ can be written in the form 10^w

(c) Show that $w = 2a + 3b$

$$10^w = (10^2)^a \times (10^3)^b \leftarrow 100 = 10^2 \text{ and } 1000 = 10^3$$

$$= 10^{2a} \times 10^{3b} \leftarrow (a^x)^y = a^{xy}$$

$$= 10^{2a+3b} \leftarrow a^x \times a^y = a^{x+y}$$

$$w = 2a + 3b \leftarrow$$

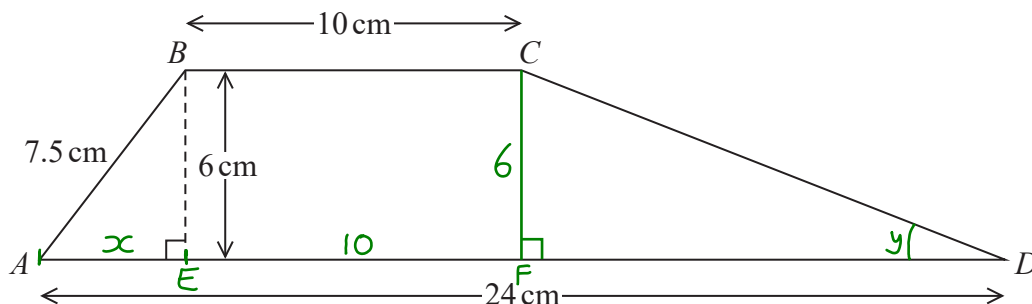
This must be as the powers on the left must be the same as the powers on the right as they are both powers of 10

(2)

(Total for Question 6 is 4 marks)

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7 $ABCD$ is a trapezium.



Work out the size of angle CDA .

Give your answer correct to 1 decimal place.

$$a^2 + b^2 = c^2$$

Pythagoras' Theorem can be used to find x as we have two sides of the right-angled triangle ABE

$$x = \sqrt{7.5^2 - 6^2} = 4.5$$

Rearranged to make a the subject and substituted in the values. c is the longest side and is opposite the right angle so is 7.5

$$24 - 10 - 4.5 = 9.5$$

Finding side FD

SỐ CÁCH TỐÁ $\frac{O}{TIA}$

We have the opposite and adjacent in triangle CFD so these have been ticked. Two ticks means we can use the TOA formula triangle

$$\tan^{-1}\left(\frac{6}{9.5}\right)$$

(tan of the angle) = opposite/adjacent. Rearranging to get the angle on its own gives angle = $\tan^{-1}(\text{opposite/adjacent})$

32.27564431 is rounded to 1 decimal place

32.3

(Total for Question 7 is 5 marks)

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8 Use your calculator to work out $\sqrt{\frac{\sin 25^\circ + \sin 40^\circ}{\cos 25^\circ - \cos 40^\circ}}$

(a) Write down all the figures on your calculator display.

Type into the calculator

2.75603957

(2)

(b) Write your answer to part (a) correct to 2 decimal places.

2.76

(1)

(Total for Question 8 is 3 marks)

9 Yesterday it took 5 cleaners $4\frac{1}{2}$ hours to clean all the rooms in a hotel.

There are only 3 cleaners to clean all the rooms in the hotel today.

Each cleaner is paid £8.20 for each hour or part of an hour they work.

How much will each cleaner be paid today?

$$\frac{5 \times 4\frac{1}{2}}{3} = 7.5$$

5 x 4½ works out how many hours worth of work need to be done.
Dividing by 3 works out how many hours it will take each of the 3 cleaners

$$8 \times 8.20$$

As they get paid the full £8.20 for part of an hour, they each get 8 lots of £8.20

£ 65.60

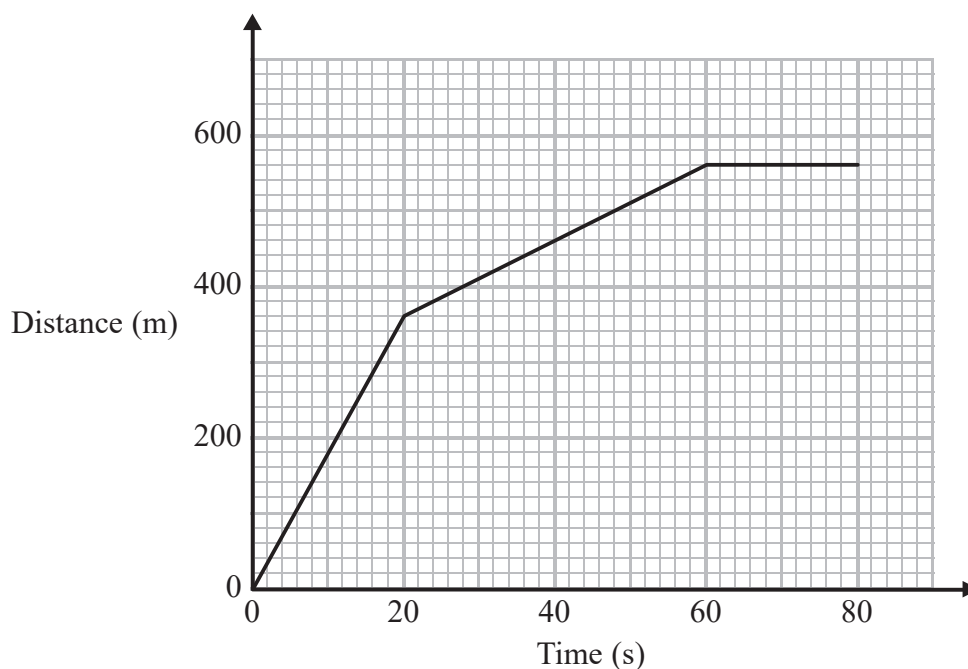
(Total for Question 9 is 3 marks)

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10 Here is part of a distance-time graph for a car's journey.



- (a) Between which two times does the car travel at its greatest speed?
Give a reason for your answer.

0 and 20 seconds as the gradient is the greatest

(2)

- (b) Work out this greatest speed.

$$\frac{360}{20}$$

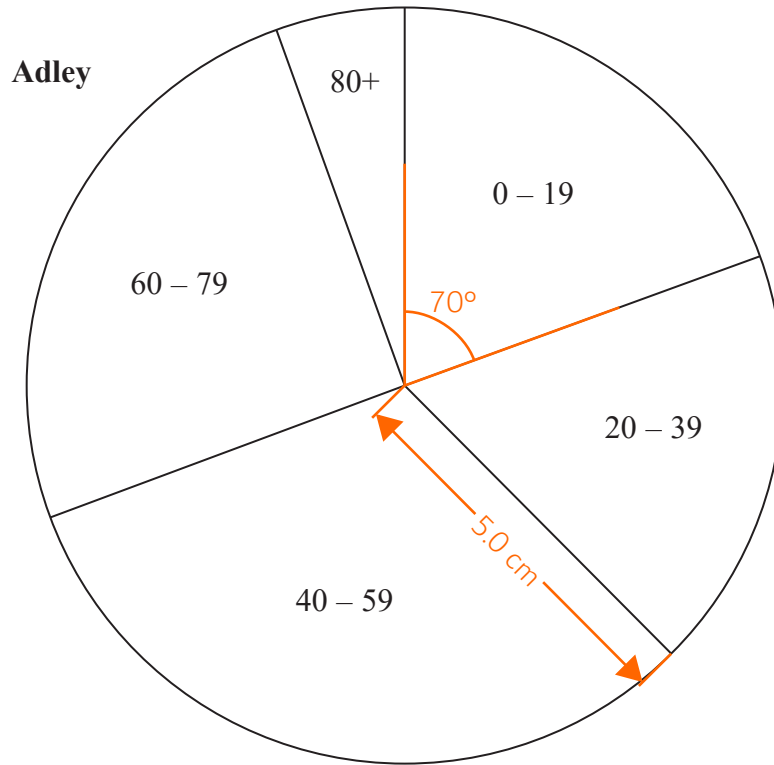
Speed = gradient = (change in y)/(change in x)

18 m/s

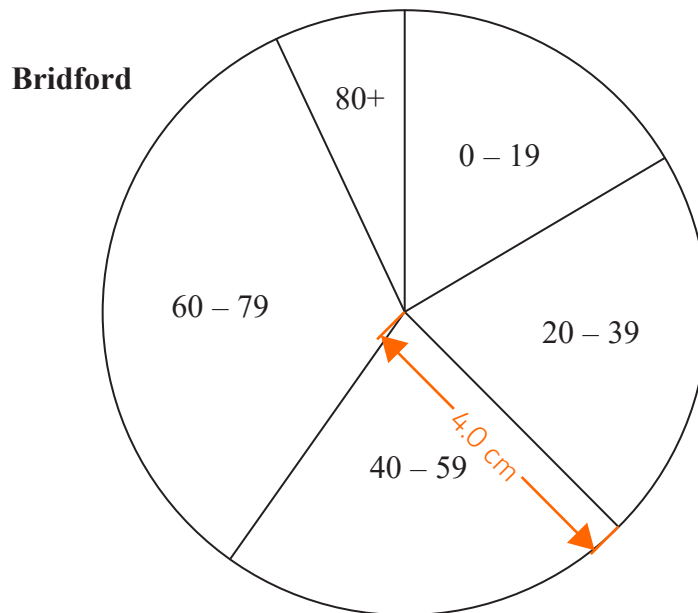
(1)

(Total for Question 10 is 3 marks)

11 The pie charts give information about the ages, in years, of people living in two towns, Adley and Bridford.



Diagrams accurately drawn



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The ratio of the number of people living in Adley to the number of people living in Bridford is given by the ratio of the areas of the pie charts.

What proportion of the total number of people living in these two towns live in Adley and are aged 0 – 19?

Give your answer correct to 3 significant figures.

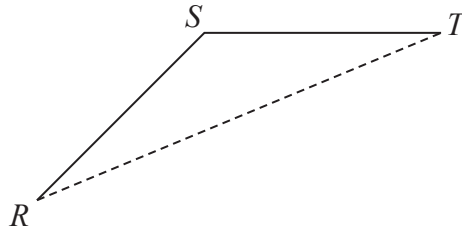
$$\frac{70}{360} \times \frac{\pi \times 5^2}{\pi \times 5^2 + \pi \times 4^2}$$

The area of the sector representing living in Adley and are aged 0 – 19 out of the total area of both circles. Area of circle = $\pi \times \text{radius}^2$. There are 70 degrees for the sector out of the total 360 degrees of the circle so multiplying 70/360 by the area of the circle gives the area of the sector

The answer of 0.1185656... is rounded to 3 significant figures

0.119

(Total for Question 11 is 3 marks)



RS and ST are 2 sides of a regular 12-sided polygon.
 RT is a diagonal of the polygon.

Work out the size of angle STR .
 You must show your working.

$$180 - \frac{360}{12} = 150$$

360/12 works out the exterior angle. Subtracting this from 180 degrees (angles along a straight line add to 180) gives the interior angle RST

$$\frac{180 - 150}{2}$$

Triangle TRS is isosceles as two of the sides are equal (it is a regular polygon) so the base angles are equal. There are 180 degrees in total in a triangle so subtracting 150 works out the combined size of the base angles. As they are both equal, this can be divided by 2 to work out one of them

15

(Total for Question 12 is 3 marks)

- 13 At the beginning of 2009, Mr Veale bought a company.
The value of the company was £50 000

Each year the value of the company increased by 2%.

- (a) Calculate the value of the company at the beginning of 2017
Give your answer correct to the nearest £100

$$50000 \times 1.02^8$$

100% + 2% = 102%, which as a decimal is 1.02. So multiplying by 1.02 increases by 2%. Raising this to the power of 8 increases by 2% 8 times, which is needed as 2017 is 8 years after 2009

The answer of 58582.96905 is rounded to the nearest 100

£ 58600

(2)

At the beginning of 2009 the value of a different company was £250 000
In 6 years the value of this company increased to £325 000

This is equivalent to an increase of $x\%$ each year.

- (b) Find the value of x .
Give your answer correct to 2 significant figures.

$$250000 \times \left(\frac{100+x}{100}\right)^6 = 325000$$

$100 + x$ expresses the percentage it increases to each year. Dividing by 100 changes this into a decimal multiplier. £250000 is increased by the percentage 6 times so the multiplier is raised to the power of 6. It is then equal to £325000

$$x = \sqrt[6]{\frac{325000}{250000}} \times 100 - 100$$

Rearranged to make x the subject by dividing by 250000, then taking the sixth root, then multiplying by 100, then subtracting 100 from both sides

The answer of 4.469750792 is rounded to 2 significant figures

4.5

(3)

(Total for Question 13 is 5 marks)

14 On the grid, shade the region that satisfies all these inequalities.

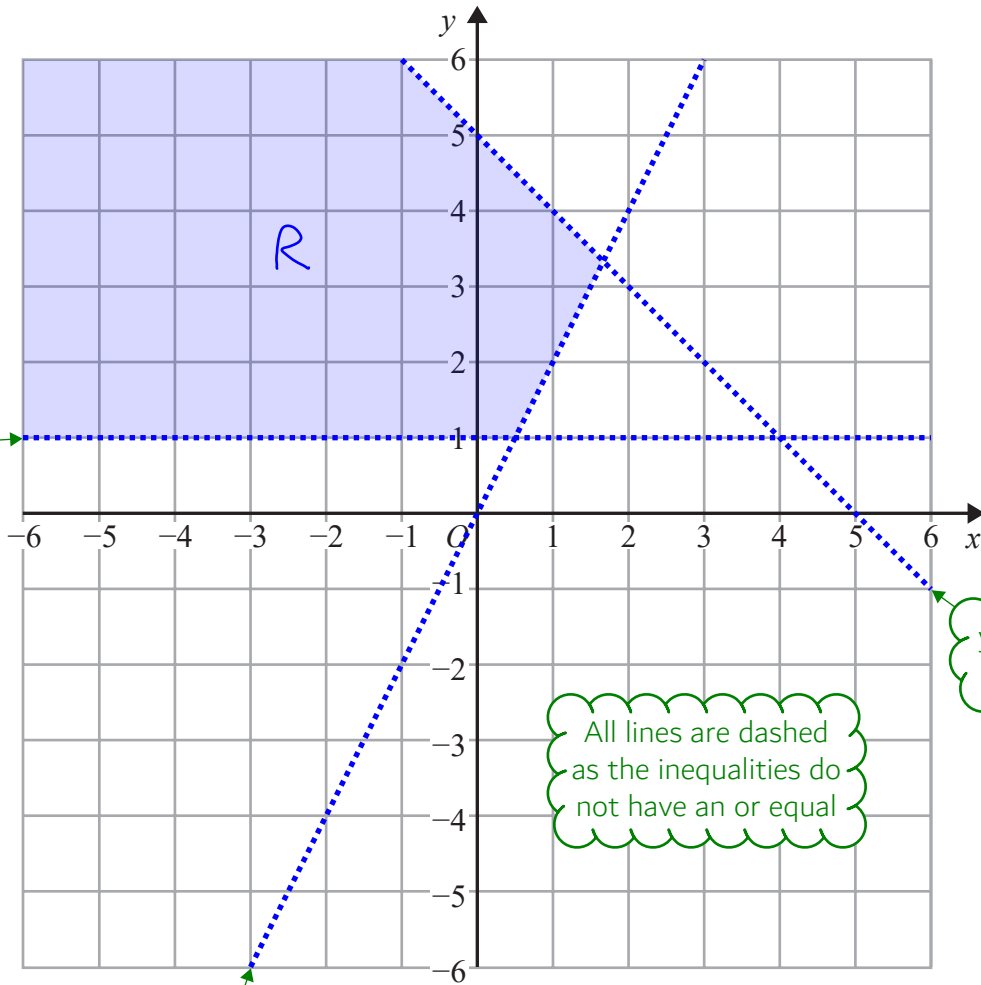
$$y > 1$$

$$x + y < 5$$

$$y > 2x$$

Label the region R.

$$y < 5 - x$$



$y = 1$. The region is above this line

$y = 5 - x$. The region is below this line

All lines are dashed as the inequalities do not have an or equal

$y = 2x$. The region is above this line

(Total for Question 14 is 3 marks)

15 Tracey is going to choose a main course and a dessert in a cafe. She can choose from 8 main courses and 7 desserts.

Tracey says that to work out the number of different ways of choosing a main course and a dessert you add 8 and 7

(a) Is Tracey correct?
You must give a reason for your answer.

No, should multiply 8 and 7

(1)

12 teams play in a competition. Each team plays each other team exactly once.

(b) Work out the total number of games played.

$$\frac{12 \times 11}{2}$$

The product rule of counting is used. Each game is counted twice (as a game is played by two of the teams, not one) so we need to divide by 2

66

(2)

(Total for Question 15 is 3 marks)

16 Solve $(x - 2)^2 = 3$

Give your solutions correct to 3 significant figures.

$$x = \sqrt{3} + 2$$

Rearranged to make x the subject by square rooting both sides then adding 2

There are two solutions as root 3 can be positive or negative. The answers of 3.732050808 and 0.2679491924 are rounded to 3 significant figures

3.73 or 0.268

(Total for Question 16 is 2 marks)

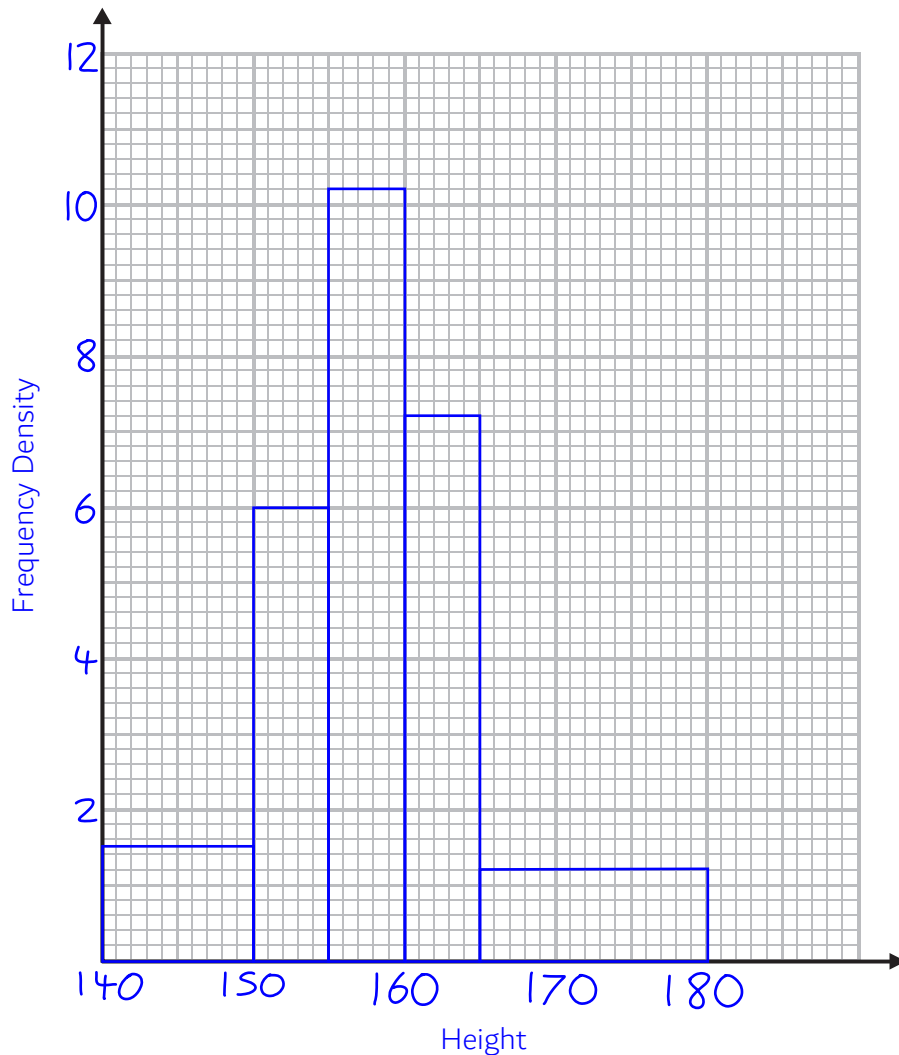
Frequency = class width \times frequency density
 Frequency density = frequency / class width

17 The table gives information about the heights of 150 students.

Class width is 10
 as $150 - 140 = 10$

Height (h cm)	Frequency	f.d.
$140 < h \leq 150$	15	1.5 $\leftarrow \frac{15}{10}$
$150 < h \leq 155$	30	6 $\leftarrow \frac{30}{5}$
$155 < h \leq 160$	51	10.2 $\leftarrow \frac{51}{5}$
$160 < h \leq 165$	36	7.2 $\leftarrow \frac{36}{5}$
$165 < h \leq 180$	18	1.2 $\leftarrow \frac{18}{15}$

(a) On the grid, draw a histogram for this information.



(3)

(b) Work out an estimate for the fraction of the students who have a height between 150 cm and 170 cm.

$$\frac{30 + 51 + 36 + 5 \times 1.2}{150}$$

Adding together the frequencies which are for categories between 150 and 170 and working out an estimate for the frequency between 165 and 170.
 Frequency = class width \times frequency density = 5×1.2
 Putting the total frequency as a fraction of the 150

$$\frac{41}{50}$$

(2)

(Total for Question 17 is 5 marks)

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18 At time $t = 0$ hours a tank is full of water.

Water leaks from the tank.

At the end of every hour there is 2% less water in the tank than at the start of the hour.

The volume of water, in litres, in the tank at time t hours is V_t

Given that

$$V_0 = 2000$$
$$V_{t+1} = kV_t$$

write down the value of k .

100% - 2% = 98%, which converted into a decimal by dividing by 100 is 0.98

$k = \dots\dots\dots 0.98 \dots\dots\dots$

(Total for Question 18 is 1 mark)

19 A triangle has vertices P , Q and R .

The coordinates of P are $(-3, -6)$

The coordinates of Q are $(1, 4)$

The coordinates of R are $(5, -2)$

M is the midpoint of PQ .

N is the midpoint of QR .

Prove that MN is parallel to PR .

You must show each stage of your working.

$$\frac{(-2) - (-6)}{5 - (-3)} = \frac{1}{2}$$

Finding the gradient of PR .
Gradient = (change in y)/(change in x)
Change is found by subtracting the coordinates of P from R

$$\frac{\frac{4-2}{2} - \frac{4-6}{2}}{\frac{1+5}{2} - \frac{1-3}{2}} = \frac{1}{2}$$

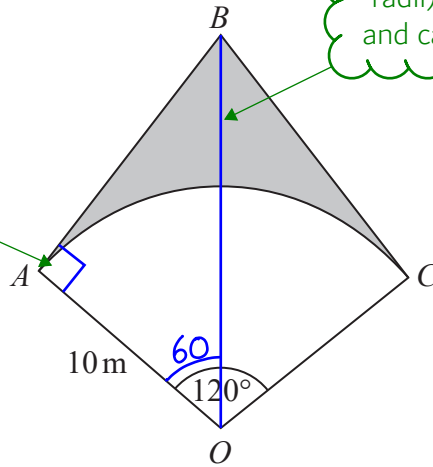
Finding the gradient of MN .
Gradient = (change in y)/(change in x)
Change is found by subtracting the coordinates of N from M . The coordinates of midpoints M and N are found by taking the mean of the two x or y coordinates they are in the middle of (e.g. the x coordinate of M is the mean of the x coordinates of P and Q)

Therefore MN and PR are parallel as they have the same gradient

(Total for Question 19 is 4 marks)

The shape is a kite as $AB = BC$ (the tangents of a circle from same point are equal in length) and $AO = OC$ (they are both radii). Therefore the shape is symmetrical and can be split into two identical triangles

The angle between a radius and tangent is 90 degrees



OAC is a sector of a circle, centre O , radius 10 m.

BA is the tangent to the circle at point A .
 BC is the tangent to the circle at point C .

Angle $AOC = 120^\circ$

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

SỐH CÁCH TỐÁ $\frac{O}{TIA}$

Working out the opposite AB in right-angled triangle AOB . We also have the adjacent so we tick O and A . This means the TOA formula triangle can be used. From the triangle, opposite = (tan of the angle) x adjacent

$$2 \times \frac{1}{2} \times 10 \times \tan 60 \times 10 - \frac{120}{360} \times \pi \times 10^2$$

Area of triangle = $\frac{1}{2} \times \text{base} \times \text{height}$. The base is 10m and the height is AB which is $\tan 60 \times 10$. Multiplying by 2 as there are 2 identical triangles and this works out the area of the whole kite

Subtracting the area of the sector OAC leaves the shaded area. Area of circle = $\pi \times \text{radius}^2$. The radius is 10m. There are 120 out the 360 degrees of the circle so we find $\frac{120}{360}$ of the circle to get the area of the sector

The answer of 68.48532564 is rounded to 3 significant figures

..... 68.5 m²

(Total for Question 20 is 5 marks)

21 There are 12 counters in a bag.

There is an equal number of red counters, blue counters and yellow counters in the bag.

There are no other counters in the bag.

3 counters are taken at random from the bag.

(a) Work out the probability of taking 3 red counters.

$$\frac{4}{12} \times \frac{3}{11} \times \frac{2}{10}$$

12 divided by the 3 colours gives 4 counters per colour. So there are 4 red counters out of the 12 to begin with. Once one red has been picked, there is one fewer so there are 3 red counters out of 11. Then there are 2 red counters out of 10. Multiplying together these fractions combines the probabilities of each of the events

$$\frac{1}{55}$$

(2)

The 3 counters are put back into the bag.

Some more counters are now put into the bag.

There is still an equal number of red counters, blue counters and yellow counters in the bag.

There are no counters of any other colour in the bag.

3 counters are taken at random from the bag.

(b) Is it now less likely or equally likely or more likely that the 3 counters will be red?

You must show how you get your answer.

$$\frac{5}{15} \times \frac{4}{14} \times \frac{3}{13} = \frac{2}{91}$$

There could now be 5 of each colour. So there are 5 red counters out of the 15 to begin with. Once one red has been picked, there is one fewer so there are 4 red counters out of 14. Then there are 3 red counters out of 13. Multiplying together these fractions combines the probabilities of each of the events

More likely

$\frac{2}{91}$ is greater than $\frac{1}{55}$ as $\frac{2}{91} - \frac{1}{55}$ is positive

(2)

(Total for Question 21 is 4 marks)

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22 The functions f and g are such that

$$f(x) = 5x + 3 \quad g(x) = ax + b \quad \text{where } a \text{ and } b \text{ are constants.}$$

$$g(3) = 20 \quad \text{and} \quad f^{-1}(33) = g(1)$$

Find the value of a and the value of b .

$$x = 5y + 3$$

$$f^{-1}(x) = \frac{x-3}{5}$$

$$f^{-1}(33) = \frac{33-3}{5} = 6$$

$$a + b = 6$$

$$3a + b = 20$$

$$2a = 14$$

$$a = 7$$

$$b = 6 - 7$$

Replacing $f(x)$ with x and x with y in $f(x)$. Rearranging it to make y the subject then replacing y back with $f^{-1}(x)$

Substituting x for 33 in $f^{-1}(x)$ to find the value of $f^{-1}(33)$

Substituting x for 1 in $g(x)$ gives $a + b$ and this is equal to 6 as $f^{-1}(33) = g(1)$

Substituting x for 3 in $g(x)$ gives $3a + b$ and this is equal to 20 as $g(3) = 20$

Solving the previous two equations simultaneously by subtracting the first equation from the second to eliminate b

Rearranging the first equation to make b the subject and substituting a for 7 to find b

$$a = \dots\dots\dots 7$$

$$b = \dots\dots\dots -1$$

(Total for Question 22 is 5 marks)

23 S is a geometric sequence.

- (a) Given that $(\sqrt{x} - 1)$, 1 and $(\sqrt{x} + 1)$ are the first three terms of S, find the value of x.
You must show all your working.

$$\frac{1}{\sqrt{x} - 1} = \frac{\sqrt{x} + 1}{1}$$

It is a geometric sequence so each term is multiplied by a certain factor (lets call this r) to get the next term. 1st term $\times r =$ 2nd term. 2nd term $\times r =$ 3rd term. Rearranging these gives 2nd term/1st term = r and also 3rd term/2nd term = r. As both are equal to r, 2nd term/1st term = 3rd term/2nd term

$$1 = (\sqrt{x} + 1)(\sqrt{x} - 1)$$

Multiplying both sides by root x - 1 to eliminate the denominator. Dividing by 1 has no effect so this is ignored

$$= x - \sqrt{x} + \sqrt{x} - 1$$

Expanding the brackets

The positive and negative root x cancel out. Then adding 1 to both sides gives $2 = x$

2

(3)

- (b) Show that the 5th term of S is $7 + 5\sqrt{2}$

$$(\sqrt{2} + 1)(\sqrt{2} + 1)$$

The third term is root 2 + 1. The 2nd term, 1, must have been multiplied by root 2 + 1 to get this. Therefore each term is multiplied by root 2 + 1 to get the next term. This calculates the 4th term

$$2 + \sqrt{2} + \sqrt{2} + 1$$

Expanding out the brackets

$$(3 + 2\sqrt{2})(\sqrt{2} + 1)$$

This calculates the 5th term as the 4th term needs to be multiplied by root 2 + 1 to get the next term

$$3\sqrt{2} + 3 + 4 + 2\sqrt{2}$$

Expanding out the brackets

$$7 + 5\sqrt{2}$$

Collecting the like terms

(2)

(Total for Question 23 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS