Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number

Candidate Number

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

Thursday 16 May 2024

Morning (Time: 1 hour 30 minutes)

Paper reference **1MA1/1H**

Mathematics

PAPER 1 (Non-Calculator)

Higher Tier

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB or B pencil, eraser, Formulae Sheet (enclosed). Tracing paper may be used.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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 not be used**.

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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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 should be written in the exam.

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

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 Here are the first four terms of an arithmetic sequence.

1 5 9 13

Find an expression, in terms of n, for the nth term of this sequence.

The sequence increases by 4 between each term so the expression must involve $4n$. Going back in the sequence finds that the 0th term (the one before the first term) would be -3. So the expression for the nth term is $4n - 3$

$4n - 3$

(Total for Question 1 is 2 marks)

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2 (a) Work out $3\frac{4}{5} - 1\frac{2}{3}$

$3\frac{12}{15} - 1\frac{10}{15}$

Converting the 4/5 and 2/3 so that they have the same denominator. Multiplying both the numerator and denominator of 4/5 by 3 and multiplying both the numerator and denominator of 2/3 by 5

The 3 subtract the 1 gives 2 as the whole number. The 12 subtract the 10 gives 2 as the numerator. The denominator of 15 stays the same

$2\frac{2}{15}$

(2)

Kevin was asked to work out $2\frac{1}{3} \times \frac{5}{8}$

Here is his working and his answer.

$$2\frac{1}{3} \times \frac{5}{8} = \frac{7}{3} \times \frac{5}{8}$$

$$= \frac{35}{24}$$

$$= 1\frac{9}{24}$$

Kevin's answer is wrong.

(b) What mistake has Kevin made?

Should be $1\frac{11}{24}$ 35/24 was correct but it was not converted into a mixed number correctly

(1)

(Total for Question 2 is 3 marks)

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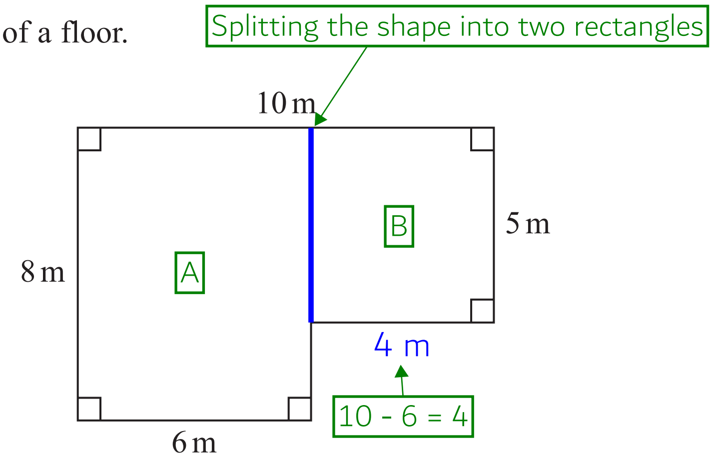
3 The diagram shows a plan of a floor.



Petra is going to cover the floor with paint.

Petra has 3 tins of paint.
There are 2.5 litres of paint in each tin.

Petra thinks 1 litre of paint will cover $10\,\text{m}^2$ of floor.

(a) Assuming Petra is correct, does she have enough paint to cover the floor?
You must show all your working.

$8 \times 6 = 48$ ← Area of rectangle = length × width. So the area of rectangle A is $48\ \text{m}^2$

$5 \times 4 = 20$ ← Area of rectangle = length × width. So the area of rectangle B is $20\ \text{m}^2$

$48 + 20 = 68$ ← Adding the areas of both rectangles works out that the total area of the floor is $68\ \text{m}^2$

$$\begin{array}{r} 2.5 \\ \times\ \ 3 \\ \hline 7.5 \end{array}$$
← Multiplying the 2.5 litres of paint in each tin by the 3 tins works out that there is 7.5 litres in total

$7.5 \times 10 = 75$ ← Multiplying the 7.5 litres of paint by the $10\ \text{m}^2$ which each litre covers works out that the paint can cover $75\ \text{m}^2$

Yes ← Petra does have enough paint as the $75\ \text{m}^2$ which can be covered is more than the $68\ \text{m}^2$ which needs to be covered

(4)

Actually, 1 litre of paint will cover 11 m^2 of floor.

(b) Does this affect your answer to part (a)?
You must give a reason for your answer.

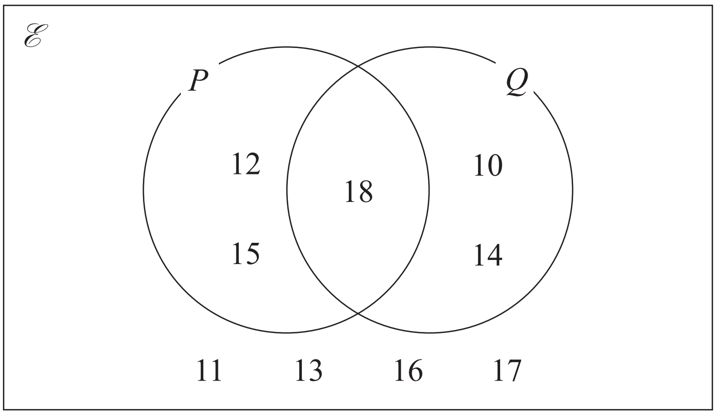
No, more area could be covered

The 7.5 litres would be multiplied by 11 m^2, which will give a greater result than the 75 m^2 which could be covered before. If more can be covered, this does not affect the answer to part (a) as only 68 m^2 needs to be covered so there will still be enough paint

(1)

(Total for Question 3 is 5 marks)

4 Here is a Venn diagram.



(a) Write down the numbers that are in set P'

The numbers not in P → 10, 14, 11, 13, 16, 17

(1)

A number is chosen at random from the universal set, ℰ

(b) Find the probability that this number is in the set $P \cup Q$

P ∪ Q is the union of P and Q, which is all numbers which are in P or Q or both. This is the numbers 12, 15, 18, 10, 14. This is 5 out of the 9 numbers → $\frac{5}{9}$

(2)

(Total for Question 4 is 3 marks)

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5 Sophie drives a distance of 513 kilometres on a motorway in France.
She pays 0.81 euros for every 10 kilometres she drives.

(a) Work out an estimate for the total amount that Sophie pays.

$500 \div 10$ 513 kilometres is rounded to 500 kilometres. Dividing this by 10 works out that roughly 50 lots of 10 kilometres were travelled

50×0.80 0.81 euros is rounded to 0.80 euros. Multiplying the 50 lots by 0.80 euros estimates the total amount Sophie pays

$5 \times 8 = 40$, so $50 \times 8 = 400$, so $50 \times 0.80 = 40$

40 euros

(3)

(b) Is your answer to part (a) an underestimate or an overestimate?
Give a reason for your answer.

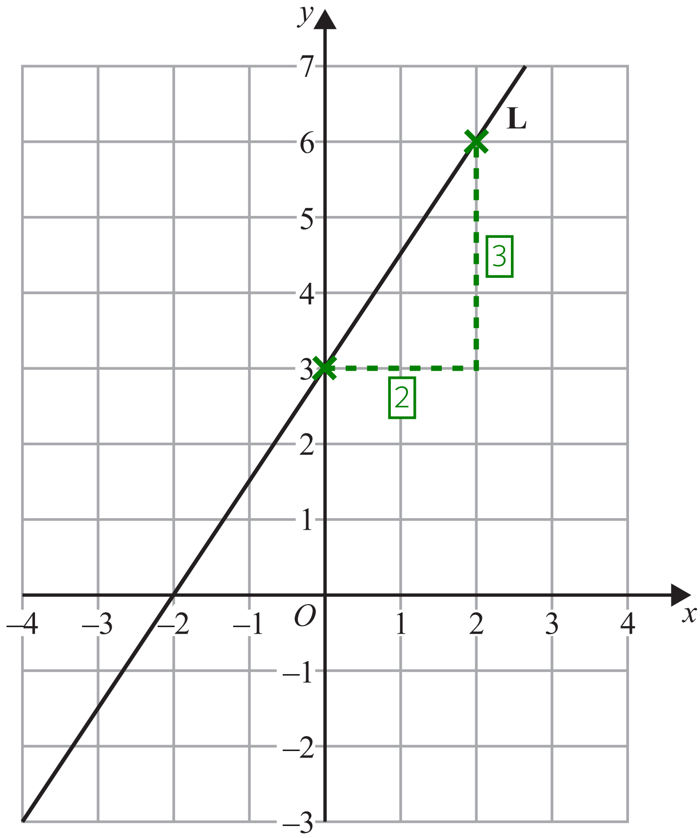
Underestimate, as the values were rounded down

Both the 513 kilometres and the 0.81 euros were rounded down. As these are multiplied together, this means that the answer of 40 euros is too low

(1)

(Total for Question 5 is 4 marks)

6 Here is a straight line **L** drawn on a grid.



(a) Find an equation for **L**.

The general equation of a straight line is $y = mx + c$, where m is the gradient and c is the y-intercept. Gradient = (change in y)/(change in x). y changes by 3 and x changes by 2 between the two green crosses on the graph. So the gradient is 3/2. The y-intercept is 3 as this is the y-coordinate where it crosses the y-axis

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

(3)

M is a different straight line with equation $y = 5x$

(b) Write down the equation of a straight line parallel to **M**.

The general equation of a straight line is $y = mx + c$, where m is the gradient and c is the y-intercept. The gradient of $y = 5x$ is 5. Parallel lines have the same gradient but different y-intercept so writing an equation with a gradient of 5 and a y-intercept of 1 (this could be any value apart from 0)

$y = 5x + 1$

(1)

(Total for Question 6 is 4 marks)

7 Kasim has some small jars, some medium jars and some large jars.
He has a total of 400 jars.

$\frac{3}{8}$ of the 400 jars are empty.

For the empty jars,

number of small jars : number of medium jars = 3 : 4
number of medium jars : number of large jars = 1 : 2

Work out the percentage of Kasim's jars that are empty small jars.

$400 \div 8$ This works out that 1/8 of the 400 jars is 50

$50 \times 3 = 150$ This works out that 3/8 of the 400 jars is 150 empty jars

S : M : L
3 4
  1 2
3 4 8

Writing the ratios above each other in columns. Multiplying both sides of the 1 : 2 ratio by 4 makes it 4 : 8, which can now be combined with the 3 : 4 ratio as they both have the same number of parts for medium. So the ratio small : medium : large = 3 : 4 : 8

$\frac{3}{15} = \frac{1}{5}$ 3 + 4 + 8 = 15 parts in total in the ratio. 3 out of these 15 parts represent the empty small jars. Writing this as a fraction then simplifying by dividing both the numerator and denominator by 3

$150 \div 5$ Doing 1/5 of the 150 empty jars works out that there are 30 empty small jars

$\frac{30}{400} \times 100$ 30 out of the 400 jars are empty small jars. Expressing this as a fraction of the total 400 jars. Multiplying this by 100 converts it into a percentage

30 × 100 = 3000. The answer can be left as a fraction which does not need to be simplified

$\frac{3000}{400}$ %

(Total for Question 7 is 5 marks)

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Turn over

8 Len has 8 parcels.

The mean weight of the 8 parcels is 2.5 kg.
The mean weight of 3 of the parcels is 2 kg.

Work out the mean weight of the other 5 parcels.

$\begin{matrix} & t & \\ m & & n \end{matrix}$ Writing a formula triangle for mean, total, number. Total is the total weight of the parcels and number is the number of parcels

$$\begin{array}{r} 2.5 \\ \times\ 8 \\ \hline 20.0 \end{array}$$

Covering t in the formula triangle finds that total = mean × number. So multiplying the mean of 2.5 kg by the 8 parcels works out that the total weight of all 8 parcels is 20 kg

2×3 Covering t in the formula triangle finds that total = mean × number. So multiplying the mean of 2 kg by the 3 parcels works out that the total weight of the 3 parcels is 6 kg

$20 - 6$ Subtracting the total weight of the 3 parcels from the total weight of the 8 parcels works out that the total weight of the other 5 parcels is 14 kg

Mean = total/number. So dividing the total weight of 14 kg by the 5 parcels works out the mean of the other 5 parcels. 14 cannot be divided by 5 to give a whole number so it can be left as a fraction

$\frac{14}{5}$ kg

(Total for Question 8 is 3 marks)

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9 In a sale, the normal price of a coat is reduced by R%

Given that

sale price = 0.7 × normal price

find the value of R.

Multiplying a decimal by 100 converts it into a percentage. 0.7 × 100 = 70%. So it is 70% of the normal price. This is a reduction of 30%

$R =$ 30

(Total for Question 9 is 1 mark)

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10 Solve the simultaneous equations

$5x - 2y = 23$ 1st equation
$2x - 3y = 18$ 2nd equation

$10x - 4y = 46$
$10x - 15y = 90$

Multiplying all terms on both sides of the 1st equation by 2 to form the 3rd equation. Multiplying all terms on both sides of the 2nd equation by 5 to form the 4th equation. Now the 3rd and 4th equation have the same number of x

$-11y = 44$ Subtracting the 3rd equation from the 4th equation cancels out the x terms leaving an equation only in terms of y

$y = -4$ Dividing both sides by -11 works out y

$2x + 12 = 18$ Substituting -4 for y in the 2nd equation. $-3 \times -4 = 12$

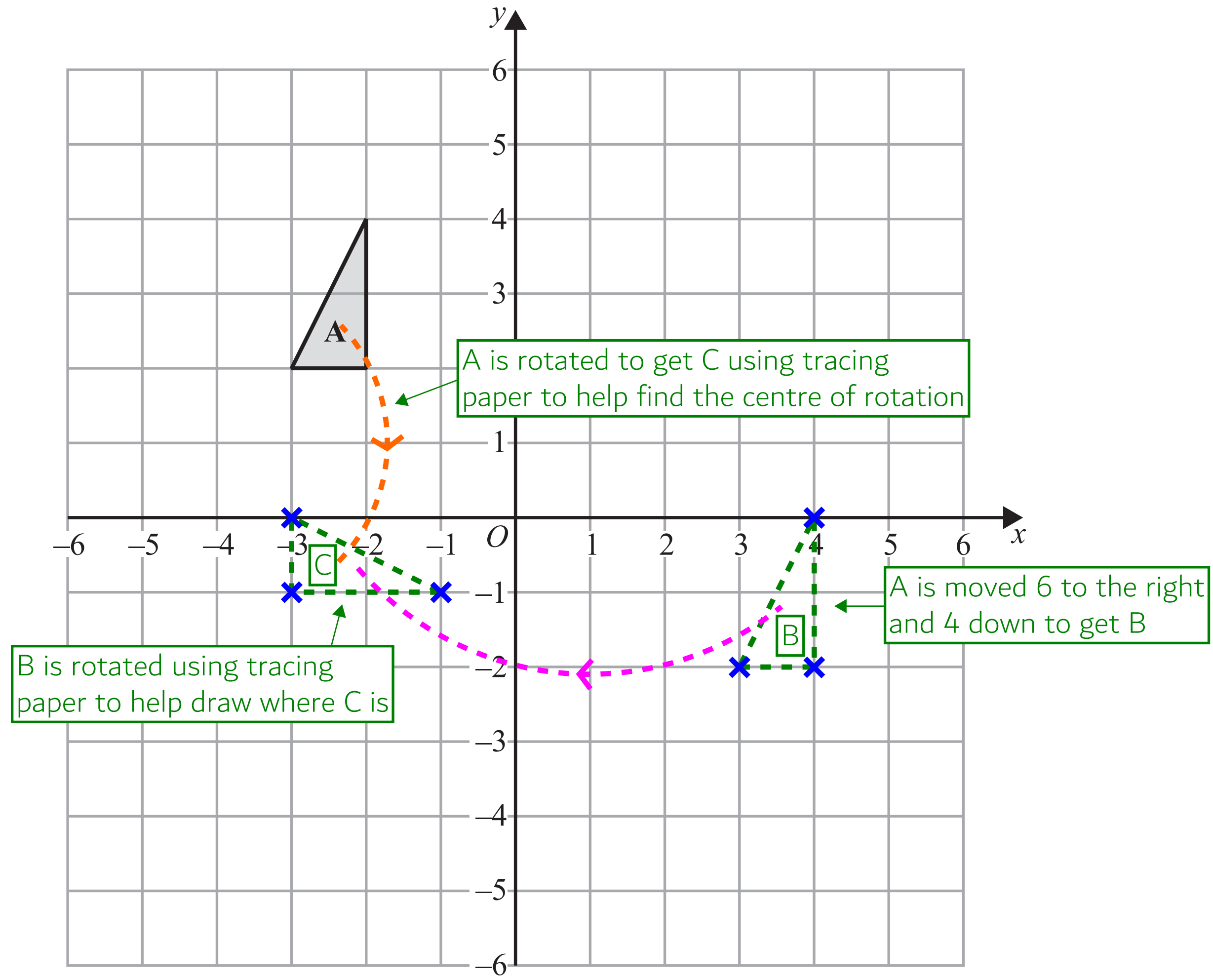
$2x = 6$ Subtracting 12 from both sides

Dividing both sides by 2 to find x $x =$ 3

$y =$ -4

(Total for Question 10 is 4 marks)

11



Triangle **A** is translated by the vector $\begin{pmatrix} 6 \\ -4 \end{pmatrix}$ to give triangle **B**.

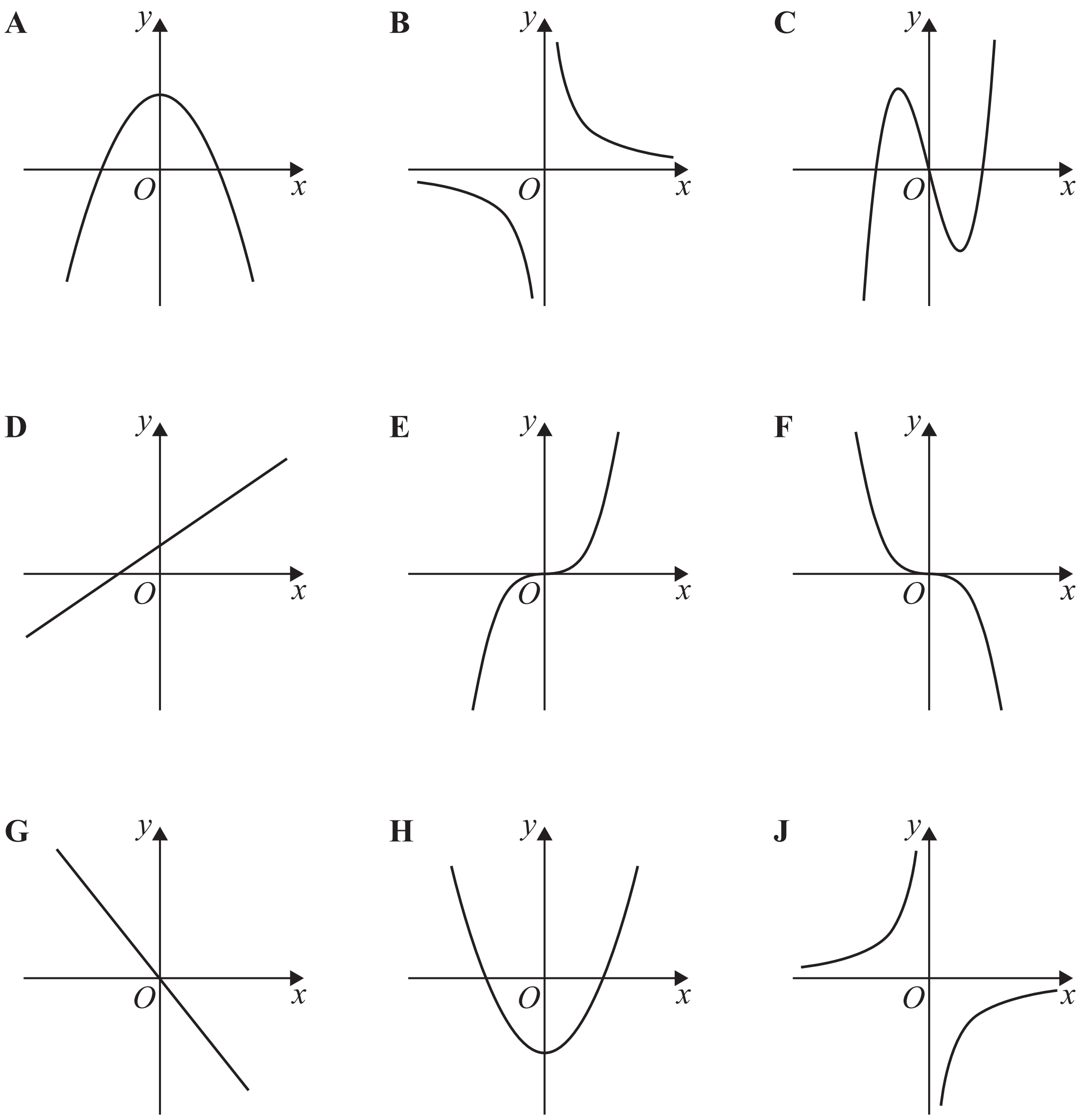
Triangle **B** is rotated 90° clockwise about the point (1, 2) to give triangle **C**.

Describe fully the single transformation that maps triangle **A** onto triangle **C**.

Rotation 90° clockwise about (-4, 1)

(Total for Question 11 is 3 marks)

12 Here are some graphs.



Write down the letter of the graph that could have the equation

(i) $y = x^2 - 4$

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

These are typical graphs so it could be possible to memorise what the graphs look like. Alternatively, doing a small table of values for each equation can help work out which graph matches it

H ....

(1)

(ii) $y = -x^3$

x	-1	0	1
y	1	0	-1

This one cannot by G as it should be a curve

F ....

(1)

(iii) $y = -\dfrac{5}{x}$

x	-1	0	1
y	5	-	-5

There is no value when x = 0 as it is not possible to divide by 0

J ....

(1)

(Total for Question 12 is 3 marks)

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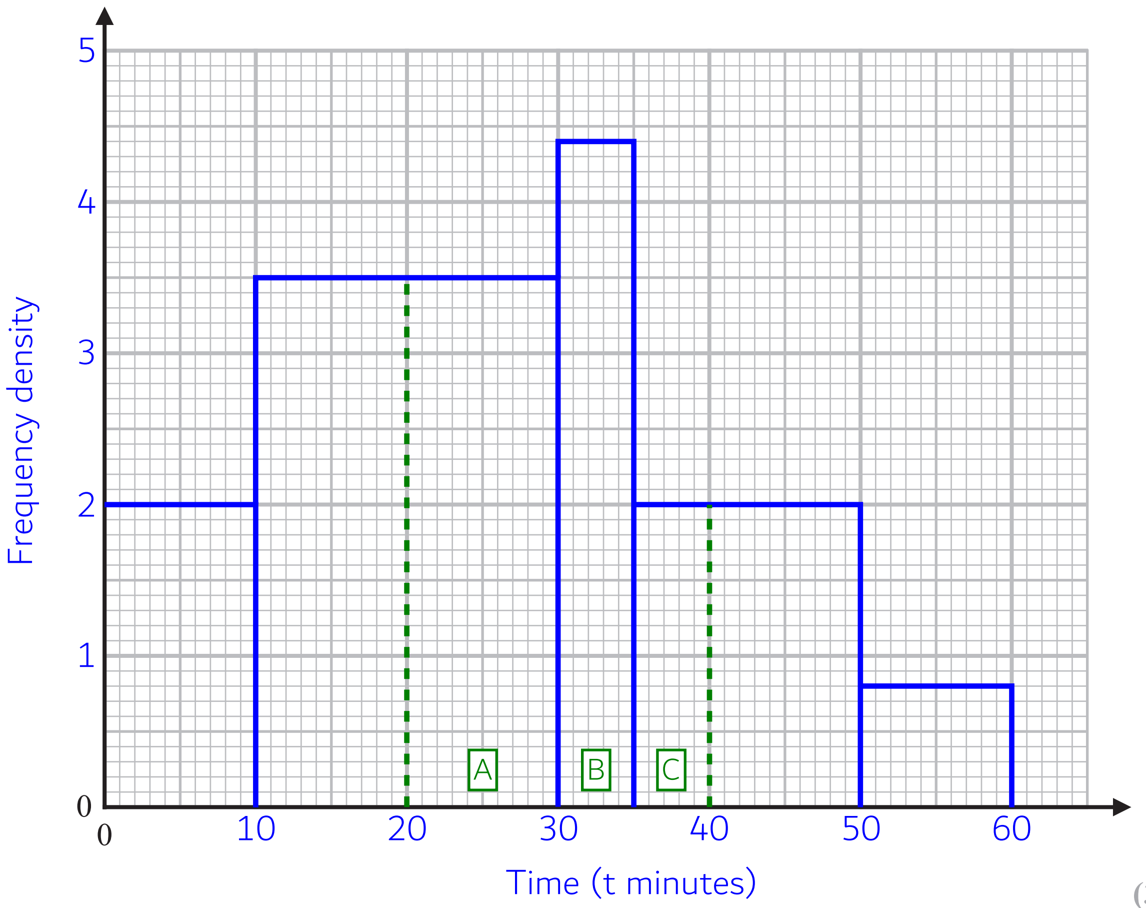
13 The table gives information about the amount of time that each of 150 people were in a shop.

See next page for an explanation

Time (t minutes)	Frequency	FD
$0 < t \leqslant 10$	20	2
$10 < t \leqslant 30$	70	3.5
$30 < t \leqslant 35$	22	4.4
$35 < t \leqslant 50$	30	2
$50 < t \leqslant 60$	8	0.8

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



(3)

(b) Work out an estimate for the fraction of these 150 people who were in the shop for between 20 minutes and 40 minutes.

$10 \times 3.5 = 35$

$5 \times 2 = 10$

Frequency is the area of each box on a histogram. Splitting the bars as shown in green dashed lines gives two new boxes. The base of box A is 10 and the height is 3.5 so its area is 35. The base of box C is 5 and the height is 2 so its area is 10

$35 + 22 + 10$

Adding the frequencies for boxes A, B and C estimates a frequency of 67 people who were in the shop for between 20 and 40 minutes

$\frac{67}{150}$

(2)

67 out of the 150 people were estimated to be in the the shop for between 20 and 40 minutes

(Total for Question 13 is 5 marks)

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The area of each box gives the frequency on a histogram. Area of rectangle = length × width. So Frequency = class width × frequency density, where class width is how wide each bar is and frequency density is the height of each bar. So to get the frequency density, the frequencies must be divided by the class widths. For example, the $0 < t \leq 10$ interval has class width of 10 (as 10 - 0 = 10) and frequency of 20 so 20 ÷ 10 = 2 as the frequency density.

14 Expand and simplify $(3x - 1)(2x + 3)(x - 5)$

$6x^2 + 9x - 2x - 3$ ← Expanding the first two brackets

$(6x^2 + 7x - 3)(x - 5)$ ← Simplifying by collecting like terms and writing the third bracket

$6x^3 - 30x^2 + 7x^2 - 35x - 3x + 15$ ← Expanding with the third bracket

Simplifying by collecting like terms → $6x^3 - 23x^2 - 38x + 15$

(Total for Question 14 is 3 marks)

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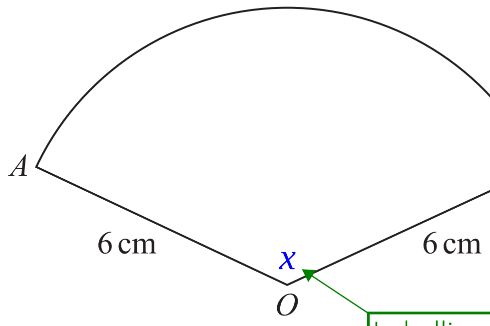
15 *OAB* is a sector of a circle with centre *O* and radius 6 cm.



Labelling the angle of the sector as x

The length of the arc *AB* is 5π cm.

Work out, in terms of π, the area of the sector.
Give your answer in its simplest form.

$\frac{x}{360} \times \pi \times 12 = 5\pi$ ← The arc AB is part of the circumference. Circumference = π × diameter. Diameter = 6 × 2 = 12 cm. There are 360° around the centre of a circle so the arc AB is x/360 of the circumference. Expressing the length of arc AB then setting this equal to the actual length of 5π cm

$\frac{x}{30} = 5$ ← Dividing both sides of the equation by π cancels them out. 12 is a numerator and 360 is a denominator so dividing both by 12 to cancel out the 12

$x = 150$ ← Multiplying both sides by 30 finds that the angle is 150°

$\frac{150}{360} \times \pi \times 6^2$ ← Expressing the area of the sector. Area of circle = π × radius^2. The sector is 150/360 of the circle

$\frac{150}{10} \times \pi$ ← 6^2 = 36, which is a numerator and 360 is a denominator so dividing both by 36 cancels out the 6^2

150/10 = 15 → 15π .... cm^2

(Total for Question 15 is 4 marks)

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16 There are only n orange sweets and 1 white sweet in a bag.

Saira takes at random a sweet from the bag and eats the sweet.
She then takes at random another sweet from the bag and eats this sweet.

Show that the probability that Saira eats two orange sweets is $\frac{n-1}{n+1}$

$\frac{n}{n+1} \times \frac{n-1}{n}$

Expressing the probability that Saira eats two orange sweets. Adding the n orange sweets and the 1 white sweet gives n + 1 sweets in total. n out of these n + 1 sweets are orange. There is then 1 fewer orange sweet for the second pick so there is n - 1 orange sweets. There is also 1 fewer sweet in total so there are n + 1 - 1, which simplifies to n sweets in total. n - 1 out of the n sweets are orange for the second pick. Orange AND orange. AND means to multiply the probabilities

$\frac{n-1}{n+1}$

The n on the numerator of the first fraction and the n on the denominator of the second fraction cancel out

(Total for Question 16 is 2 marks)

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17 (a) Rationalise the denominator of $\frac{1}{\sqrt{7}}$

Multiplying both the numerator and denominator by $\sqrt{7}$ gives an equivalent fraction with a rational denominator. $1 \times \sqrt{7} = \sqrt{7}$ and $\sqrt{7} \times \sqrt{7} = 7$

$\frac{\sqrt{7}}{7}$

(1)

(b) Simplify fully $\sqrt{80} - \sqrt{5}$

$5\overline{)8^{3}0}$ = 16

$\sqrt{a} \times \sqrt{b} = \sqrt{ab}$, so dividing the 80 by 5 works out that $\sqrt{16} \times \sqrt{5} = \sqrt{80}$

$4\sqrt{5} - \sqrt{5}$

$\sqrt{16} = 4$, so $\sqrt{80} = 4\sqrt{5}$

$4x - x = 3x$

$3\sqrt{5}$

(2)

(Total for Question 17 is 3 marks)

18 Show that $0.\dot{1}\dot{5} + 0.2\dot{2}\dot{7}$ can be written in the form $\dfrac{m}{66}$ where m is an integer.

$$\begin{array}{r} 0.1\dot{5}\dot{1} \\ +\ 0.2\dot{2}\dot{7} \\ \hline 0.3\dot{7}\dot{8} \end{array}$$

Adding the two recurring decimals to get one recurring decimal. This is done by forcing the $0.\dot{1}\dot{5}$ so that the recurring digits are in the same decimal places as in $0.2\dot{2}\dot{7}$

$x = 0.3\dot{7}\dot{8}$

Let x be the recurring decimal

$100x = 37.8\dot{7}\dot{8}$

There are two recurring digits so multiplying by ten twice allows it to be written in a different way with the recurring digits in the same decimal places

$99x = 37.5$

Subtracting x from $100x$ cancels out the recurring digits

$x = \dfrac{37.5}{99}$

Dividing both sides by 99 expresses x as a fraction

$= \dfrac{375}{990}$

Simplifying the fraction to get rid of the decimal by multiplying both the numerator and denominator by ten

$$\begin{array}{r|l} & 0\ \ 1\ \ 5 \\ \hline 66 & 9\ {}^{9}9\ {}^{33}0 \end{array}$$

This works out that the denominator of 990 must be divided by 15 to get 66

$$\begin{array}{r|l} & 0\ \ 2\ \ 5 \\ \hline 15 & 3\ {}^{3}7\ {}^{7}5 \end{array}$$

So the numerator of 375 must also be divided by 15 to keep the fraction equivalent

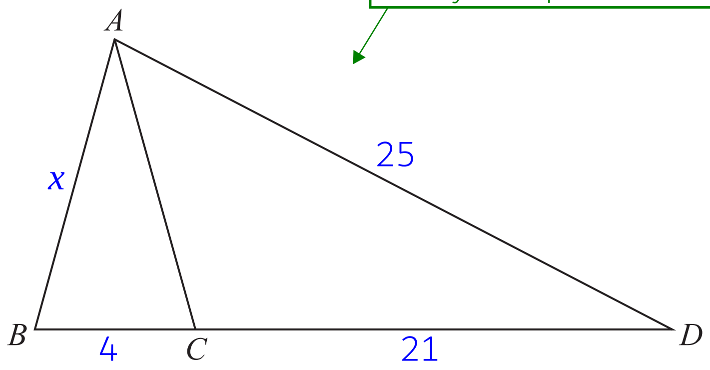
$x = \dfrac{25}{66}$

Dividing both the numerator and denominator of 375/990 by 15 gives a fraction with 66 as the denominator

(Total for Question 18 is 3 marks)

Labelling how many parts of the ratio each side is worth. 4 + 21 = 25, which is side BD and so is side AD as they are equal. AB is unknown so labelling it as x

19



ABC and *DAB* are similar isosceles triangles.

$AB = AC$
$AD = BD$

$BC : CD = 4 : 21$

Find the ratio $AB : AD$

$\frac{25}{x} = \frac{x}{4}$

AB is the smaller version of AD in the similar triangles (as they are both the longer sides of the isosceles triangles) so dividing AD by AB expresses the scale factor. BC is the smaller version of AB in the similar triangles (as they are both the shorter side of the isosceles triangles) so dividing AB by BC also expresses the scale factor. These expressions must be equal as they both express the scale factor

$100 = x^2$

Multiplying both sides by x and multiplying both sides by 4 to eliminate the denominators

$x = 10$

Square rooting both sides. So AB is worth 10 parts of the ratio

AB is 10 parts and AD is 25 parts. There is no need to simplify

10 : 25

(Total for Question 19 is 3 marks)

20 $2^x = \dfrac{2^n}{\sqrt[3]{2}} \qquad 2^y = \left(\sqrt{2}\right)^5$

Given that $x + y = 8$

work out the value of n.

$n - \dfrac{1}{3} + \dfrac{5}{2}$

This is an expression for $x + y$.

Highlighted in orange: this is an expression for x. The cube root of 2 is $2^{1/3}$ and $a^w/a^z = a^{w-z}$ so the indices are subtracted. x must be n - 1/3 as this is the power of 2 on the right of the first equation.

Highlighted in pink: this is an expression for y. The square root of 2 is $2^{1/2}$ and then raising this to the power of 5 gives $2^{5/2}$ as $(a^w)^z = a^{wz}$. y must be 5/2 as this is the power of 2 on the right of the second equation.

$n - \dfrac{2}{6} + \dfrac{15}{6}$

Multiplying both the numerator and denominator of 1/3 by 2 and multiplying both the numerator and denominator of 5/2 by 3 to make the denominators the same

$n + \dfrac{13}{6} = \dfrac{48}{6}$

-2 + 15 = 13. Then setting the expression of $x + y$ equal to 48/6, as this is 8 converted into a fraction with 6 as the denominator

Subtracting 13/6 from both sides gets n on its own

$n = \dfrac{35}{6}$

(Total for Question 20 is 3 marks)

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21 A solid cuboid has a volume of 300 cm^3
The cuboid has a total surface area of 370 cm^2

The length of the cuboid is 20 cm.
The width of the cuboid is greater than the height of the cuboid.

Work out the height of the cuboid.
You must show all your working.

$20wh = 300$ ← Let w be the width and h be the height. Volume of cuboid = length × width × height. The length is 20 cm, the width is w and the height is h so these are all multiplied together. This must be equal to the actual volume of 300 cm^3

$wh = 15$ ← Dividing both sides by 20

$h = \frac{15}{w}$ ← Rearranging to make h the subject by dividing both sides by w

$2 \times 20 \times w + 2 \times 20 \times h + 2 \times w \times h$ ← Expressing the surface area in terms of w and h. Area of rectangle = length × width. There are 6 rectangles on the surface of the cuboid and the opposite faces are equal. So doing 2 lots of the front face, 2 lots of the top face and 2 lots of the side face and adding them all together

$40w + 40h + 2wh$ ← Simplifying the expression of the surface area

$40w + \frac{600}{w} + 30 = 370$ ← Substituting 15/w for h in 40h and substituting 15 for wh. so that the h is eliminated and there is now an expression only in terms of w. Setting equal to the actual surface area of 370 cm^2

$40w^2 + 600 + 30w = 370w$ ← Multiplying all terms on both sides by w to eliminate it as the denominator

$40w^2 - 340w + 600 = 0$ ← Putting into the quadratic form by subtracting 370w from both sides

$4w^2 - 34w + 60 = 0$ ← Simplifying by dividing all terms on both sides by 10

$2w^2 - 17w + 30 = 0$ ← Simplifying by dividing all terms on both sides by 2

$2w^2 - 5w - 12w + 30 = 0$
$w(2w - 5) - 6(2w - 5) = 0$
$w(2w - 5) - 6(2w - 5) = 0$
$(w - 6)(2w - 5) = 0$

← Factorising the left side by multiplying a by c (the 2 by the 30) to give 60. Two numbers which multiply to give this 60 and add to give b (the -17) are -5 and -12. Splitting the middle w term into these numbers of w then factorising the left two terms and the right two terms. Finally putting it into the factorised form by writing the repeated bracket once and bringing together the w and -6

$2w - 5 = 0$ ← One of the two brackets must be 0 so 2w - 5 could be equal to 0

$2w = 5$ ← Adding 5 to both sides to get the w term on its own

$w = 2.5$ ← Dividing both sides by 2 finds that the width could be 2.5 cm

$w = 6$ ← If w - 6 = 0, adding 6 to both sides finds that the width could also be 6 cm

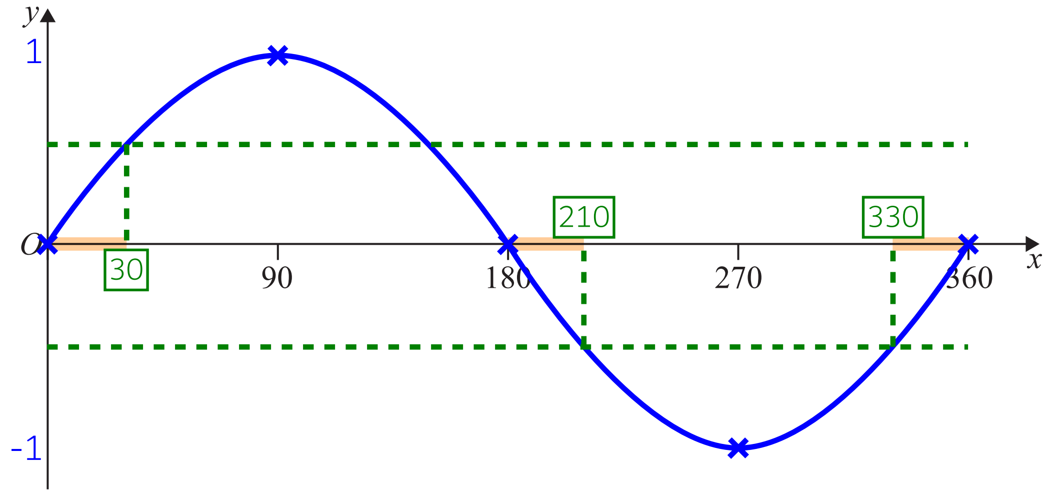
Both w and h are basically the same in the expression of the surface area 40w + 40h + 2wh and this was used to solve w. So the height could also be 2.5 cm or 6 cm. However, the width is greater than the height so the width must be 6 cm and the height must be 2.5 cm

2.5 cm

(Total for Question 21 is 5 marks)

DO NOT WRITE IN THIS AREA

22 (a) Sketch the graph of $y = \sin x°$ for $0 \leqslant x \leqslant 360$



It is best to memorise what a sin graph looks like for this question

(2)

(b) Solve the equation $2\sin x° = -1$ for $0 \leqslant x \leqslant 360$

$\sin x = -\frac{1}{2}$ Dividing both sides by 2 to make sin$x$ the subject

0	30	45	60	90
0	1	2	3	4

Ignoring the negative for now and working out a sin value which gives 1/2. Listing the angles of 0, 30, 45, 60, 90 degrees. Then listing 0, 1, 2, 3, 4 under these, which can then be square rooted and put over 2. So sin30 = 1/2

The sketch of the graph helps. Drawing a line across at y = -1/2 then reading up works out the values of x needed. All the distances highlighted in orange are 30 in the x direction

210, 330

(2)

(Total for Question 22 is 4 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

23 **C** is a circle with centre (0, 0)
L is a straight line.

The circle **C** and the line **L** intersect at the points P and Q.
The coordinates of P are (5, 10)
The x coordinate of Q is -2

L has a positive gradient and crosses the y-axis at the point $(0, k)$ ← This is the y-intercept as x is 0

Find the value of k.

$x^2 + y^2 = r^2$ ← This is the general equation of a circle with its centre at (0, 0), where r is the radius

$10^2 + 5^2 = r^2$ ← Substituting in the x and y-coordinates from P as it is on the circle so must satisfy the equation

$r^2 = 100 + 25$ ← $10^2 = 100$ and $5^2 = 25$. So $r^2 = 125$

$(-2)^2 + y^2 = 125$ ← Substituting in the x-coordinate of Q and substituting 125 for r^2

$y^2 = 121$ ← $(-2)^2 = 4$. Then subtracting 4 from both sides

$y = \pm 11$ ← Doing the positive and negative square root of both sides to get rid of the power of 2 on the left

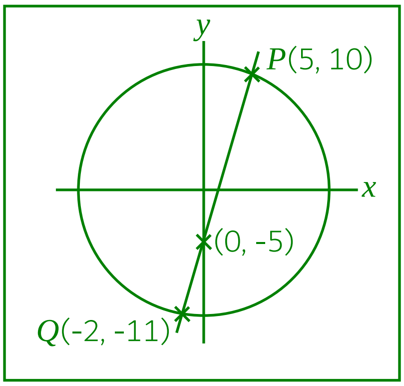
The y-coordinate of Q must be -11 as the gradient is positive. This means that y must decrease as it goes to the left and the x-coordinate of -2 is to the left of the x-coordinate of 5. It cannot be positive 11 as this is above the y-coordinate of 10

$\frac{10 - -11}{5 - -2}$ ← This is an expression of the gradient of line L. Gradient of straight line = (change in y)/(change in x). y changes from -11 to 10 so the change in y is 10 - -11. x changes from -2 to 5 so the change in x is 5 - -2

$\frac{21}{7}$ ← 10 - -11 = 10 + 11 = 21 and 5 - -2 = 5 + 2 = 7. So the gradient of line L is 3

$10 = 3(5) + c$ ← The general equation of a straight line is $y = mx + c$, where m is the gradient and c is the y-intercept. Substituting in the coordinates of P and substituting 3 for m

$c = -5$ ← 3(5) = 15 then subtracting 15 from both sides finds c



(0, k) is the y-intercept as x is 0. c is the y-coordinate of the y-intercept

$k =$ -5

(Total for Question 23 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS