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)

Monday 3 June 2024

Morning (Time: 1 hour 30 minutes) | **Paper reference** **1MA1/2H**

Mathematics
PAPER 2 (Calculator)
Higher Tier

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB or B pencil, eraser, calculator, 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 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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F:1/1/1/

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.

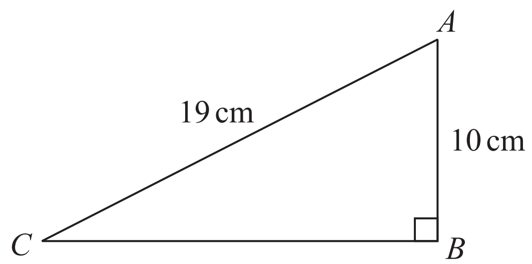
If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 *ABC* is a right-angled triangle.



Work out the length of *CB*.
Give your answer correct to 3 significant figures.

$CB^2 + 10^2 = 19^2$ ← Pythagoras' Theorem can be used. $a^2 + b^2 = c^2$, where a and b are the shorter sides and c is the longest side. Substituting CB for a, 10 cm for b and 19 cm for c

$CB^2 = 261$ ← Subtracting 10^2 from both sides

Square rooting both sides gets CB on its own. Formatting the answer as a decimal and rounding 16.15... to 2 significant figures → 16.2 cm

(Total for Question 1 is 2 marks)

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2 (a) Write 90 as a product of its prime factors.

Using the calculator to format 90 as a product of prime factors → $2 \times 3^2 \times 5$

(2)

$A = 2^2 \times 3$

$B = 2 \times 3^2$

(b) Write down the lowest common multiple (LCM) of A and B.

$2^2 \times 3^2$ ← The lowest common multiple can be found by multiplying the highest power of each prime factor in both A and B

Alternatively the calculator may be able to give the LCM without having to do this method

36

(1)

(Total for Question 2 is 3 marks)

3 The number of hours, H, that some machines take to make 5000 bottles is given by

$$H = \frac{72}{n} \quad \text{where } n \text{ is the number of machines.}$$

On Monday, 6 machines made 5000 bottles.
On Tuesday, 9 machines made 5000 bottles.

The machines took more time to make the bottles on Monday than on Tuesday.

How much more time?

$\frac{72}{6} = 12$ ← *n* is 6 on Monday. Substituting this into the formula finds that it took 12 hours on Monday

$\frac{72}{9} = 8$ ← *n* is 9 on Tuesday. Substituting this into the formula finds that it took 8 hours on Tuesday

$12 - 8$ ← Subtracting the 8 hours it took on Tuesday from the 12 hours it took on Monday works out the difference and so how much more time it took on Monday than on Tuesday

4 hours

(Total for Question 3 is 2 marks)

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4 There are only red discs, blue discs and yellow discs in a bag.
There are 24 yellow discs in the bag.

Mel is going to take at random a disc from the bag.

The probability that the disc will be yellow is 0.16

the number of red discs : the number of blue discs = 5 : 4

Work out the number of red discs in the bag.

$0.16T = 24$ ← Let T be the total number of discs. Multiplying T by the probability of yellow will give the number of yellow discs

$T = 150$ ← Dividing both sides by 0.16 works out that T, the total number of discs, is 150

$150 - 24$ ← Subtracting the 24 yellow discs from the 150 total discs works out that there are 126 red and blue discs

$126 \div 9$ ← 5 + 4 = 9 parts in total in the ratio. These 9 parts represent the 126 red and blue discs. So dividing 126 by 9 works out that 1 part of the ratio is worth 14

14×5 ← Multiplying the value of 1 part of the ratio by the 5 parts representing red works out that the 5 parts representing red is worth 70. So there are 70 red discs

70

(Total for Question 4 is 4 marks)

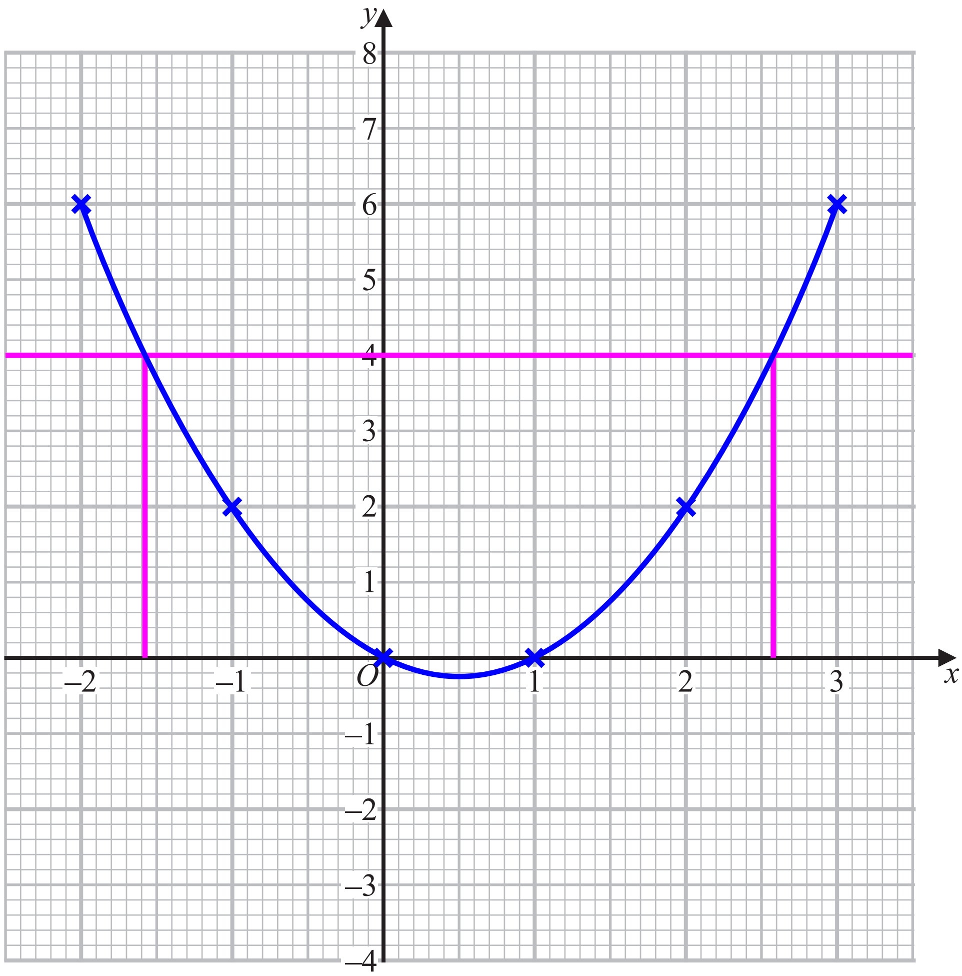
5 (a) Complete the table of values for $y = x^2 - x$

x	-2	-1	0	1	2	3
y	6	2	0	0	2	6

Using table mode on the calculator, set f(x) = x^2 - x. Start: -2. End: 3. Step: 1

(2)

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



Plotting the points from the table of values and joining them up with a curve

(2)

(c) Use your graph to find estimates for the solutions of the equation $x^2 - x = 4$

y has been replaced with 4. So drawing the line of y = 4 and finding the x-coordinates where the graph drawn in (b) meets this

-1.6, 2.6

(2)

(Total for Question 5 is 6 marks)

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6 Andy, Luke and Tina share some sweets in the ratio 1 : 6 : 14

Tina gives $\frac{3}{7}$ of her sweets to Andy.

Tina then gives $12\frac{1}{2}$% of the rest of her sweets to Luke.

12.5%

Tina says,

"Now all three of us have the same number of sweets."

Is Tina correct?
You must show how you get your answer.

Assume that Andy has 1 sweet, Luke has 6 sweets and Tina has 14 sweets

$\frac{3}{7} \times 14$ ← This works out that 3/7 of Tina's sweets is 6. So Tina gives 6 sweets to Andy

$A = 1 + 6 = 7$ ← Adding the 6 sweets to the 1 which Andy has works out that Andy now has 7 sweets

$14 - 6$ ← Subtracting the 6 sweets from the 14 which Tina had works out that Tina now has 8 sweets

$\frac{12.5}{100} \times 8$ ← Putting the 12.5% over 100 converts it to a fraction, which when multiplied by the 8 sweets Tina now has works out that 12.5% of the rest of Tina's sweets is 1. So Tina gives 1 sweet to Luke

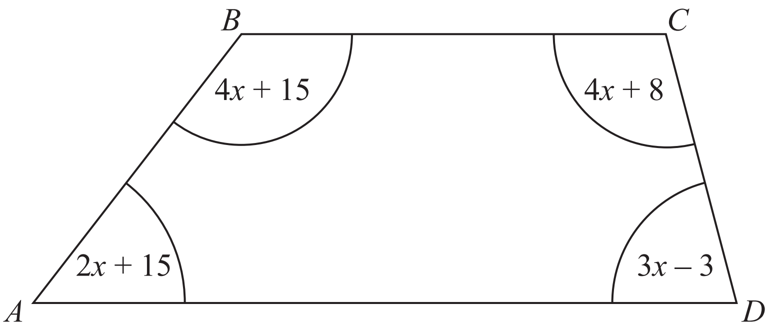
$L = 6 + 1 = 7$ ← Adding the 1 sweet to the 6 which Luke has works out that Luke now has 7 sweets

$T = 8 - 1 = 7$ ← Subtracting the 1 sweet from the 8 which Tina has works out that Tina now has 7 sweets

Yes ← They all have 7 sweets (given the assumption at the start). As it is ratio, they could all have any multiple of 7 but will always have the same number of sweets

(Total for Question 6 is 4 marks)

7 *ABCD* is a quadrilateral.



All angles are measured in degrees.

Show that *ABCD* is a trapezium.

$13x + 35 = 360$ ← 4x + 4x + 2x + 3x = 13x and 15 + 8 + 15 - 3 = 35. So the total of the angles is 13x + 35, which must equal to 360° as there are this many degrees in a quadrilateral

$13x = 325$ ← Subtracting 35 from both sides to get the x term on its own

$x = 25$ ← Dividing both sides by 13 gets x on its own

$A = 2 \times 25 + 15$ ← Substituting 25 for x in 2x + 15 finds that angle A is 65°

$= 65$

$B = 4 \times 25 + 15$ ← Substituting 25 for x in 4x + 15 finds that angle B is 115°

$65 + 115 = 180$ ← Adding angles A and B gives 180, meaning that they are co-interior angles

AD is parallel to BC ← As the angles are co-interior. So the quadrilateral must be a trapezium as it has one pair of parallel sides. Angles B and C cannot be co-interior as C would be less than 65° and adding this to B would not give 180°. So it cannot be a parallelogram

(Total for Question 7 is 4 marks)

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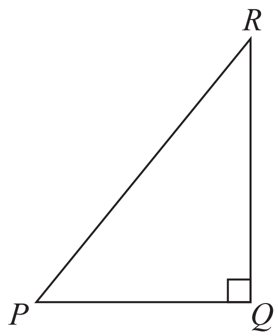
8 A playground is in the shape of a right-angled triangle.



Dan makes a scale drawing of the playground.
He uses a scale of 1 cm represents 5 m

The area of the playground on the scale drawing is 28 cm^2

The real length of *QR* is 40 m

Work out the real length of *PQ*.

$40 \div 5 = 8$ ← Every 5 m is represented by 1 cm so dividing the real length of QR by 5 works out that QR is represented by 8 cm on the scale drawing

$\frac{1}{2} b \times 8$ ← Area of triangle = 1/2 × base × height. Let b be PQ, the base. QR is the height and is 8 cm on the scale drawing

$4b = 28$ ← Simplifying the expression of the area of the triangle on the scale drawing. 1/2 × 8 = 4. Then setting equal to the actual area of 28 cm^2

$b = 7$ ← Dividing both sides by 4 finds that b, PQ on the scale drawing, is 7 cm

7×5 ← 1 cm represents 5 m so multiplying the length of PQ on the scale drawing by 5 works out that the real length of PQ is 35 m

.......................35....................... m

(Total for Question 8 is 3 marks)

9 A number N is rounded to 2 significant figures.
The result is 7.3

(a) Write down the least possible value of N.

The 5 after the 2 causes it to round up to a 3 so it becomes 7.3 to 2 significant figures. It cannot be any smaller than this

7.25

(1)

Leila says,

"The value of N cannot be greater than 7.349 because 7.350 would round up to 7.4"

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

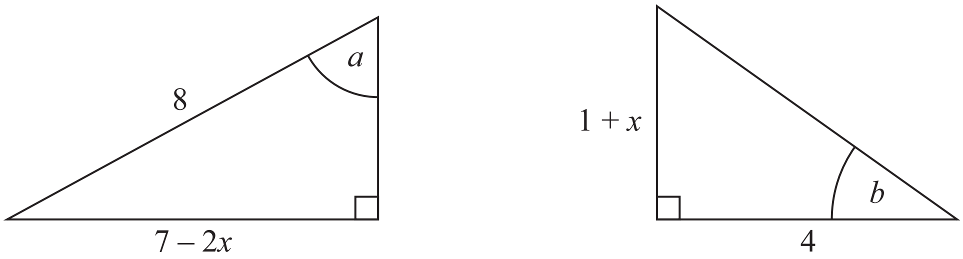
No, could be 7.3499

There are numbers between 7.349 and 7.350

(1)

(Total for Question 9 is 2 marks)

10 The diagram shows two right-angled triangles.



All lengths are measured in centimetres.

Given that

$$\sin a = \tan b$$

work out the value of x.

S O/H C A/H T O/A ← Right-angled trigonometry can be used to express $\sin a$ and $\tan b$ in term of x. So writing SOH CAH TOA as formula triangles

$\frac{7 - 2x}{8} = \frac{1 + x}{4}$ ← From the SOH formula triangle, $\sin a$ = opposite/hypotenuse. $7 - 2x$ is the opposite and 8 is the hypotenuse. From the TOA formula triangle, $\tan b$ = opposite/adjacent. $1 + x$ is the opposite and 4 is the adjacent. Setting the expression of $\sin a$ in terms of x equal to the expression of $\tan b$ in terms of x

$28 - 8x = 8 + 8x$ ← Multiplying both sides by 8 and then multiplying both sides by 4 to eliminate the denominators

$28 = 8 + 16x$ ← Adding $8x$ to both sides to get all the x on the same side

$20 = 16x$ ← Subtracting 8 from both sides to get the x term on its own

Dividing both sides by 16 gets x on its own → $x =$ 1.25

(Total for Question 10 is 3 marks)

11 The frequency table gives information about the weights of 60 parcels.

Weight (w kg)	Frequency
$0 < w \leqslant 2$	7
$2 < w \leqslant 4$	21
$4 < w \leqslant 6$	15
$6 < w \leqslant 8$	11
$8 < w \leqslant 10$	6

(a) Complete the cumulative frequency table.

Weight (w kg)	Cumulative frequency
$0 < w \leqslant 2$	7
$0 < w \leqslant 4$	28
$0 < w \leqslant 6$	43
$0 < w \leqslant 8$	54
$0 < w \leqslant 10$	60

Adding the frequencies as they go.
7 + 21 = 28
28 + 15 = 43
43 + 11 = 54
54 + 6 = 60

(1)

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

(2)

Plotting the cumulative frequencies at the end point of each interval then joining them up with a series of straight lines or a curve

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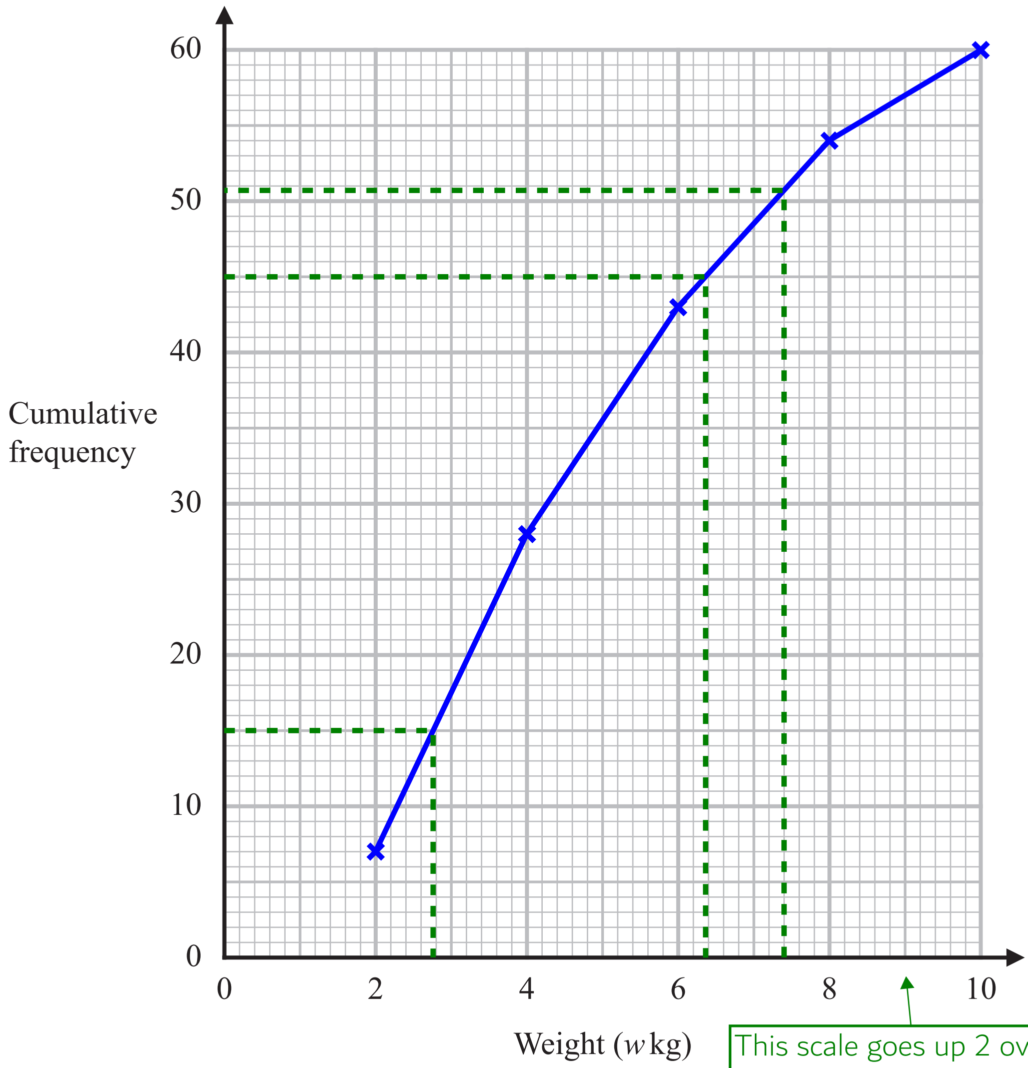

This scale goes up 2 over 10 small boxes.
$2 \div 10 = 0.2$, so each small box is worth 0.2

(c) Use your graph to find an estimate for the interquartile range.

6.4 - 2.8

15 is roughly 1/4 of the way through the 60 parcels so reading across from the cumulative frequency of 15 to the line then down estimates that the lower quartile is 2.8 (to the nearest half a box). 45 is roughly 3/4 of the way through the 60 parcels so reading across from the cumulative frequency of 45 to the line then down estimates that the upper quartile is 6.4 (to the nearest half a box). Interquartile range = upper quartile - lower quartile

3.6 kg

(2)

(d) Use your graph to find an estimate for the number of these parcels with a weight greater than 7.4 kg.

Reading up from 7.4 to the line then across estimates that 50 parcels (it is less than 51 so it hasn't quite reached the 51st parcel) have a weight less than 7.4 kg. So this leaves 10 parcels which would have a weight greater than 7.4 kg

10

(2)

(Total for Question 11 is 7 marks)

12 f is inversely proportional to d^2

$f = 3.5$ when $d = 8$

(a) Find an equation for f in terms of d.

$f = \frac{k}{d^2}$ ← Writing the proportion as an equation, using k to represent a constant

$k = 3.5 \times 8^2$ ← Multiplying both sides by d^2 gets k on its own. Substituting 3.5 for f and 8 for d

Substituting the value of k back into the original equation → $f = \frac{224}{d^2}$

(2)

(b) Find the positive value of d when $f = 10$

Give your answer correct to 3 significant figures.

$fd^2 = 224$ ← Multiplying both sides of the equation by d^2 to eliminate d as the denominator

$d^2 = \frac{224}{10}$ ← Dividing both sides by f to get d^2 on its own. Substituting 10 for f

$d = \pm\sqrt{22.4}$ ← Doing the positive and negative square root to eliminate the power of 2

Ignoring the negative solution as it is asking for the positive value → $d =$ 4.73

(2)

(Total for Question 12 is 4 marks)

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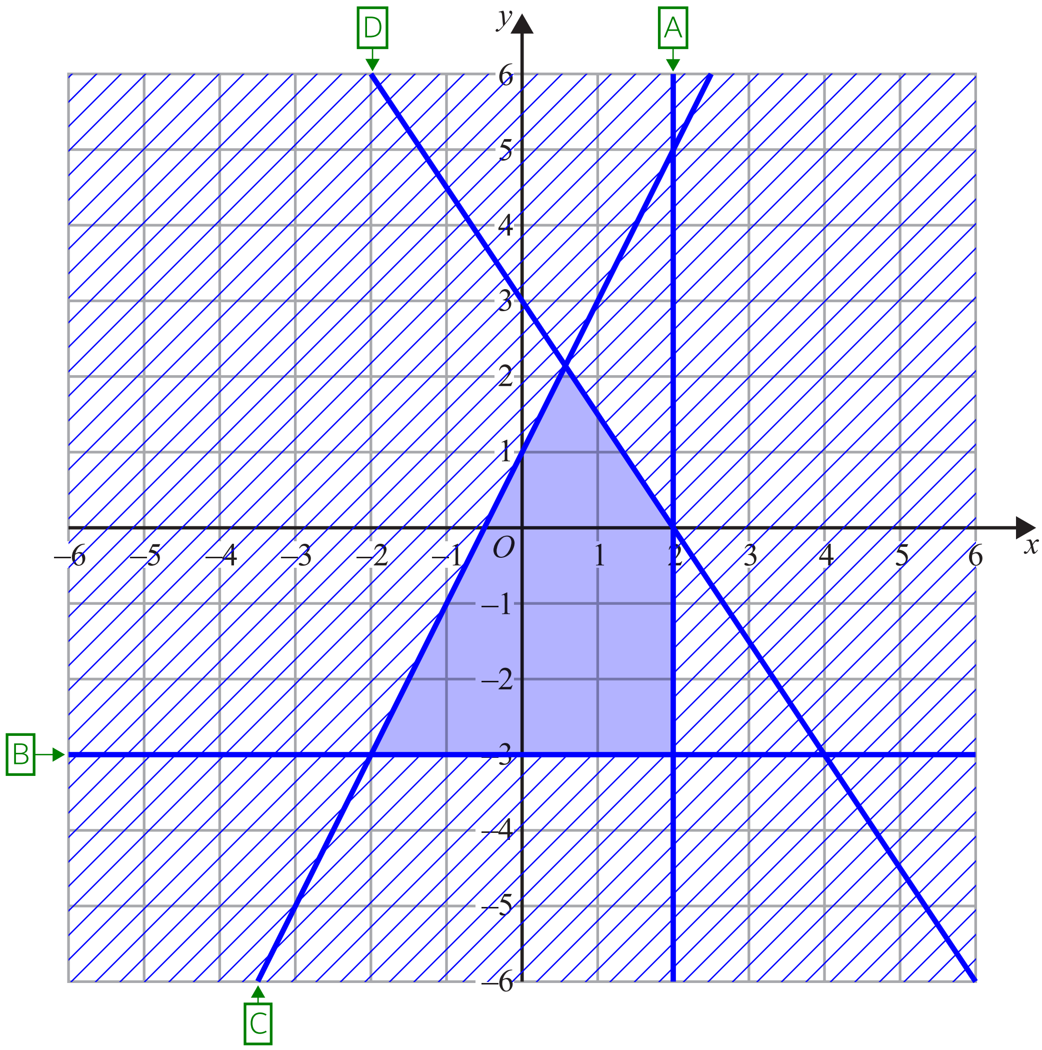
13



On the grid, shade the region **R** that satisfies all the following inequalities.

$x \leqslant 2 \qquad y \geqslant -3 \qquad y \leqslant 2x + 1 \qquad 3x + 2y \leqslant 6$

Label the region **R**.

$2y \leq 6 - 3x$

$y \leq 3 - 1.5x$

Rearranging the fourth inequality to make y the subject

(Total for Question 13 is 3 marks)

A: Drawing the line of $x = 2$. Crossing out to the right of this line as x is less.

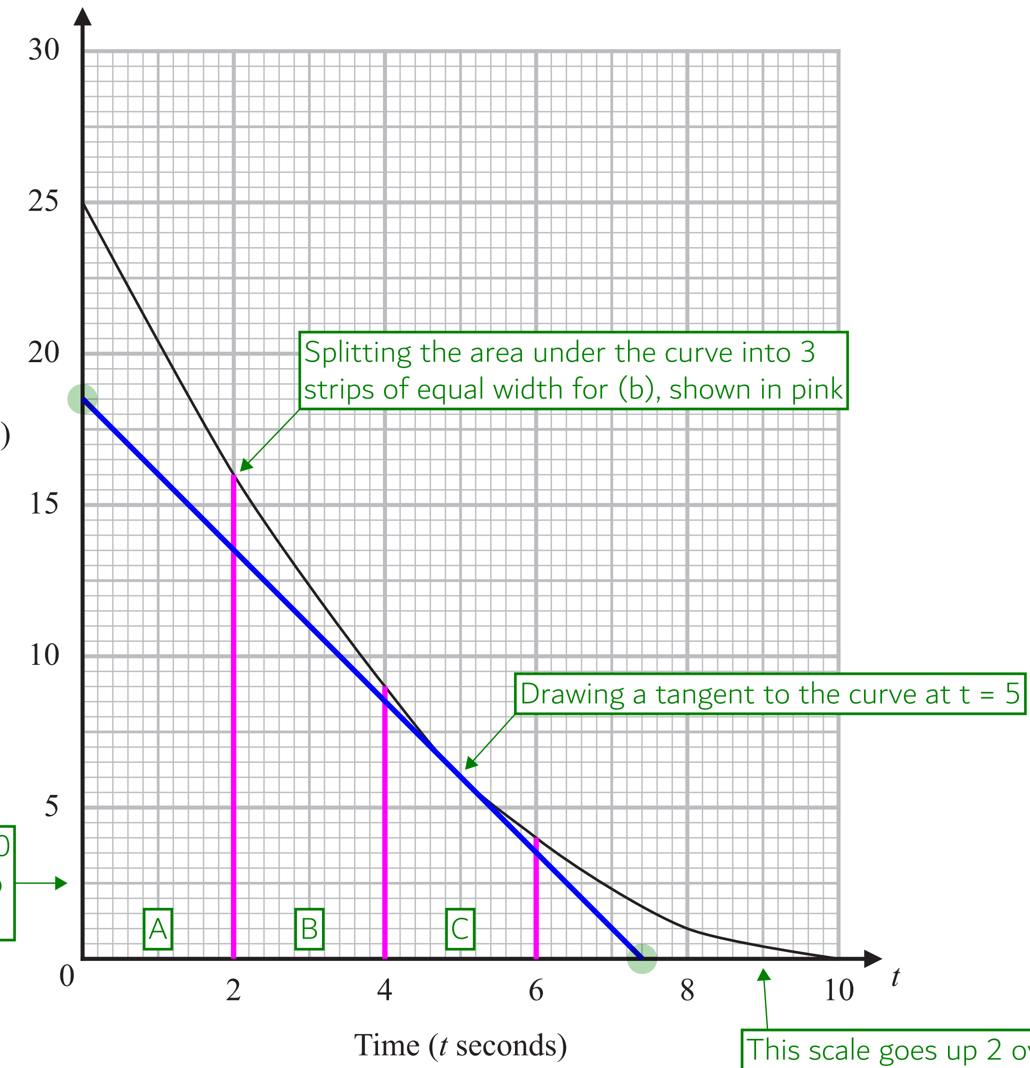
B: Drawing the line of $y = -3$. Crossing out below this line as y is greater.

C: Drawing the line of $y = 2x + 1$. Crossing out above this line as y is less.

D: Drawing the line of $y = 3 - 1.5x$. Crossing out above this line as y is less.

All of the lines are solid (not dashed) as they involve equal to in the inequalities.
The region R is where it is not crossed out

14 The graph shows the velocity of a car, in metres per second, t seconds after it starts to slow down.



(a) Calculate an estimate for the acceleration of the car when $t = 5$
You must show all your working.

$\frac{0 - 18.5}{7.4 - 0}$

Acceleration on a velocity-time graph is the gradient of the line. The tangent has the same gradient as the curve at t = 5. Gradient = (change in y)/(change in x). Using the two points at the end of the line. y changes from 18.5 to 0 and x changes from 0 to 7.4

-2.5 m/s²

(3)

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(b) Work out an estimate for the distance the car travels in the first 6 seconds after it starts to slow down.
Use 3 strips of equal width.

$\frac{1}{2}(25 + 16) \times 2 + \frac{1}{2}(16 + 9) \times 2 + \frac{1}{2}(9 + 4) \times 2$ ← Adding the areas of trapezium A, B and C estimates the area under the curve for the first 6 seconds, which is an estimate of the distance travelled

Area of trapezium A | Area of trapezium B | Area of trapezium C

Area of trapezium = 1/2 (a + b) × h, where a and b are the parallel sides and h is the distance between them

79 m
(3)

(Total for Question 14 is 6 marks)

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15 Given that a is a prime number, rationalise the denominator of $\frac{1}{\sqrt{a}+1}$

Give your answer in its simplest form.

$\frac{1}{\sqrt{a}+1} \times \frac{\sqrt{a}-1}{\sqrt{a}-1}$ ← Multiplying by the denominator over the denominator but flipping the + to -

Expanding.
$1(\sqrt{a} - 1) = \sqrt{a} - 1$
$\sqrt{a} \times \sqrt{a} = a$
$\sqrt{a} \times -1 = -\sqrt{a}$
$1 \times \sqrt{a} = \sqrt{a}$
$1 \times -1 = -1$

$\frac{\sqrt{a}-1}{a - \sqrt{a} + \sqrt{a} - 1}$

$-\sqrt{a} + \sqrt{a}$ cancels out → $\frac{\sqrt{a}-1}{a-1}$

(Total for Question 15 is 2 marks)

16 Solve $(4x - 3)(x + 5) < 0$ ← Solving for $(4x - 3)(x + 5) = 0$ to begin with

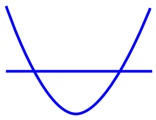
$4x - 3 = 0$ ← One of the two brackets must be 0 in order to multiply to 0

$4x = 3$ ← Adding 3 to both sides gets the x term on its own

$x = 0.75$ ← Dividing both sides by 4 gets x on its own

$x + 5 = 0$ ← One of the two brackets must be 0 in order to multiply to 0

$x = -5$ ← Subtracting 5 from both sides gets x on its own

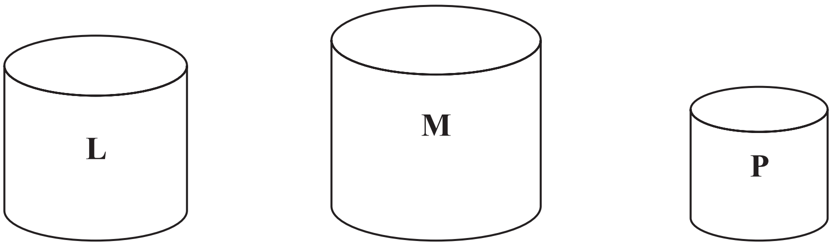


← Drawing a sketch of the graph. Expanding the brackets would give $4x^2$ so the quadratic graph must be u-shaped. The two points where it crosses the x-axis (where is is equal to 0) must be $x = -5$ (on the left) and $x = 0.75$ (on the right)

From the graph, the solutions to the inequality where it is less than 0 in the y-direction are between $x = -5$ and $x = 0.75$ → $-5 < x < 0.75$

(Total for Question 16 is 2 marks)

17 **L**, **M** and **P** are three similar solid cylinders made from the same material.



L has a mass of 64 g
M has a mass of 125 g

M has a total surface area of 144 cm^2
P has a total surface area of 16 cm^2

Work out

height of cylinder **L** : height of cylinder **M** : height of cylinder **P**

Mass is directly proportional to volume so the ratio of volume of L : volume of M is 64 : 125. Cube rooting both sides (as the unit of volume would be cm^3 and cube rooting this gives cm) finds that the ratio of height of L : height of M is 4 : 5.

The ratio of surface area of M : surface area of P is 144 : 16. Square rooting both sides (as the unit of area is cm2 and square rooting this gives cm) finds that the ratio of height of M : height of P is 12 : 4.

Writing these ratios of heights above each other so that they can be combined

L : M : P
4   5
    12 4

M is in common to both ratios so making the same number of parts for M in both ratios allows them to be combined. Multiplying both sides of 4 : 5 by 12 gives 12 : 60 and multiplying both sides of 12 : 4 by 5 gives 60 : 20. These can both be combined to give 48 : 60 : 20

48 : 60 : 20

(Total for Question 17 is 4 marks)

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18 There are only 4 red counters, 3 yellow counters and 1 green counter in a bag.

Tony takes at random three counters from the bag.

Work out the probability that there are now more yellow counters than red counters in the bag.
You must show all your working.

RRR, RRG, RGR, GRR

Listing out the events which would result in there being more yellow counters than red counters. This can happen if three red counters are picked (as there would be 1 red counter remaining and 3 yellow counters remaining) or if two red and one green are picked (as there would be 2 red counter remaining and 3 yellow counters remaining)

$$\frac{4}{8} \times \frac{3}{7} \times \frac{2}{6} + \frac{4}{8} \times \frac{3}{7} \times \frac{1}{6} \times 3$$

For RRR: 4 out of the 8 counters are red for the first pick, then (as there is one fewer red counter and one fewer counter in total) 3 out of the 7 counters are red, then (as there is one fewer red counter and one fewer counter in total) 2 out of the 6 counters are red. Expressing these as fractions and multiplying them (as it is red AND red AND red. AND means to multiply the probabilities).

For RRG: 4 out of the 8 counters are red for the first pick, then (as there is one fewer red counter and one fewer counter in total) 3 out of the 7 counters are red, then (as there is one fewer counter in total) 1 out of the 6 counters are green. Expressing these as fractions and multiplying them (as it is red AND red AND green. AND means to multiply the probabilities).

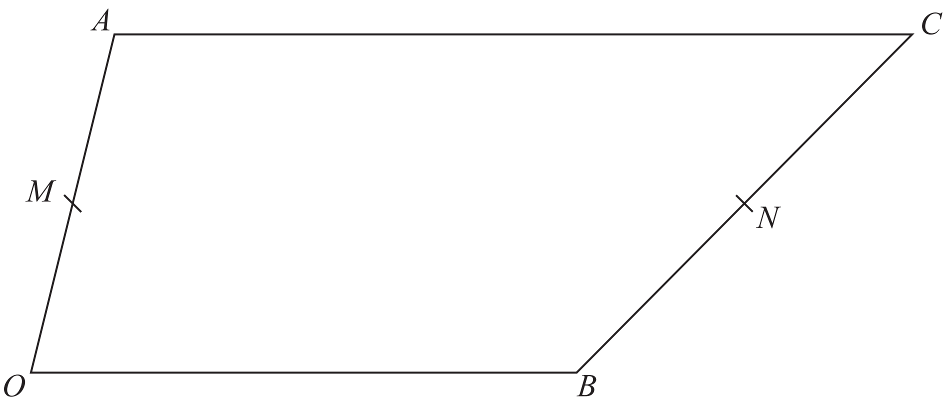
Multiplying the probability of RRG by 3 as the probabilities for RRG, RGR and GRR are the same (as the numerators and denominators are the same for each of the orders and they are all multiplied. The order does not matter when multiplying).

Adding the probabilities of RRR and RRG × 3 as it is RRR OR RRG OR RGR OR GRR. OR means to add the probabilities

$\frac{5}{28}$

(Total for Question 18 is 5 marks)

19 The diagram shows quadrilateral $OACB$.



M is the midpoint of OA.
N is the point on BC such that $BN : NC = 4 : 5$

$\overrightarrow{OA} = \mathbf{a}$ $\quad \overrightarrow{OB} = \mathbf{b}$ $\quad \overrightarrow{AC} = k\mathbf{b}$ where k is a positive integer.

(a) Express $\overrightarrow{MN}$ in terms of k, $\mathbf{a}$ and $\mathbf{b}$.
Give your answer in its simplest form.

$\frac{5}{9}(-kb - a + b)$ ← Expressing $\overrightarrow{CN}$, which is 5/9 of $\overrightarrow{CB}$ (as 4 + 5 = 9 parts in total in the ratio representing CB and 5 of these represent CN). $\overrightarrow{CB} = \overrightarrow{CA} + \overrightarrow{AO} + \overrightarrow{OB}$. $\overrightarrow{CA} = -\overrightarrow{AC}$ and $\overrightarrow{AO} = -\overrightarrow{OA}$

$\frac{1}{2}a + kb - \frac{5}{9}kb - \frac{5}{9}a + \frac{5}{9}b$ ← $\overrightarrow{MN} = \overrightarrow{MA} + \overrightarrow{AC} + \overrightarrow{CN}$. $\overrightarrow{MA} = 1/2\ \overrightarrow{OA}$ as M is the midpoint of OA. Expanding the bracket for $\overrightarrow{CN}$

Collecting like terms → $-\frac{1}{18}a + (\frac{5}{9} + \frac{4}{9}k)b$

(4)

(b) Is MN parallel to OB?
Give a reason for your answer.

No, $\overrightarrow{MN}$ is not a multiple of b

$\overrightarrow{OB}$ involves just b. $\overrightarrow{MN}$ involves a and b. So $\overrightarrow{OB}$ cannot be multiplied to give $\overrightarrow{MN}$

(1)

(Total for Question 19 is 5 marks)

20 The curve **C** has equation $y = 2x^2 - 12x + 7$

Find the coordinates of the turning point on **C**.

$2(x^2 - 6x) + 7$ ← Bringing out 2 as a factor on the first two terms so that it is possible to complete the square

$2(x - 3)^2 + 7 - 18$ ← Completing the square by halving the -6 to get -3, putting this in a bracket with x, squaring this bracket, squaring the -3 to get 9, multiplying this by the 2 to get 18 and subtracting this 18 from the end

The turning point is where the square bracket is equal to 0. For this to happen, $x = 3$. When the square bracket is ignored, $y = 7 - 18 = -11$ → (........3........ , ...-11........)

(Total for Question 20 is 3 marks)

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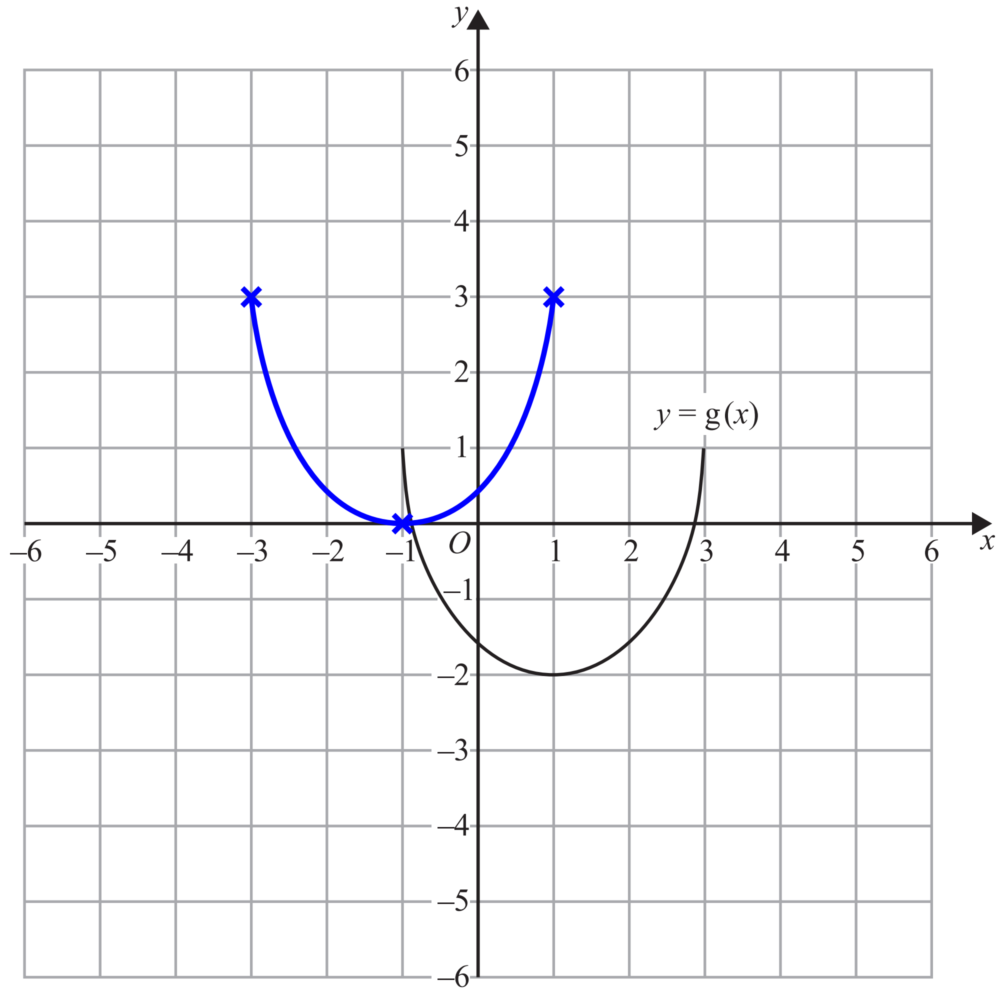
DO NOT WRITE IN THIS AREA

21 The graph of $y = g(x)$ is shown on the grid.



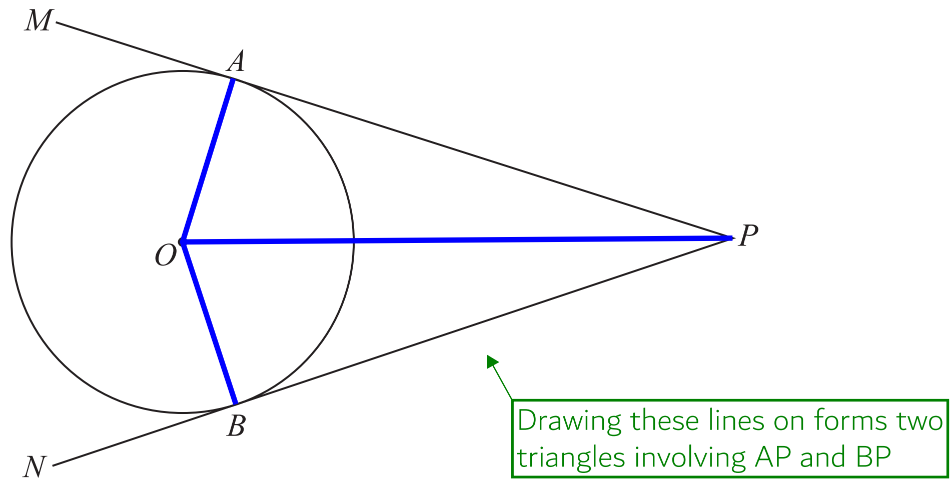
On the grid, draw the graph of $y = g(-x) + 2$

Making x negative reflects it in the y-axis. Adding 2 to the end moves it up 2 in the y-direction

(Total for Question 21 is 2 marks)

Turn over for Question 22

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



MAP and *NBP* are tangents to the circle.

Prove that $AP = BP$

Angle OAP and angle OBP are 90° as the radius and tangent are perpendicular

So angle OAP = angle OBP

OA = OB as they are both radii ← O is at the centre of the circle and a radius is a straight line from the centre of the circle to the outside of the circle

OP is common to triangles OAP and OBP

So triangle OAP is congruent to triangle OBP as RHS

Both triangles are right-angled triangles, have the same hypotenuse and have another side which is the same. So they are the same shape and size

So AP = BP

(Total for Question 22 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS