



Model Solutions

Please write clearly in block capitals.

Centre number

Candidate number

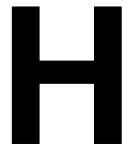
Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS



Higher Tier Paper 2 Calculator

Thursday 4 June 2020

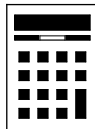
Morning

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a calculator
- mathematical instruments.



Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

For Examiner's Use	
Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
24–25	
26–27	
28–29	
TOTAL	

Advice

In all calculations, show clearly how you work out your answer.



JUN2083002H01

Answer **all** questions in the spaces provided.

1 Which of these is a correct identity?
Circle your answer.

[1 mark]

$x + 4x \equiv 5x$

$6x \equiv 18$

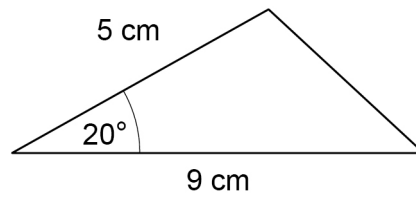
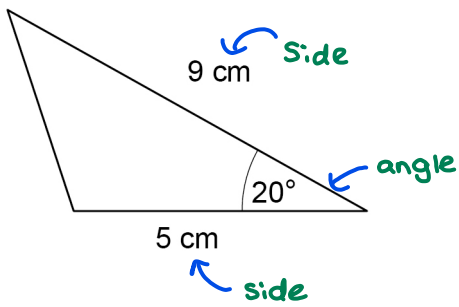
$2x + 1 \equiv 7$

$7x + 9 \equiv x$

$x + 4x = 5x$

2

Not drawn
accurately



Circle the reason why these triangles are congruent.

[1 mark]

RHS

ASA

SSS

SAS



3 Circle the number that is written in standard form.

[1 mark]

0.9×10^{-3}

$6 \times 10^{0.5}$

5.2×10^{-4}

12×10^7

↑ whole number
↑
 $0 < n < 10$

4 Circle the expression that has the **largest** value when $a < -1$

[1 mark]

$\frac{1}{2}a$

a

a^2

a^3

$\frac{1}{2} \times -1 = -\frac{1}{2}$

-1

$(-1)^2 = 1$

$(-1)^3 = (-1)^2 \times (-1)$
 $= 1 \times -1$
 $= -1$

Turn over for the next question

Turn over ►



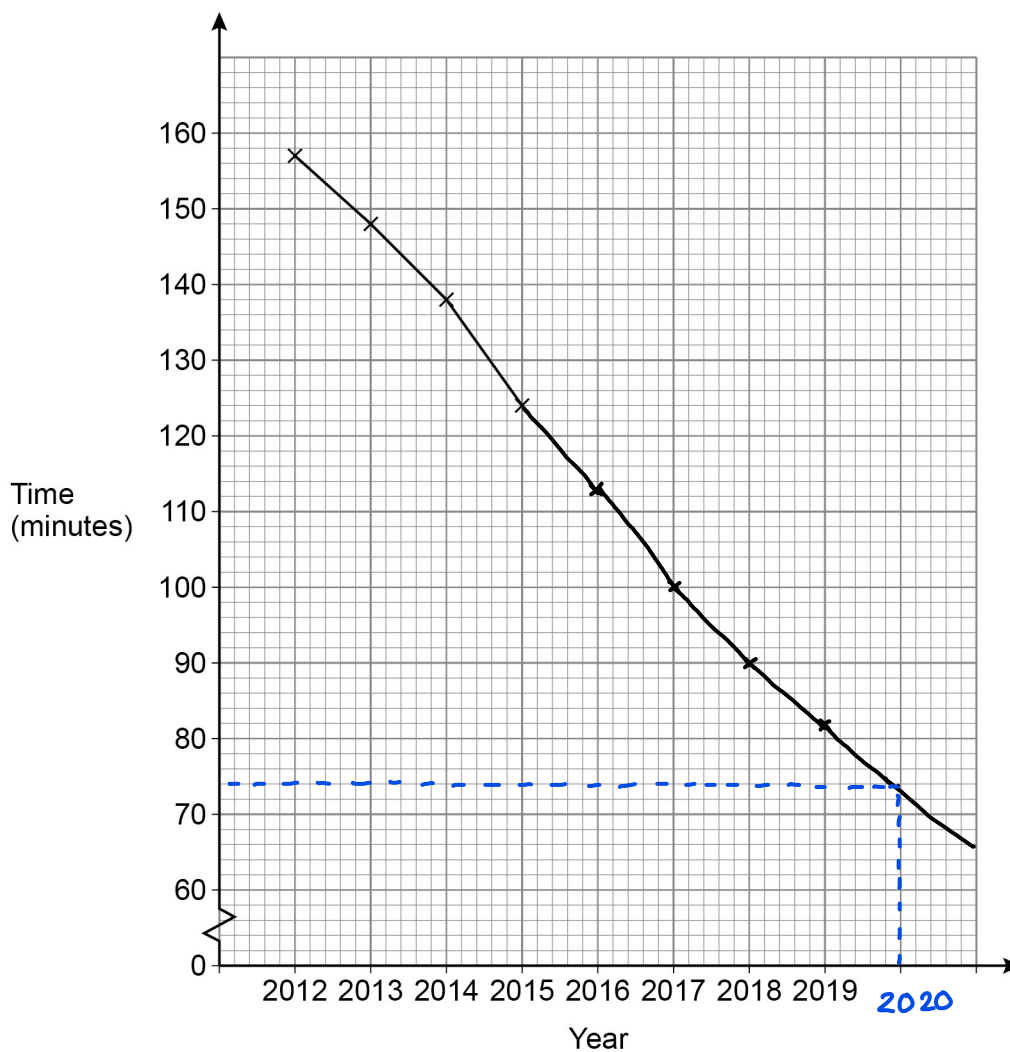
5 The time students spent watching TV was recorded.

The table shows the average daily time per student each year from 2012 to 2019

Year	2012	2013	2014	2015	2016	2017	2018	2019
Time (minutes)	157	148	138	124	113	100	90	82

A time series graph is drawn to represent the data.

The first four points have been plotted.



5 (a) Complete the graph.

[2 marks]

5 (b) Use the graph to estimate the average daily time per student in 2020

[1 mark]

[use line of best fit and straight line from 2020]

Answer 74 minutes

6 Work out the highest common factor (HCF) of 75 and 105

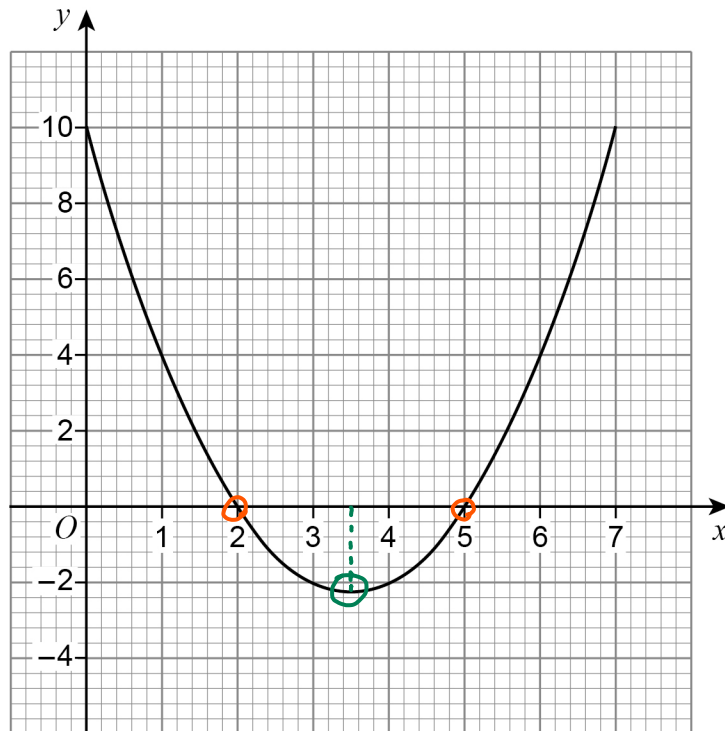
[2 marks]

factors { 75: 3, 5, 15, 25, 75
105: 3, 5, 7, 15, 21, 35, 105
HCF

Answer 15



7 Here is the graph of $y = x^2 - 7x + 10$ for values of x from 0 to 7



7 (a) Write down the roots of $x^2 - 7x + 10 = 0$

x-coordinates when $y=0$

[2 marks]

Answer 2, 5

7 (b) Write down the x -coordinate of the turning point of the curve.

[1 mark]

Shown in green

Answer 3.5



8 At a party there are 90 people.
 48 are women and 42 are men.
 Some women leave.
 Some men arrive.
 The ratio of women to men is now 10 : 11
 Are there now more than 90 people at the party?
 Tick **one** box.

Yes

No

Cannot tell

Show working to support your answer.

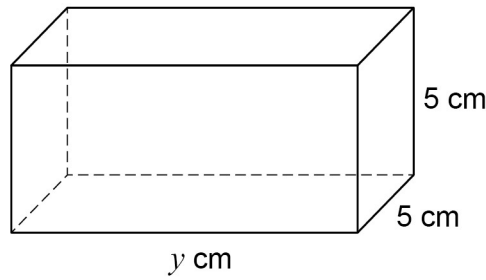
[2 marks]

$\frac{4}{2}$	$\left\{ \begin{array}{l} \text{Women} < 48 \\ \text{Men} > 42 \end{array} \right.$	(women leave) (men arrive)																								
<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; border-bottom: 1px solid black;">Women</th> <th style="text-align: center; border-bottom: 1px solid black;">:</th> <th style="text-align: right; border-bottom: 1px solid black;">Men</th> <th></th> </tr> </thead> <tbody> <tr> <td style="text-align: left;">10</td> <td style="text-align: center;">:</td> <td style="text-align: right;">11</td> <td></td> </tr> <tr> <td style="text-align: left;">20</td> <td style="text-align: center;">:</td> <td style="text-align: right;">22</td> <td></td> </tr> <tr> <td style="text-align: left;">30</td> <td style="text-align: center;">:</td> <td style="text-align: right;">33</td> <td></td> </tr> <tr> <td style="text-align: left;">40</td> <td style="text-align: center;">:</td> <td style="text-align: right;">44</td> <td style="padding-left: 20px;">← adheres to the statements</td> </tr> <tr> <td style="text-align: left;">50</td> <td style="text-align: center;">:</td> <td style="text-align: right;">55</td> <td></td> </tr> </tbody> </table>			Women	:	Men		10	:	11		20	:	22		30	:	33		40	:	44	← adheres to the statements	50	:	55	
Women	:	Men																								
10	:	11																								
20	:	22																								
30	:	33																								
40	:	44	← adheres to the statements																							
50	:	55																								
$\therefore 40 + 44 = 84$																										

Turn over for the next question



9 Here is a cuboid.



9 (a) Assume that the total surface area of the cuboid is 200 cm^2

Work out the volume of the cuboid.

Left and Right

[3 marks]

$$\text{Total surface area} = \underset{\substack{\uparrow \\ \text{Front and Back}}}{2 \times y \times 5} + \underset{\substack{\downarrow \\ \text{Left and Right}}}{2 \times 5 \times 5} + \underset{\substack{\uparrow \\ \text{Top and Bottom}}}{2 \times y \times 5}$$

$$= 10y + 50 + 10y$$

$$\begin{aligned} 200 &= 20y + 50 \\ 150 &= 20y \\ 7.5 &= y \end{aligned}$$

$$\therefore \text{Volume} = l \times b \times h = 7.5 \times 5 \times 5$$

Answer 187.5 cm^3



9 (b) In fact, the total surface area of the cuboid is smaller than 200 cm^2

What does this mean about the volume of the cuboid?

Tick **one** box.

[1 mark]

It is smaller than the answer to part (a)

It is bigger than the answer to part (a)

It is the same as the answer to part (a)

It could be any of the above

Turn over for the next question

Turn over ►



10

Alex and Bev sat six tests, each with 50 marks.
The table shows their mean percentages after five tests.

Alex	60%
Bev	52%

After all six tests, their mean percentages were equal. (also means mean marks were equal)
In the sixth test, Alex scored 24 out of 50

Work out Bev's score, out of 50, in the sixth test.

[4 marks]

$$\text{Alex's mean mark} = 60\% \text{ of } 50 = \frac{60}{100} \times 50 = 30$$

$$\text{Bev mean mark} = 52\% \text{ of } 50 = \frac{52}{100} \times 50 = 26$$

$$\text{Alex's mean mark after 6th test: } \frac{\text{Sum of marks for the first five tests } + 24}{6} = 29 = \text{Bev's mean mark after 6th test}$$

$$\therefore 29 = \frac{\text{Sum of marks for the first five tests } + x}{6}$$

$$29 \times 6 = 26 \times 5 + x$$

$$174 = 130 + x$$

$$x = 44$$

Answer 44 out of 50



- 11 A solid piece of silver has
mass 2.625 kilograms
volume 250 cm³

Work out the density of the piece of silver.

Give your answer in grams per cubic centimetre.

$$\text{density} = \frac{\text{mass}}{\text{volume}} = \frac{2.625 \text{ kg}}{250 \text{ cm}^3} = \frac{2625 \text{ g}}{250 \text{ cm}^3} = 10.5 \text{ g/cm}^3 \quad [2 \text{ marks}]$$

$1 \text{ kg} = 1000 \text{ g}$
 $\therefore 2.625 \text{ kg} = 2625 \text{ g}$

Answer 10.5 g/cm³

- 12 Work out the gradient of the straight line through $(-2, 3)$ and $(1, 9)$

$$m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{9 - 3}{1 - (-2)} = \frac{6}{1 + 2} = \frac{6}{3} = 2 \quad [2 \text{ marks}]$$

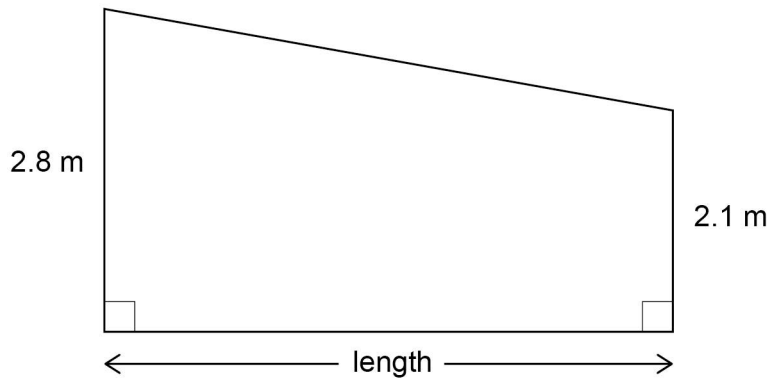
$$\text{gradient (m)} = \frac{\text{difference in } y}{\text{difference in } x}$$

Answer 2

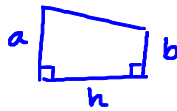
Turn over for the next question



13 The diagram shows a wall.



The area of the wall is 39.2 m^2



Work out the length of the wall.

[3 marks]

$$\text{Area of a trapezium} = \frac{1}{2} \times h \times (a + b)$$

$$\text{Area} = \frac{1}{2} \times \text{length} \times (2.1 + 2.8)$$

$$39.2 = \frac{1}{2} \times 4.9 \times \text{length}$$

$$2 \times 39.2 = 4.9 \times \text{length}$$

$$\frac{2 \times 39.2}{4.9} = \text{length} = 16$$

Answer 16 m



- 14 A marathon takes place each year.
In 2020 there were 6500 runners.

Prediction

For each of the next 3 years the number of runners will increase by 5%

Does this predict that in 2023 there will be more than 7500 runners?

You **must** show your working.

[3 marks]

$$\begin{array}{l}
 2020 = 6500 \\
 2021 = \frac{105}{100} \times 6500 = 6825 \\
 2022 = \frac{105}{100} \times 6825 = 7166.25 \\
 2023 = \frac{105}{100} \times 7166.25 = 7524.6 \approx 7525 \\
 \therefore \text{Yes as } 7525 > 7500
 \end{array}$$

current percentage
increase
new percentage
new fraction
round up to nearest whole number because humans are a whole number

Turn over for the next question



15

Rearrange $a = \frac{b}{c} + 5$ to make c the subject.

[3 marks]

$$a - 5 = \frac{b}{c} \quad \left. \begin{array}{l} \text{ } \\ \text{ } \end{array} \right\} -5$$

$$c(a - 5) = b \quad \left. \begin{array}{l} \text{ } \\ \text{ } \end{array} \right\} \times c$$

$$c = \frac{b}{a - 5} \quad \left. \begin{array}{l} \text{ } \\ \text{ } \end{array} \right\} \div (a - 5)$$

Answer $c = \frac{b}{a - 5}$



16 On a restaurant menu there are

22 main dishes, of which $\frac{4}{11}$ are gluten-free $\rightarrow P(\text{gf.M}) = \frac{4}{11}$

7 rice dishes, which are all gluten-free $\rightarrow P(\text{gf.R}) = \frac{1}{1}$

5 naan breads, of which 40% are gluten-free. $\rightarrow P(\text{gf.N}) = 40\% = \frac{40}{100}$

This Meal Deal is on the menu.

Choose one main dish, one rice dish and one naan bread

How many of the possible Meal Deals are totally gluten-free?

[3 marks]

$$P(\text{gluten free}) = P(\text{gf.M}) \times P(\text{gf.R}) \times P(\text{gf.N})$$

$$= \frac{4}{11} \times 1 \times \frac{40}{100}$$

$$= \frac{160}{1100}$$

\rightarrow certain since all rice are gluten free

$$= \frac{16}{110}$$

$$\text{No. of possible combinations} = 22 \times 7 \times 5 = 770 \text{ Meals}$$

$$\therefore \frac{16}{110} \times 770 = 16 \times 7 = 112$$

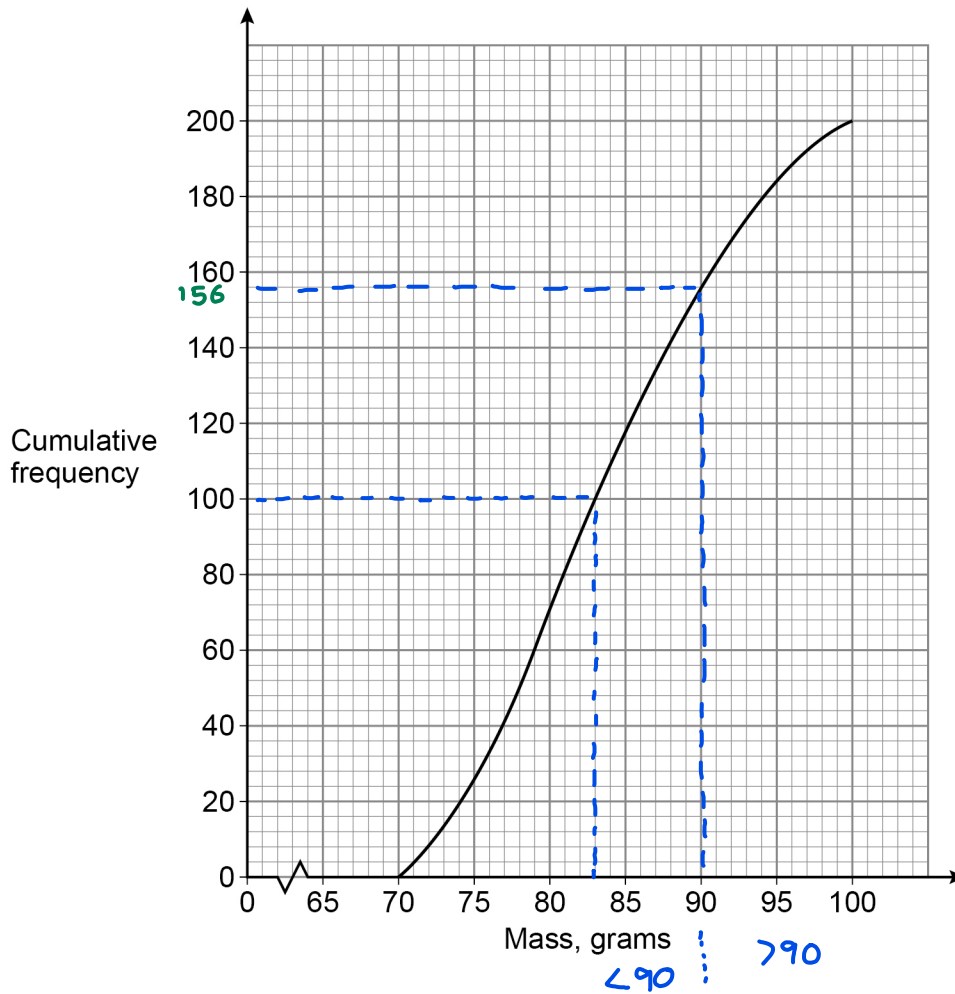
$P(\text{all gluten}) \times$ \uparrow No. of possible combinations Answer 112

Turn over for the next question

Turn over ►



17 The cumulative frequency graph shows information about the masses of 200 apples.



17 (a) Estimate the median mass.

[1 mark]

$$\frac{1}{2} \times 200 = 100 \text{ th apple}$$

Answer 83 grams



17 (b)

Apples with mass 90 grams or less cost 32p each.

← £0.32

Apples with mass more than 90 grams cost 39p each.

← £0.39

Estimate the **total** cost of the 200 apples.

[3 marks]

$$\text{mass} \leq 90 : 156 \rightarrow \text{cost} = 156 \times \text{£}0.32$$

$$\text{mass} > 90 : (200 - 156 = 44) \rightarrow \text{cost} = 44 \times \text{£}0.39$$

read these from graph

$$\text{Total} = 156 \times \text{£}0.32 + 44 \times \text{£}0.39$$

$$= \text{£}49.92 + \text{£}17.16$$

Answer £ 67.08

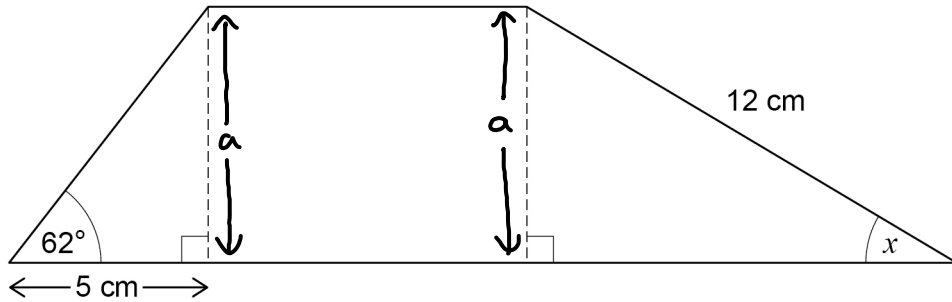
Turn over for the next question



18

This shape is made from two right-angled triangles and a rectangle.

Not drawn
accurately



Work out the size of angle x .

$$\tan = \frac{\text{opp}}{\text{adj}}$$

[4 marks]

$$\begin{aligned} \tan(62) &= \frac{a}{5} \\ 5 \times \tan(62) &= a \end{aligned}$$

$$\sin = \frac{\text{adj}}{\text{hyp}}$$

$$9.40 = a$$

$$\sin(x) = \frac{a}{12}$$

$$\sin(x) = \frac{9.4}{12}$$

$$\begin{aligned} x &= \sin^{-1}\left(\frac{9.4}{12}\right) \\ &= 51.6^\circ \end{aligned}$$

Answer 51.6 degrees



Do not write
outside the
box

19 a and b are positive values.

Show that $\frac{7a+2b-3a}{8a+6b+2a-b}$ always simplifies to the same value.

$$\frac{7a-3a+2b}{8a+2a+6b-b} = \frac{4a+2b}{10a+5b} = \frac{2(2a+b)}{5(2a+b)} = \frac{2}{5}$$

[3 marks]

Turn over for the next question

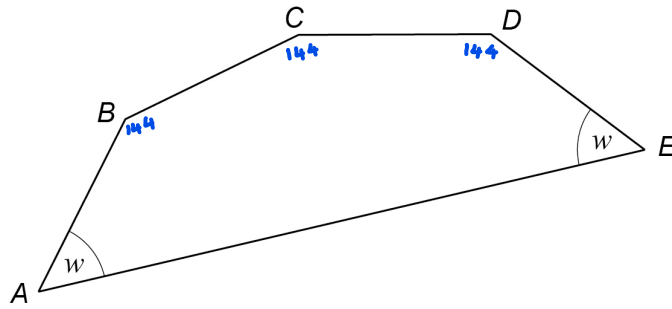
7

Turn over ►



20

AB, BC, CD and DE are four of the sides of a regular decagon.



Not drawn
accurately

Work out the size of angle w .

$$(n-2)180$$



[3 marks]

$$\text{Sum of angles in a regular Decagon} = (10-2)180$$

$$= 8 \times 180 = 1440^\circ$$

$$\text{Interior angle of a regular Decagon} = \frac{1440}{10} = 144^\circ$$

10 sides

$$\text{Sum of angles in the above figure} = (5-2)180$$

(5 sides)

$$= 3 \times 180 = 540^\circ$$

$$\therefore 540^\circ = w + w + 144 + 144 + 144$$

$$540 = 2w + 432 \Rightarrow 108 = 2w \Rightarrow w = 54^\circ$$

Answer 54 degrees



21 (a) Circle the point that is on the graph of $y = \frac{1}{x}$

(-1, 1)

(0.3, 3)

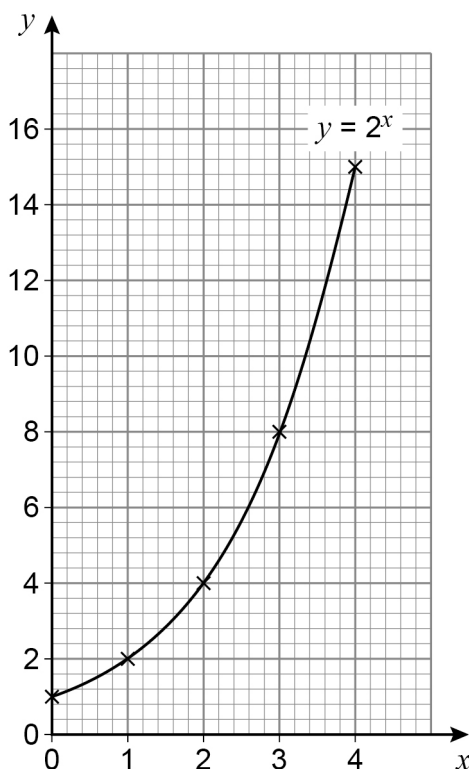
(0.8, 0.2)

(x, y) [1 mark]

(2.5, 0.4)

$$0.4 = \frac{1}{2.5}$$

21 (b) Leo wants to draw the graph of $y = 2^x$ for values of x from 0 to 4
Here is his graph.



Make one criticism of his graph.

[1 mark]

When $x = 4$; $y = 2^4 = 2 \times 2 \times 2 \times 2 = 16$ not 15.



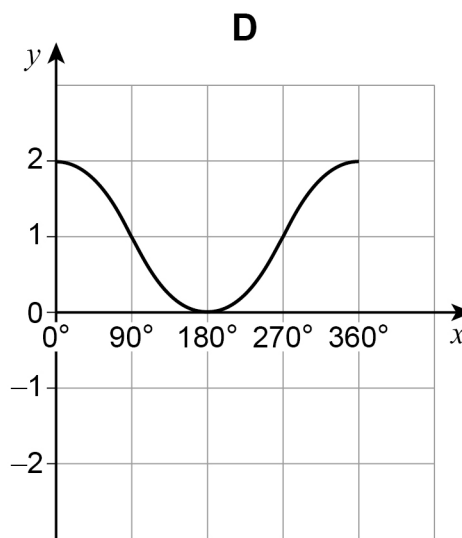
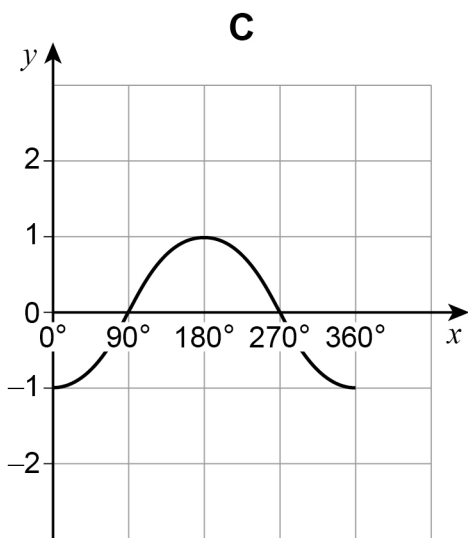
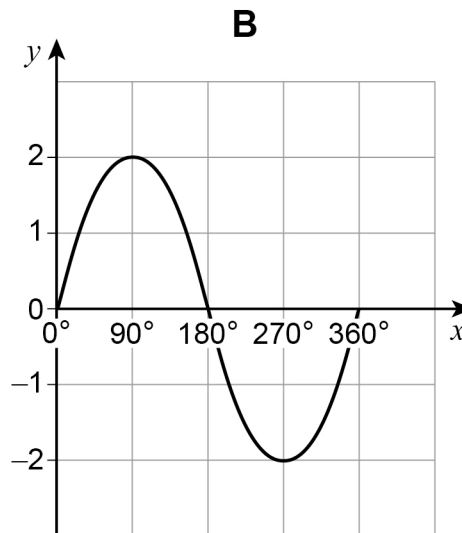
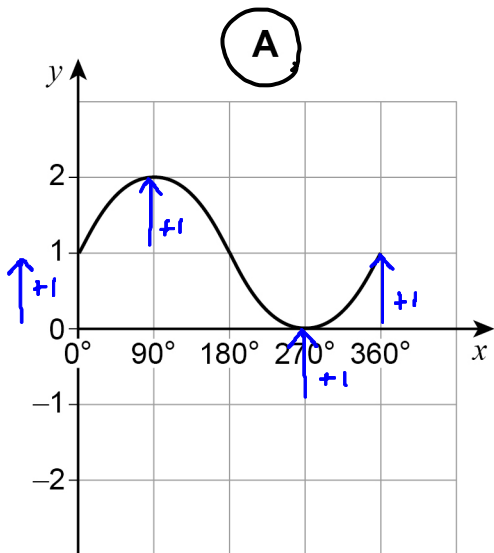
Do not write outside the box

22

One of these is the graph of $y = 1 + \sin x$ for $0^\circ \leq x \leq 360^\circ$ Sine graph translated in y-axis by 1.

Circle the letter above the correct graph.

[1 mark]



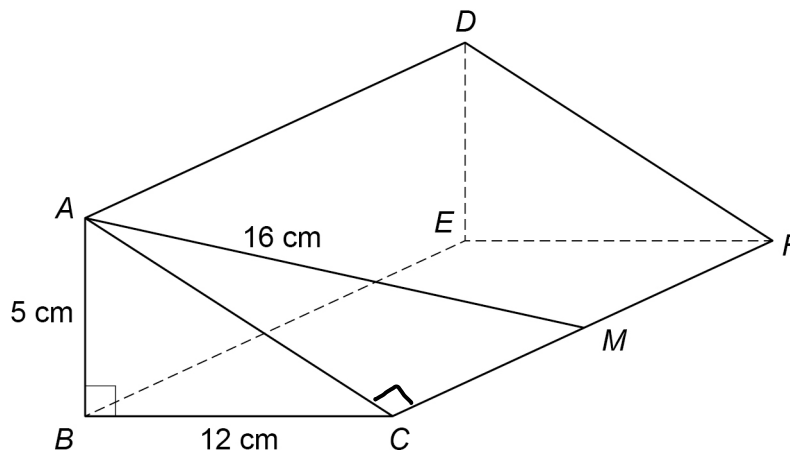
23

Right-angled triangle ABC is the cross section of a prism.

$AB = 5 \text{ cm}$ $BC = 12 \text{ cm}$

M is the midpoint of CF .

$AM = 16 \text{ cm}$



Work out the volume of the prism.

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

[4 marks]

$AC^2 = AB^2 + BC^2$ (pythagoras' theorem)

$AC^2 = 5^2 + 12^2$

$AC^2 = 25 + 144$

$AC^2 = 169$

$AC = \sqrt{169} = 13$

area of cross-section length

Volume = $\frac{1}{2} \times b \times h \times l$

= $\frac{1}{2} \times 12 \times 5 \times 2\sqrt{87}$

= $30 \times 2\sqrt{87}$

= $60\sqrt{87}$

= 559.64

ACM is a right angle triangle

$AM^2 = AC^2 + CM^2$

$16^2 = 13^2 + CM^2$

$256 = 169 + CM^2$

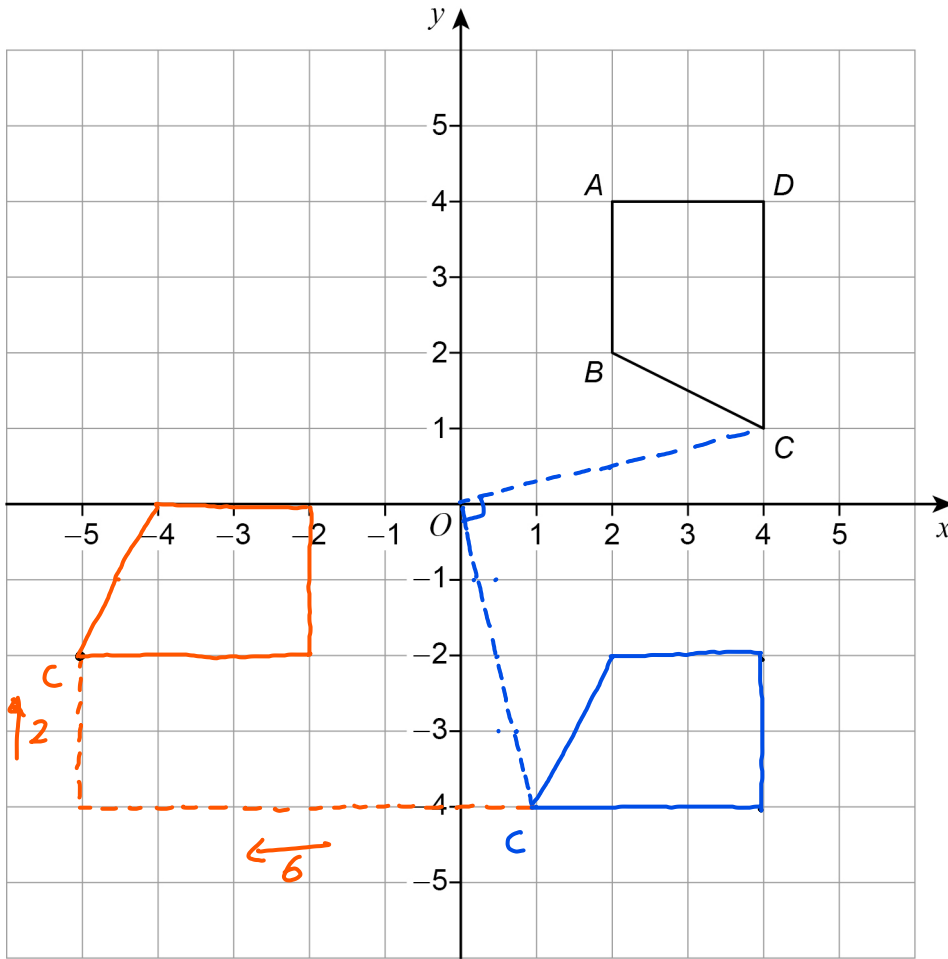
$87 = CM^2$

$CM = \sqrt{87} \therefore CF = 2 \times CM = 2\sqrt{87}$

Answer 559.64 cm^3



24 Quadrilateral $ABCD$ is shown.



24 (a) Work out the coordinates of C when $ABCD$ is

--- rotated 90° clockwise about O

then

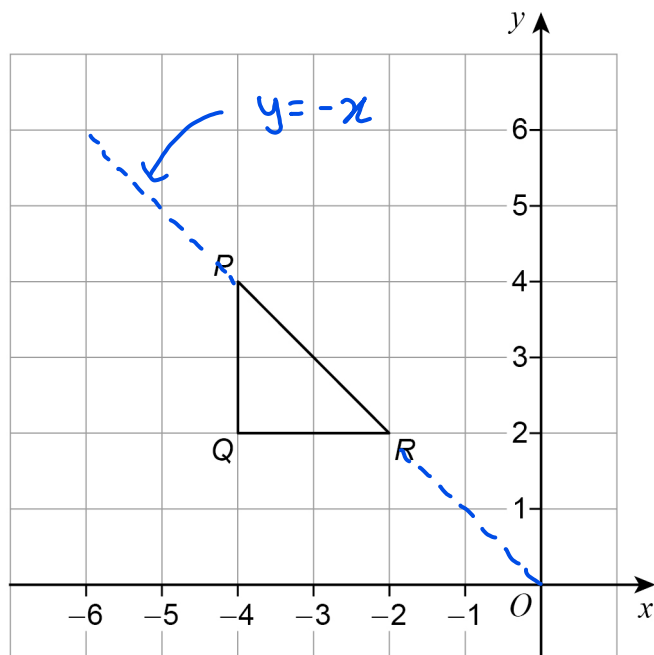
--- translated by $\begin{pmatrix} -6 \\ 2 \end{pmatrix}$

[2 marks]

Answer (-5 , -2)



24 (b) Triangle PQR is shown.



When PQR is reflected in a line, P and R are invariant points.

Circle the equation of the line.

\rightarrow doesn't change

[1 mark]

$y = x + 6$

$y = -x$

$y = 2$

$x = -4$

25

Factorise $3x^2 + 11x - 20$

$15x - 4x \rightarrow 15x - 4 = -60$
 $3x - 20 = -60$

[2 marks]

$3x^2 - 4x + 15x - 20$

$x(3x - 4) + 5(3x - 4) \Rightarrow (x + 5)(3x - 4)$

Answer $(x + 5)(3x - 4)$



26

Edith's van can safely carry a maximum load of 920 kilograms.

She wants to use her van to carry

30 sacks of potatoes, each of mass 25 kilograms to the nearest kilogram

and

20 sacks of carrots, each of mass 7.5 kilograms to 1 decimal place.

Can she definitely use her van safely in one journey?

You **must** show your working.

$$\frac{1\text{kg}}{2} = 0.5\text{kg}$$

[4 marks]

Upper bound: Mass of a potatoe sack = $25 + 0.5 = 25.5\text{kg}$

Mass of a carrot sack = $7.5 + 0.05 = 7.55\text{kg}$

$1\text{dp} = 0.1$; $\frac{0.1}{2} = 0.05$

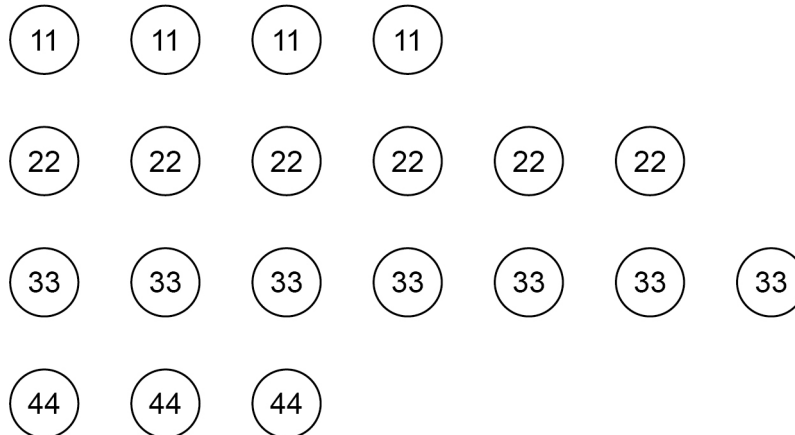
Max weight = $\underbrace{30 \times 25.5}_{\text{potatoes}} + \underbrace{20 \times 7.55}_{\text{Carrot}} = 916\text{kg}$

$920\text{kg} > 916\text{kg}$; Yes



27

These 20 discs are in a bag.



Two of the discs are taken at random from the bag.

Work out the probability that the first disc has a **smaller** number than the second disc.

[4 marks]

Getting first disk as

$$\left. \begin{array}{l} 11 : P(\text{getting a } 11) \times P(\text{getting a } 22 \text{ OR } 33 \text{ OR } 44) \\ \frac{4}{20} \times \frac{16}{19} = \frac{64}{380} \\ 22 : P(\text{getting a } 22) \times P(\text{getting a } 33 \text{ OR } 44) \\ \frac{6}{20} \times \frac{10}{19} = \frac{60}{380} \\ 33 : P(\text{getting a } 33) \times P(\text{getting a } 44) \\ \frac{7}{20} \times \frac{3}{19} = \frac{21}{380} \end{array} \right\}$$

$$\therefore P = \frac{64}{380} + \frac{60}{380} + \frac{21}{380} = \frac{145}{380} \left(\frac{29}{76} \right)$$

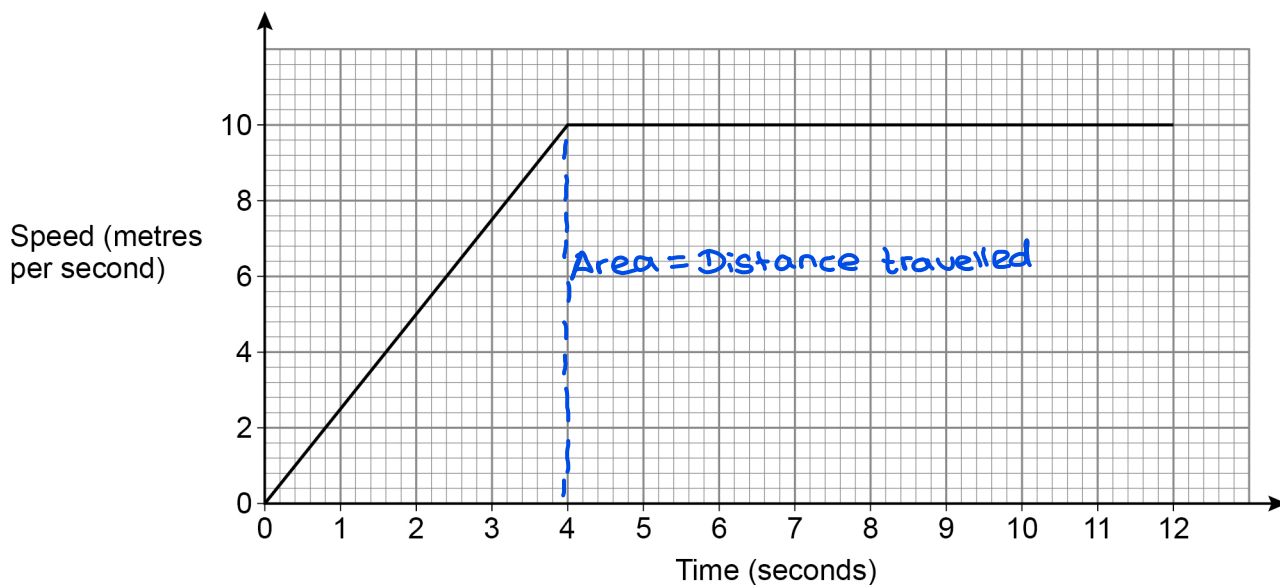
Answer $\frac{145}{380}$



28

A horse runs in a field.

The speed-time graph represents the first 12 seconds of the run.



After how many seconds had the horse run a distance of 75 metres? $\frac{1}{2} \times b \times h$ [3 marks]

Distance travelled till 4s : $\frac{1}{2} \times 4 \times 10 = 2 \times 10 = 20\text{m}$

Distance needed to be : $75\text{m} - 20\text{m} = 55\text{m}$
travelled from 4 to x sec

$$55\text{m} = (x - 4) \times 10$$

$$\div 10 \quad 5.5 = x - 4 \quad \text{Area of a rectangle}$$

$$9.5 = x \quad l \times b$$

Answer 9.5 seconds



29

Solve $\frac{5}{4x+1} = \frac{2x}{x^2+3}$

Give your solutions to 3 significant figures.

You **must** show your working.

[5 marks]

$$4x+1 \times \frac{5}{4x+1} = \frac{2x}{x^2+3} \times 4x+1$$

$$(x^2+3) \times 5 = \frac{2x(4x+1)}{x^2+3} \times (x^2+3)$$

$$5(x^2+3) = 2x(4x+1)$$

$$5x^2 + 15 = 8x^2 + 2x$$

$$0 = 3x^2 + 2x - 15$$

$$= \frac{-2 \pm \sqrt{4 - 4(3)(-15)}}{2 \times 3} = \frac{-2 \pm \sqrt{184}}{6}$$

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-2 + \sqrt{184}}{6} \quad \text{or} \quad \frac{-2 - \sqrt{184}}{6}$$

$$= 1.927 \quad \text{or} \quad -2.594$$

$$\approx 1.93 \quad \text{or} \quad -2.59$$

↗ > 5 ∴ round up ↖ < 5 ∴ round down

Answer 1.93 or -2.59

END OF QUESTIONS



There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**



Do not write
outside the
box

Question number	Additional page, if required. Write the question numbers in the left-hand margin.
	<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>
	<p>Copyright information</p> <p>For confidentiality purposes, all acknowledgements of third-party copyright material are published in a separate booklet. This booklet is published after each live examination series and is available for free download from www.aqa.org.uk.</p> <p>Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team.</p> <p>Copyright © 2020 AQA and its licensors. All rights reserved.</p>

