Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

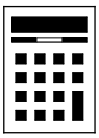
H

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.

Advice

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

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	

Please note that these worked solutions have neither been provided nor approved by AQA 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

.CG Maths.

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

Do not write outside the box

1 Which of these is a correct identity?

Circle your answer.

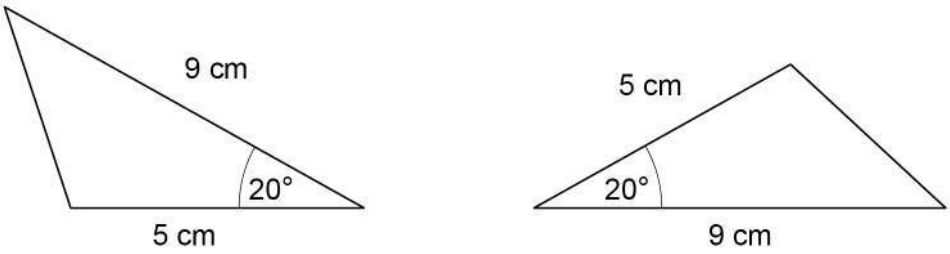
[1 mark]

$x + 4x \equiv 5x$ $\quad 6x \equiv 18$ $\quad 2x + 1 \equiv 7$ $\quad 7x + 9 \equiv x$

It is an identity because it is true for any value of x. The others are only true for some values of x

2

Not drawn accurately



Circle the reason why these triangles are congruent.

[1 mark]

RHS $\quad$ ASA $\quad$ SSS $\quad$ SAS

Two sides and an angle are the same

Do not write outside the box

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}

Standard form: a x 10^n, where $1 \leq a < 10$ and n is an integer

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

[1 mark]

$\frac{1}{2}a$ a a^2 a^3

1/2 x -2 = -1
-2 = -2
$(-2)^2 = 4$
$(-2)^3 = -8$

-2 is less than -1 so this can be substituted into each expression to work out which would be the largest

Turn over for the next question

4

Do not write outside the box

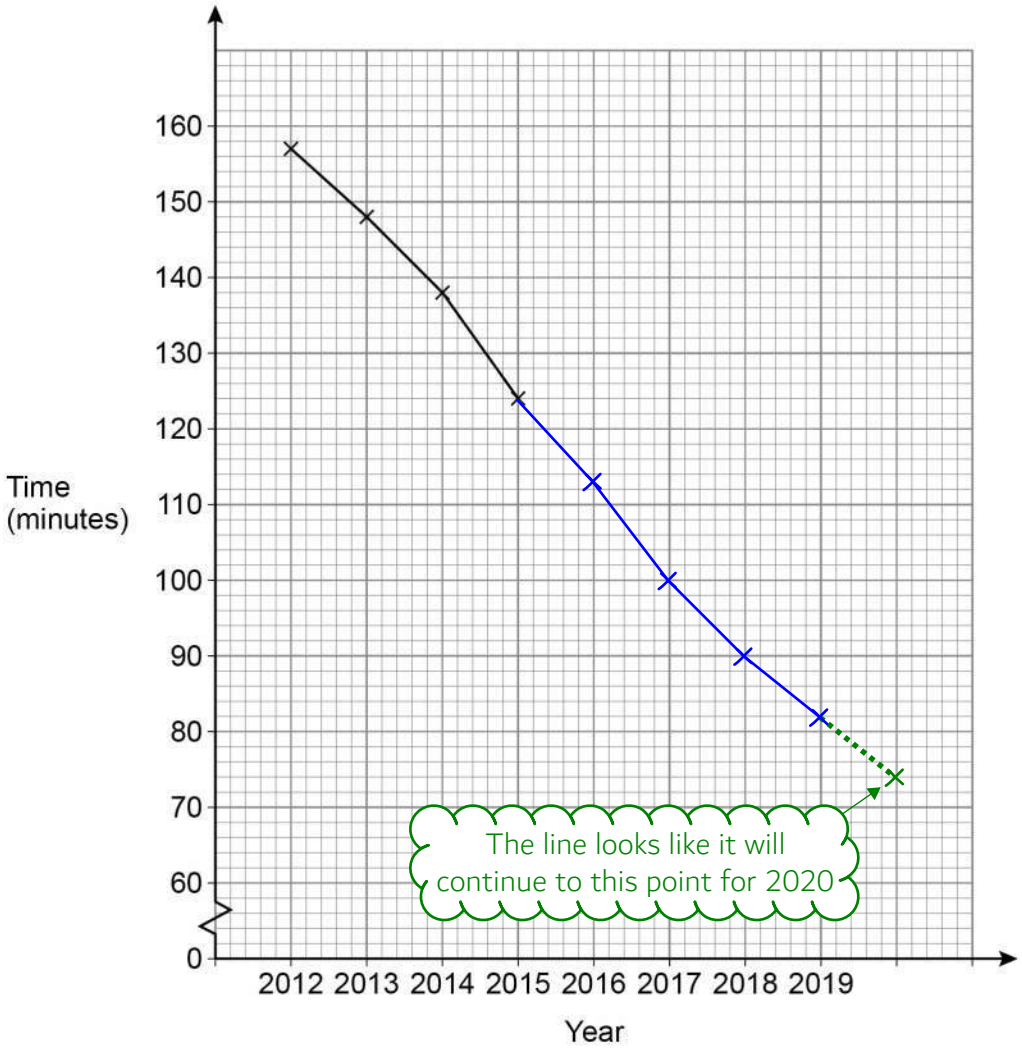
5 The time students spent watching TV was recorded.

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.



The scale increases by 10 over 5 boxes. 10/5 = 2 so each box is worth 2. Half a box is worth 1

Do not write outside the box

5 (a) Complete the graph.

[2 marks]

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

[1 mark]

Answer 74 minutes

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

[2 marks]

$75 = 3 \times 5^2$

$105 = 3 \times 5 \times 7$

To get a number as a product of prime factors, enter the number, press = then SHIFT then FACT, which is the button on the right

3×5

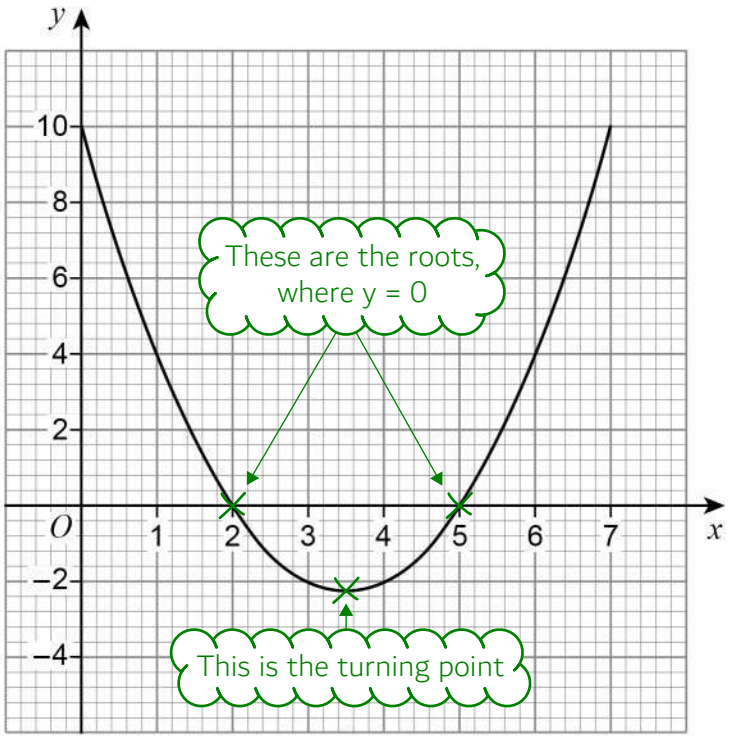
The highest common factor is the lowest power of each prime factor multiplied together. The lowest power of the 3s is 1, of the 5s is 1 and there are no 7s in 75

Answer 15

5

Do not write outside the box

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 $x^2 - 7x + 10 = 0$

[2 marks]

Answer 2, 5

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

[1 mark]

Answer 3.5

Do not write outside the box

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]

$40 + \frac{40}{10} \times 11 = 84$

Adding together the greatest possible number of women and greatest possible number of men gives the greatest possible total number of people now at the party

The greatest possible number of women is 40 as this is the greatest multiple of 10 less than 48. The number of women must be a multiple of 10 as the ratio is in its simplest form and there are 10 parts for women

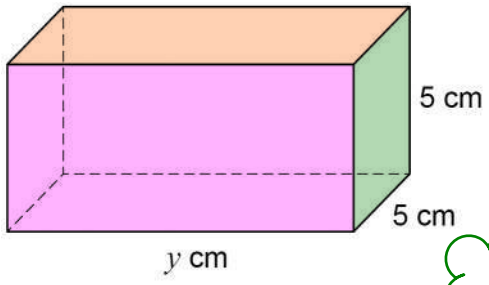
The number of men when there is the greatest possible number of women. 10 parts of the ratio represent the 40 women so dividing by 10 works out 1 part. Multiplying by 11 works out 11 parts, which represents how many men there are

Turn over for the next question

5

Do not write outside the box

9 Here is a cuboid.



Area of rectangle = length x width.
Opposite faces on a cuboid are the same

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

Work out the volume of the cuboid.

[3 marks]

$2 \times 5 \times 5 + 4 \times 5y = 200$

Adding together the area of all of the faces on the cuboid gives the surface area

The area of two of the green face

The area of two of the pink and two of the orange faces

$y = \frac{200 - 2 \times 5 \times 5}{4 \times 5}$

Finding y by subtracting 2 x 5 x 5 from both sides to get the y terms on their own then dividing by 4 x 5 to make y the subject

$7.5 \times 5 \times 5$

Volume of cuboid = length x width x height. The length is y, which is 7.5. The width and height are both 5

Answer 187.5 cm^3

Do not write outside the box

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

Both the width and height are still 5cm so y must be smaller. If y is smaller the volume will be smaller

Turn over for the next question

4

Do not write outside the box

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.

In the sixth test, Alex scored 24 out of 50

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

[4 marks]

$5\times0.6\times50+24-5\times0.52\times50$

Alex's total score after all six tests. This is worked out by finding 60% of 50 (which is found by multiplying 0.6 by 50), multiplying by 5 to work out the total of the first five tests, then adding her score in the sixth test

Bev's score after the first five tests. This is worked out by finding 52% of 50 (which is found by multiplying 0.52 by 50) then multiplying by 5

The mean percentages were equal therefore they must have had the same total scores. Subtracting Bev's score after the first five tests from Alex's total score after all six tests leaves Bev's score in the sixth test

Answer 44 out of 50

Do not write outside the box

11 A solid piece of silver has

mass 2.625 kilograms

volume 250 cm^3

Work out the density of the piece of silver.

Give your answer in grams per cubic centimetre.

[2 marks]

$\frac{2.625 \times 1000}{250}$

The units tell us that the mass in grams needs to be divided by the volume in cm^3. There are 1000 grams in a kilogram so multiplying by 1000 converts the kilograms to grams

Answer 10.5 g/cm^3

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

[2 marks]

$\frac{9-3}{1--2}$

Gradient = (change in y)/(change in x). 9 - 3 works out the change in y. 1 - -2 works out the change in x

Answer 2

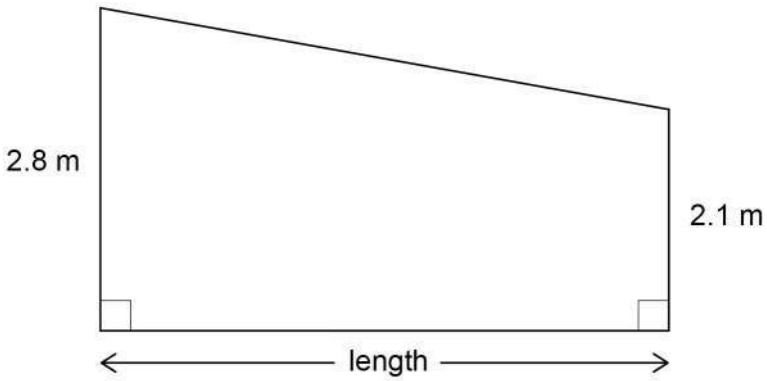
Turn over for the next question

8

Do not write outside the box

13 The diagram shows a wall.

Not drawn accurately



The area of the wall is 39.2 m^2

Work out the length of the wall.

[3 marks]

$\frac{1}{2}(2.8+2.1)h=39.2$ ← Area of trapezium = 1/2 (a + b)h, where a and b are the parallel sides and h is the distance between them. Substituting in the values and setting equal to the area

$h=\frac{39.2}{\frac{1}{2}(2.8+2.1)}$ ← Rearranged to find h by dividing both sides by 1/2 (2.8 + 2.1)

Answer 16 m

Do not write outside the box

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]

$6500 \times 1.05^3 = 7525$

Using the compound interest formula. 100% + 5% = 105% and this is 1.05 as a decimal so multiplying by this increases it by 5%. This is raised to the power of 3 as it needs to increase by 5% 3 times. The result is rounded to the nearest whole number

Yes

7525 is more than 7500

Turn over for the next question

6

Do not write outside the box

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

[3 marks]

$\frac{b}{c} = a - 5$ ← Subtracting 5 from both sides gets the terms involving c on their own

$\frac{c}{b} = \frac{1}{a-5}$ ← Doing the reciprocal of both sides makes c a numerator rather than denominator

Multiplying both sides by b makes c the subject

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

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

Do not write outside the box

16 On a restaurant menu there are

22 main dishes, of which $\frac{4}{11}$ are gluten-free

7 rice dishes, which are all gluten-free

5 naan breads, of which 40% are gluten-free.

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]

$\frac{4}{11} \times 22 \times 7 \times 0.4 \times 5$

Using the product rule for counting. Multiplying the number of outcomes for each individual event gives the total number of outcomes for all of them

The number of main dishes which are gluten-free

The number of naan breads which are gluten-free

The number of rice dishes which are gluten-free

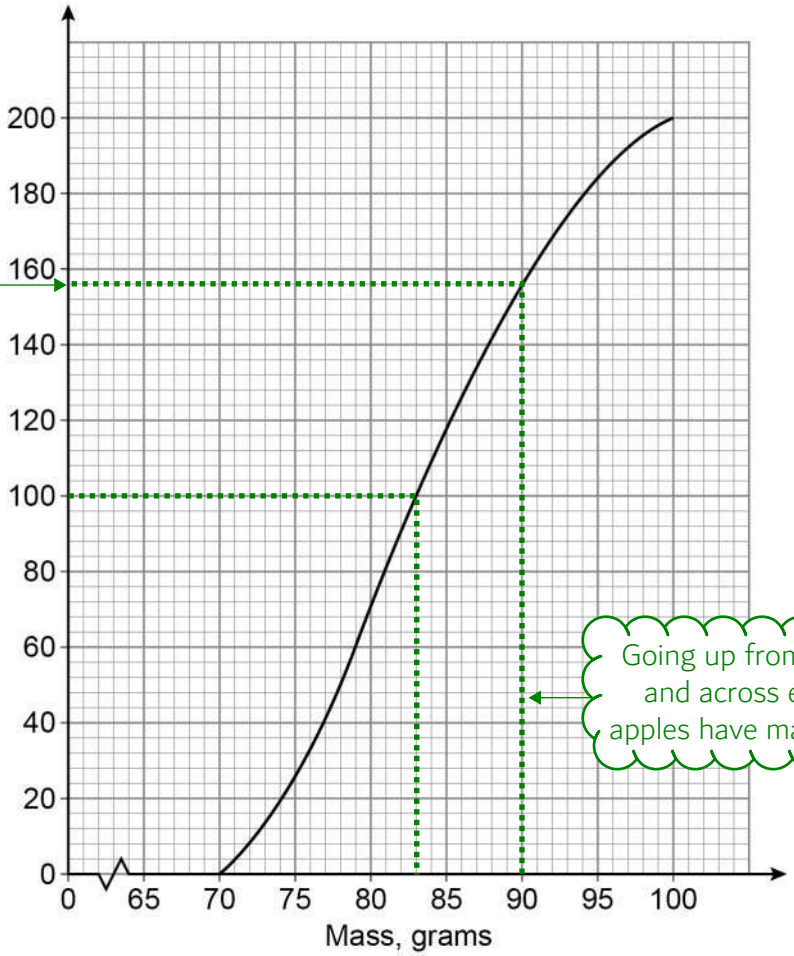
Answer 112

Turn over for the next question

6

Do not write outside the box

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



The scale goes up 20 over 5 boxes. 20/5 = 4 so each box is worth 4

Going up from 90 grams to the line and across estimates how many apples have mass of 90 grams or less

17 (a) Estimate the median mass.

[1 mark]

Answer 83 grams

The median is roughly half way through the 200 apples. The 100th apple can be estimated by going across from 100 to the line then down

Do not write outside the box

17 (b) Apples with mass 90 grams or less cost 32p each.

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

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

[3 marks]

$156 \times 0.32 + (200 - 156) \times 0.39$

Adding the cost of the apples with mass 90 grams or less and the cost of the apples with mass more than 90 grams gives the total cost of the 200 apples

According to the graph, there are 156 apples with a mass with mass 90 grams or less. Multiplying by £0.32 works out the cost of these

200 - 156 works out the rest of the apples, which must have a mass more than 90 grams. Multiplying by £0.39 works out the cost of these

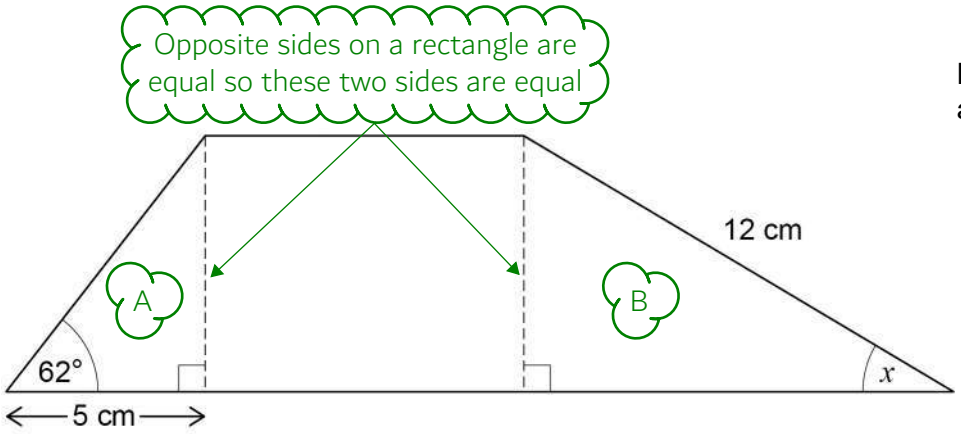
Answer £ 67.08

Turn over for the next question

4

Do not write outside the box

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



Not drawn accurately

Work out the size of angle x.

[4 marks]

SOH CAH TOA

Right angled trigonometry can be used in triangles A and B. Finding the dashed line in triangle A helps as this is the same as the dashed line in triangle B. Writing SOH CAH TOA as formula triangles then ticking what we have and are trying to find in triangle A. We have the 5cm which is the adjacent and we are trying to work out the opposite. Underlining what we have and are trying to find in triangle B. The dashed line is the opposite and 12cm is the hypotenuse

$\sin^{-1}\left(\frac{\tan 62 \times 5}{12}\right)$

Two letters are underlined in SOH so this formula triangle can be used in triangle B. Covering S because this term involves the angle tells us that (sin of the angle) = opposite/hypotenuse.
So Angle = $\sin^{-1}$(opposite/hypotenuse). The hypotenuse is 12. The opposite is the dashed line, which is equal to the dashed line in triangle A. There are two ticks on TOA so this formula triangle can be used in triangle A. Covering O tells us that opposite = (tan of the angle) x adjacent. The angle is 62 and the adjacent is 5

Answer 51.6 degrees

Do not write outside the box

19 a and b are positive values.

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

[3 marks]

$\frac{4a+2b}{10a+5b}$ ← Collecting like terms on the numerator and denominator

$\frac{2(2a+b)}{5(2a+b)}$ ← Factorising the numerator and denominator

$\frac{2}{5}$ ← Cancelling out the (2a + b) from the numerator and denominator as it is a common factor. 2/5 is constant so is always the same value

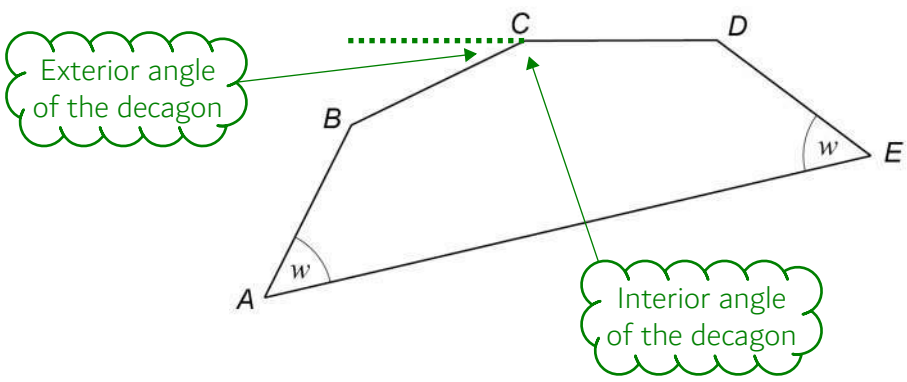
Turn over for the next question

7

Do not write outside the box

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.

[3 marks]

$$\frac{(5-2)\times 180-3\left(180-\frac{360}{10}\right)}{2}$$

(n - 2) x 180, where n is the number of sides, works out the sum of the interior angles. The shape has 5 sides so n is 5. The exterior angles of any polygon add up to 360 so as the decagon is regular and has 10 sides, dividing 360 by 10 works out each exterior angle. The exterior angle lies on a straight line with the interior angle so subtracting the exterior angle from 180 works out the interior angle. Subtracting 3 lots of the interior angle from the sum of interior angles leaves 2 of angle w. Dividing the result by 2 finds w

Answer 54 degrees

Do not write outside the box

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

[1 mark]

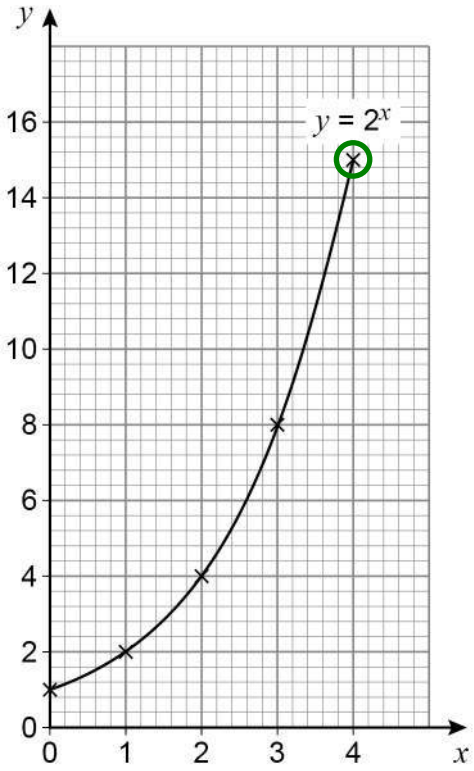
(–1, 1) (0.3, 3) (0.8, 0.2) (2.5, 0.4)

1/-1 = -1
1/0.3 = 10/3
1/0.8 = 1.25
1/2.5 = 0.4

Substituting in the x coordinate for each point into the equation of the graph to work out the y coordinate. Only 2.5 gives the correct y coordinate

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]

$2^4 = 16$

The graph shows that 2^4 is 15

Use table mode by pressing MENU then 3. f(x) = 2^x. Start: 0. End: 4. Step: 1. This works out what points should be on the graph by giving a table of values

5

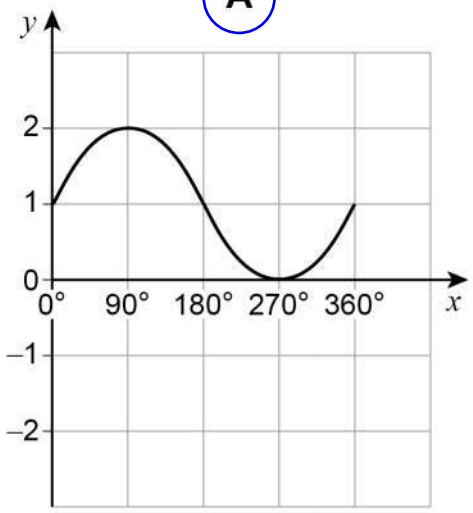
Do not write outside the box

22 One of these is the graph of $y = 1 + \sin x$ for $0° \leqslant x \leqslant 360°$

Circle the letter above the correct graph.

[1 mark]

A



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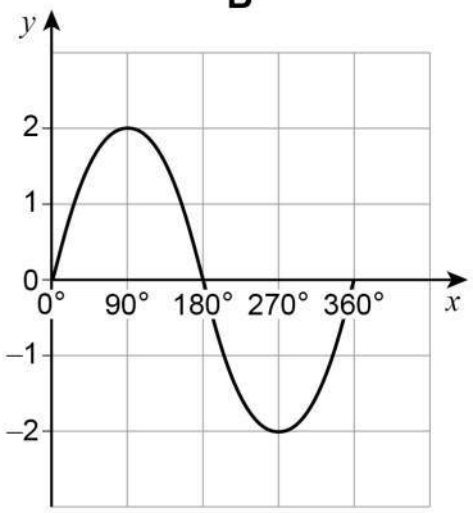

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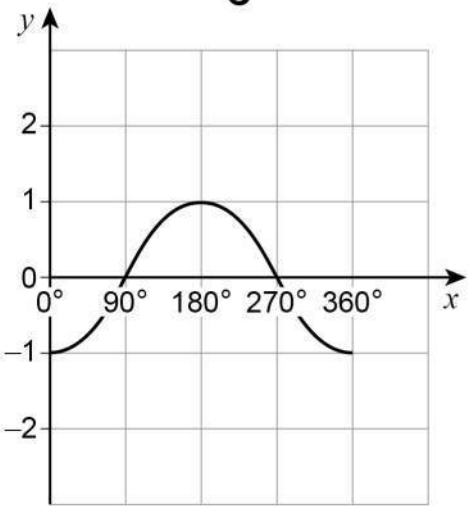

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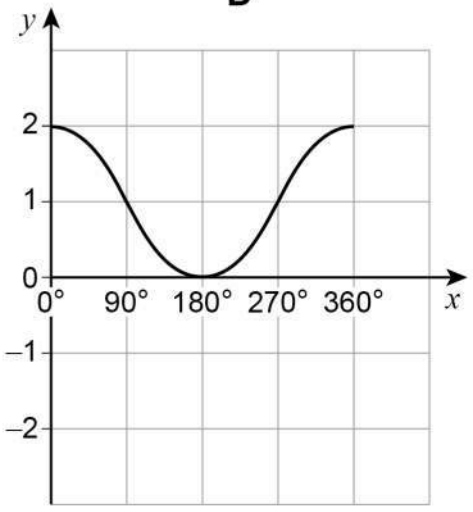


Use table mode by pressing MENU then 3. f(x) = 1 + sin(x). Start: 0. End: 360. Step: 90. Use the table of values to check which graph goes through the right points

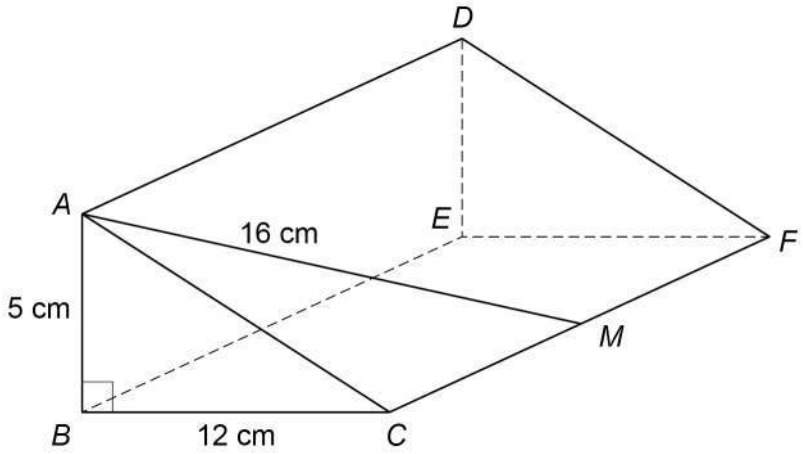
Do not write outside the box

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

AB = 5 cm *BC* = 12 cm

M is the midpoint of *CF*.

AM = 16 cm



Work out the volume of the prism.

[4 marks]

$a^2 + b^2 = c^2$ ← Pythagoras' Theorem, where c is the longest side and a and b are the shorter sides, can be used to to work out side AC and then side CM

$c = \sqrt{a^2 + b^2}$ ← AC is the longest side of right angled triangle ABC so rearranged to make c the subject

$a = \sqrt{c^2 - b^2}$ ← CM is a shorter side of right angled triangle ACM so rearranged to make a the subject

$\frac{1}{2} \times 12 \times 5 \times 2\left(\sqrt{16^2 - \sqrt{5^2 + 12^2}^2}\right)$ ← Volume of prism = cross sectional area x length. Triangle ABC is the cross section and CF is the length

Cross sectional area, which is triangle ABC. Area of triangle = 1/2 x base x height. 12cm is the base and 5cm is the height

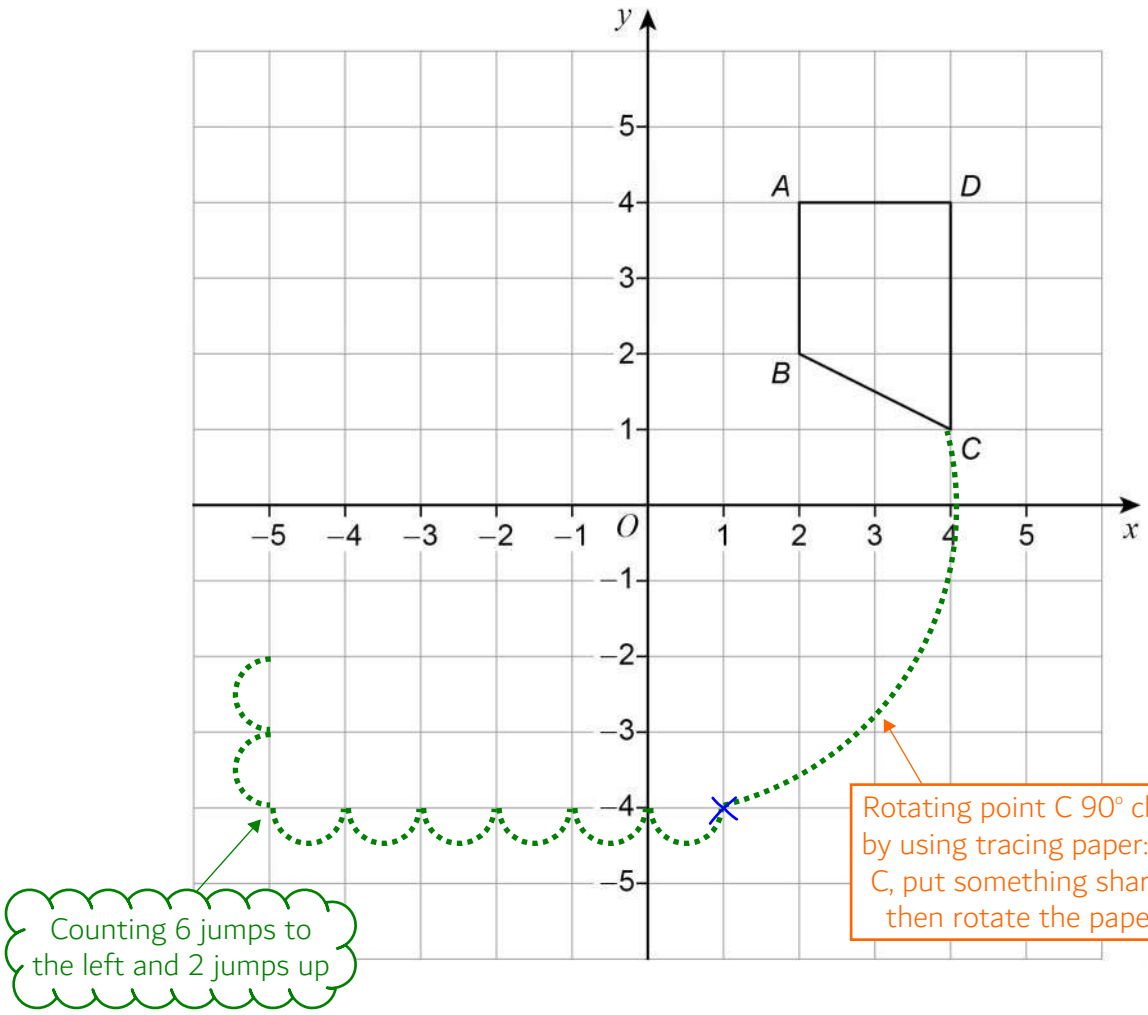
$\sqrt{5^2 + 12^2}$ works out side AC. $\sqrt{16^2 - AC^2}$ works out side CM. Length CF is double CM as M is the midpoint of CF so CM is multiplied by 2

Answer $60\sqrt{87}$ cm^3

5

Do not write outside the box

24 Quadrilateral *ABCD* is shown.



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

rotated 90° clockwise about O

then

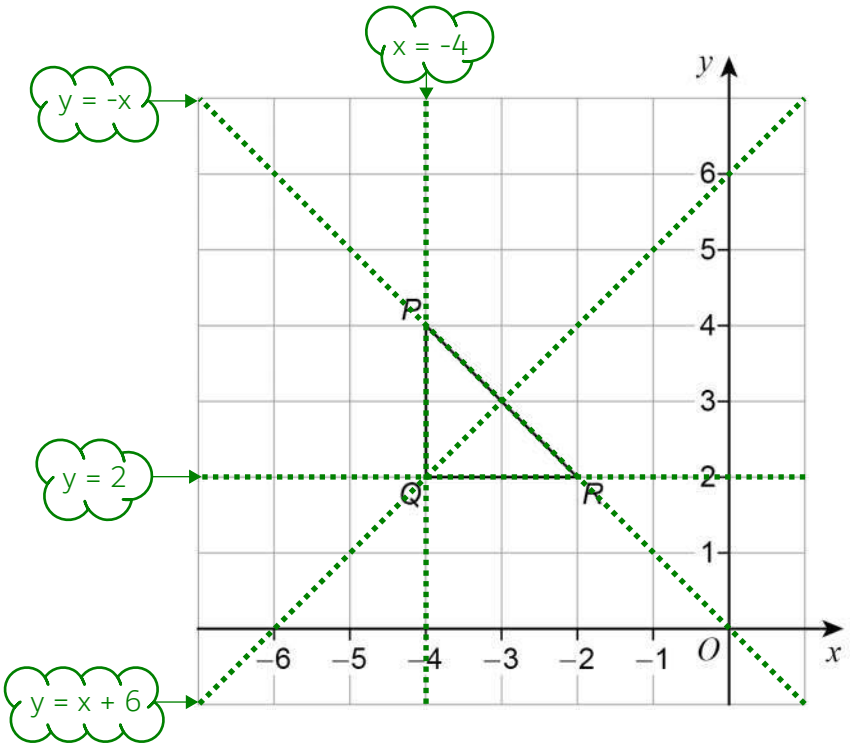
translated by $\begin{pmatrix} -6 \\ 2 \end{pmatrix}$

[2 marks]

Answer (-5 , -2)

Do not write outside the box

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.

[1 mark]

$y = x + 6$ $\quad$ $y = -x$ $\quad$ $y = 2$ $\quad$ $x = -4$

P and R are invariant on this line as they are on the line so won't be moved when reflected

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

[2 marks]

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

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

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

It is in the form $ax^2 + bx + c$. Multiplying a by c gives -60. Two numbers which multiply to this and add to b, which is 11, are 15 and -4. Splitting the middle term into these numbers of x. Factorising the left two terms and right two terms separately. Then bringing into the factorised form

To find the numbers which multiply to -60 and add to 11, use table mode by pressing MENU then 3. f(x) = 60/x. Start: 1. End: 30. Step: 1. This lists out the factor pairs of 60. One of the numbers needs to be negative to multiply to -60. Go through the numbers until a pair would add to 11

5

Do not write outside the box

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.

[4 marks]

$30(25+\frac{1}{2})+20(7.5+\frac{0.1}{2})$

Adding the upper bound of the mass of the potatoes and the upper bound of the mass of the carrots gives the upper bound of the total mass

Adding half of the resolution of the mass of one sack of potatoes, which is 1kg, to the quoted value of 25kg gives the upper bound of one sack. Multiplying this by 30 gives the upper bound for all 30 sacks

Adding half of the resolution of the mass of one sack of carrots, which is 0.1kg, to the quoted value of 7.5kg gives the upper bound of one sack. Multiplying this by 20 gives the upper bound for all 20 sacks

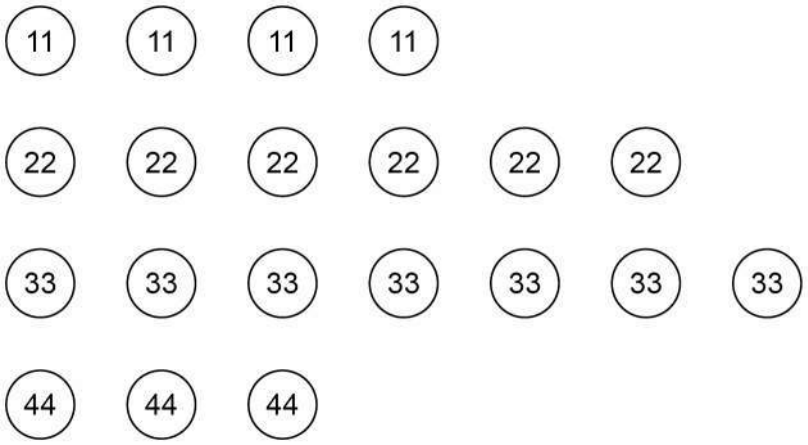
916

Yes

The upper bound of the total mass is 916kg, which is less than the maximum load of 920kg so it is definitely safe

Do not write outside the box

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]

$\frac{4}{20} \times \frac{16}{19} + \frac{6}{20} \times \frac{10}{19} + \frac{7}{20} \times \frac{3}{19}$

Taking 11 as the first disc AND taking 22, 33, 44 as the second disc OR taking 22 as the first disc AND taking 33, 44 as the second disc OR taking 33 as the first disc AND taking 44 as the second disc. AND means to multiply the probabilities, OR means to add the probabilities. There are 20 disks on the first pick and there are 19 on the second pick as there is one fewer disk once one is taken

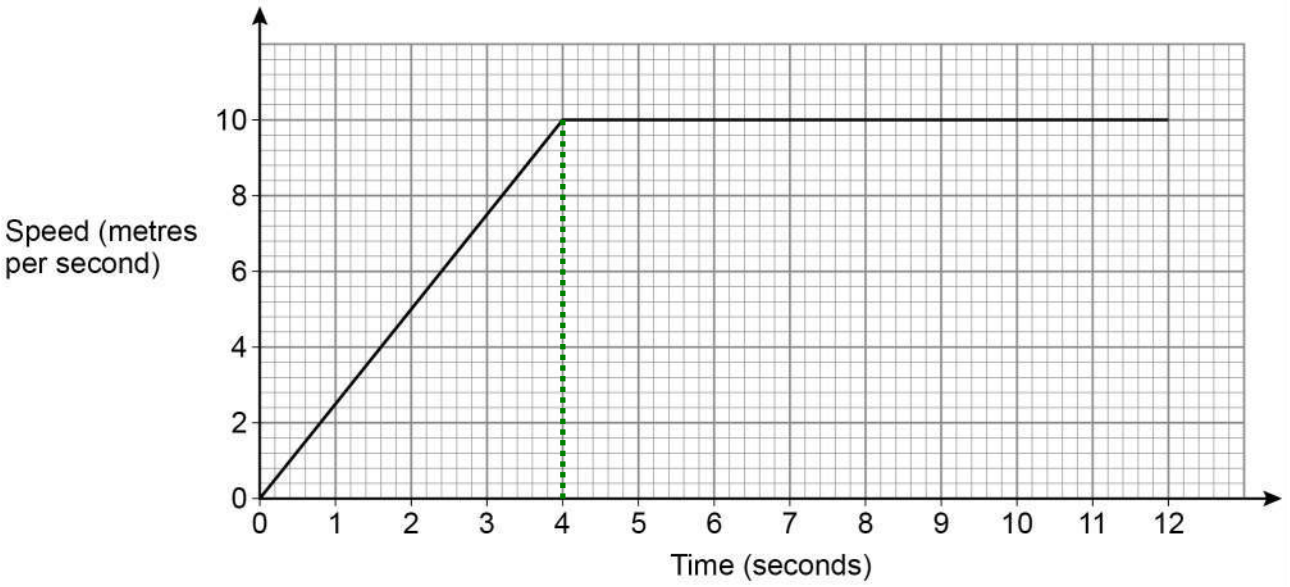
Answer $\frac{29}{76}$

8

Do not write outside the box

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?

[3 marks]

$4 + \frac{75 - \frac{1}{2} \times 4 \times 10}{10}$

Distance on a speed-time graph is the area under the line. Area of triangle = 1/2 x base x height so 1/2 x 4 x 10 works out the area of the triangle. Subtracting this from the 75m works out how far the horse still needs to go. Area of rectangle = length x width so width = area/length. The area is the how far the horse still needs to go and the length is 10 so dividing by 10. The width of the rectangle is the time taken for the horse to do the rest of the 75m so this is added to the first 4 seconds of the journey to work out how long it took in total for the 75m

Answer 9.5 seconds

Do not write outside the box

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]

$5(x^2+3) = 2x(4x+1)$ ← Multiplying both sides by the denominators to eliminate the denominators

$5x^2+15 = 8x^2+2x$ ← Expanding the brackets

$0 = 3x^2+2x-15$ ← Bringing into the quadratic form by subtracting $5x^2$ and 15 from both sides

$x = \frac{-2 \pm \sqrt{2^2-4\times3\times-15}}{2\times3}$ ← Using the quadratic formula

Answer 1.93 , -2.59

END OF QUESTIONS

8