

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

GCSE MATHEMATICS

H

Higher Tier

Paper 2 Calculator

Thursday 4 June 2020

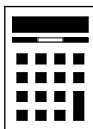
Morning

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 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 in the spaces provided.

1 Which of these is a correct identity?

Circle your answer.

[1 mark]

$x + 4x \equiv 5x$

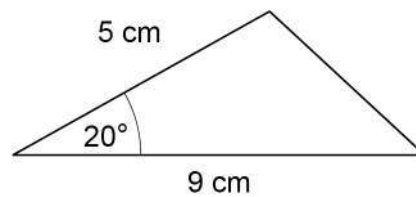
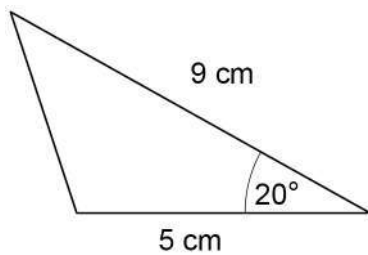
$6x \equiv 18$

$2x + 1 \equiv 7$

$7x + 9 \equiv x$

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

ASA

SSS

SAS

Two sides and the angle between them are the same



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: $a \times 10^n$, 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

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

-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

Turn over ►



5

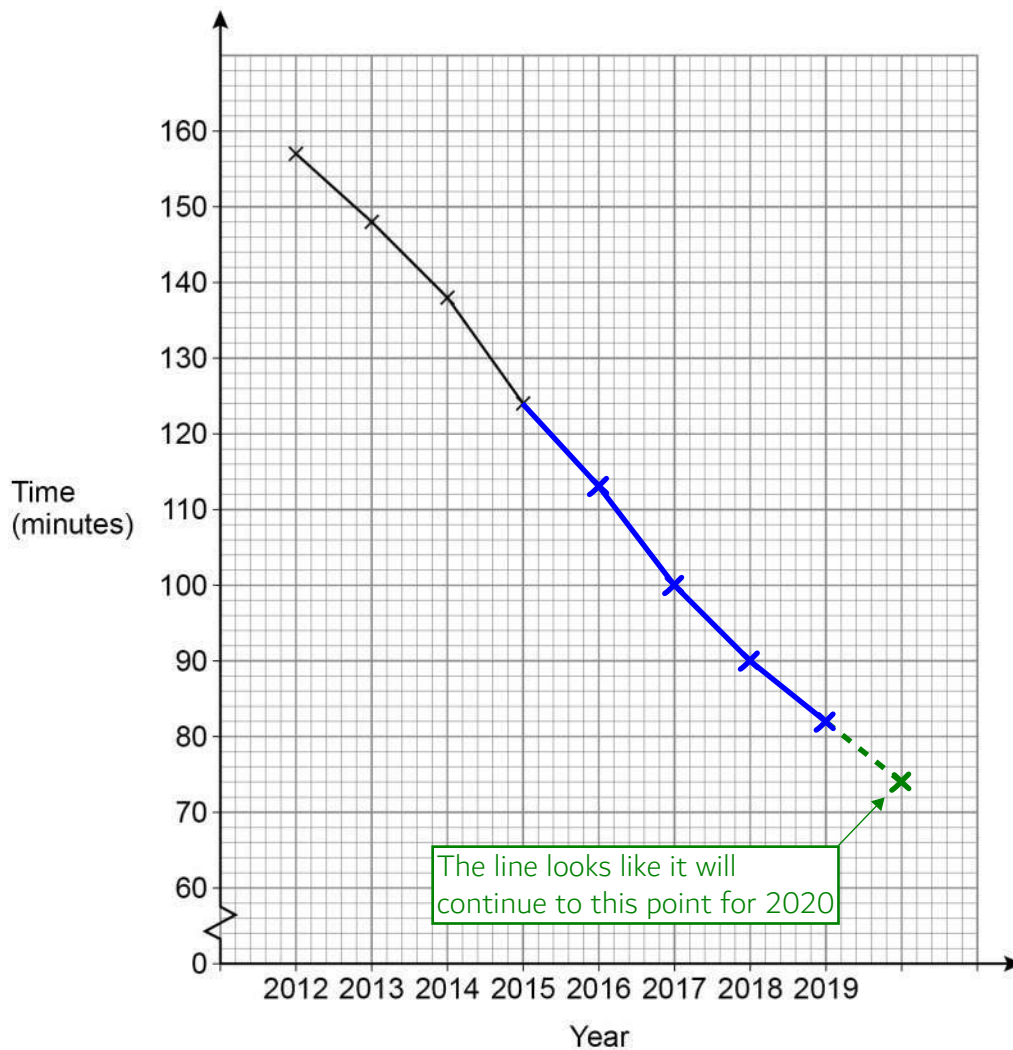
The time students spent watching TV was recorded.

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.



The vertical scale increases by 10 over 5 small boxes. $10 \div 5 = 2$ so each small box is worth 2. Half a small box is worth 1



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]

$$3 \times 5^2$$

← Expressing 75 as a product of prime factors using the calculator

$$3 \times 5 \times 7$$

← Expressing 105 as a product of prime factors using the calculator

$$3 \times 5$$

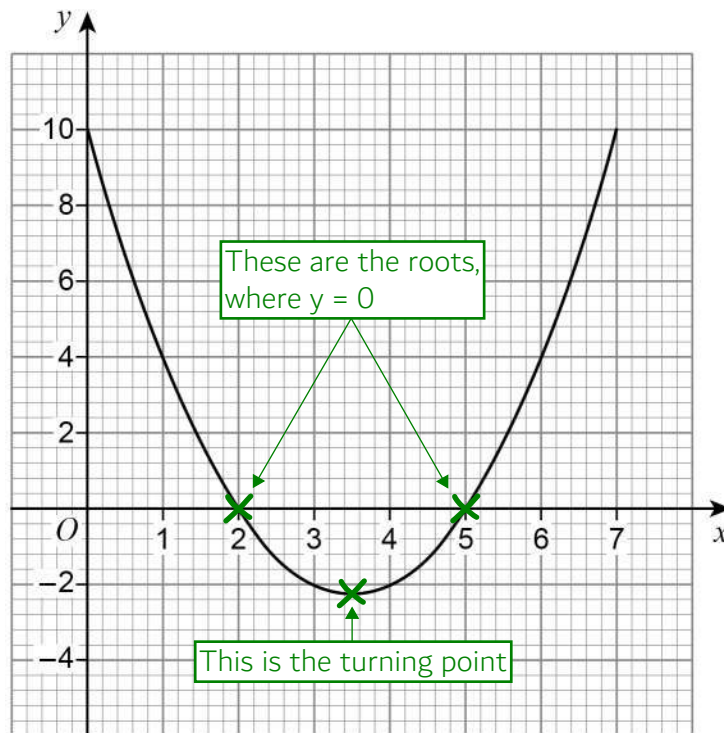
← The highest common factor is the lowest power of each prime factor multiplied together. The lowest power of the 3s is 1, of the 5s is 1 and there are no 7s in 75

Newer models of Casio calculators can calculate the highest common factor of two numbers without having to do this method

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

[2 marks]

Answer 2,5

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

[1 mark]

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]

$$40 \div 10$$

The ratio of 10 : 11 cannot be simplified. So the number of women needs to be a multiple of 10. Some women leave so the number of women could now be 40, which is represented by 10 parts of the ratio. So dividing the 40 women by the 10 parts works out that 1 part of the ratio is worth 4 people

$$4 \times 11$$

Multiplying the value of 1 part of the ratio by the 11 parts of the ratio which represent the men works out that there would be 44 men

$$40 + 44 = 84$$

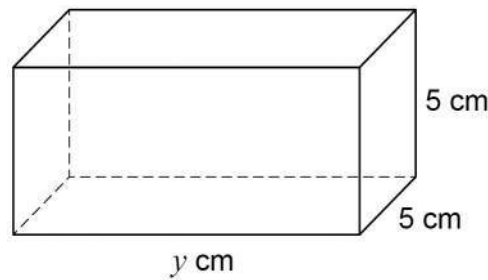
Adding the 40 women and 44 men works out that there are now 84 people at the party. This is not more than 90

There are multiples of 10 which are less than 40 however these do not need to be tried for the number of women as if there were less than 40 women there would be less than 44 men. The 84 people is already less than 90 so we can be certain that there cannot be more than 90 people

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.

[3 marks]

$$5 \times 5 \times 2 = 50$$

This works out that the total area of the left and right faces is 50 cm^2 .
Area of rectangle = length $\times$ width. Both the length and width are 5 cm.
Multiplying by 2 as both the left and right are identical faces

$$5 \times y \times 4$$

This expresses the total area of the top, bottom, front and back faces. Area of rectangle = length $\times$ width. The length is $y \text{ cm}$ and the width is 5 cm for each of these faces.
Multiplying by 4 as all 4 of them are identical faces. The expression simplifies to $20y$

$$20y + 50 = 200$$

Adding the area of all of the faces must give the surface area of 200 cm^2

$$20y = 150$$

Subtracting 50 from both sides to get the y term on its own

$$y = 7.5$$

Dividing both sides by 20 to get y on its own

$$7.5 \times 5 \times 5$$

Volume of cuboid = length $\times$ width $\times$ height. The length is 7.5 cm, the width is 5 cm and the height is 5 cm

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

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

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.

In the sixth test, Alex scored 24 out of 50

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

[4 marks]

$$50 \times 5$$

Multiplying the 50 marks in each test by the first 5 tests works out that there are 250 marks in total in the first 5 tests

$$\frac{60}{100} \times 250$$

Putting the 60% over 100 converts it into a fraction, which finds 60% of the 250 marks when multiplied. So Alex got 150 marks in the first 5 tests

$$150 + 24 = 174$$

Adding the 24 marks in the sixth to the 150 in the first 5 tests works out that Alex scored 174 marks in all six tests

$$\frac{52}{100} \times 250$$

Putting the 52% over 100 converts it into a fraction, which finds 52% of the 250 marks when multiplied. So Bev got 130 marks in the first 5 tests

$$174 - 130$$

They both have the same mean percentages after all six tests, meaning that the total marks in all six tests must be the same. Subtracting the 130 marks Bev got in the first 5 tests from the 174 Alex needs to get in all six tests works out that Bev must have scored 44 marks in the sixth test

Answer 44 out of 50



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]

$$2.625 \times 1000$$

There are 1000 grams in a kilogram so multiplying the 2.625 kilograms by 1000 converts it into 2625 grams

$$2625 \div 250$$

Per means to divide so dividing the grams by the cubic centimetres

Answer 10.5 g/cm³

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

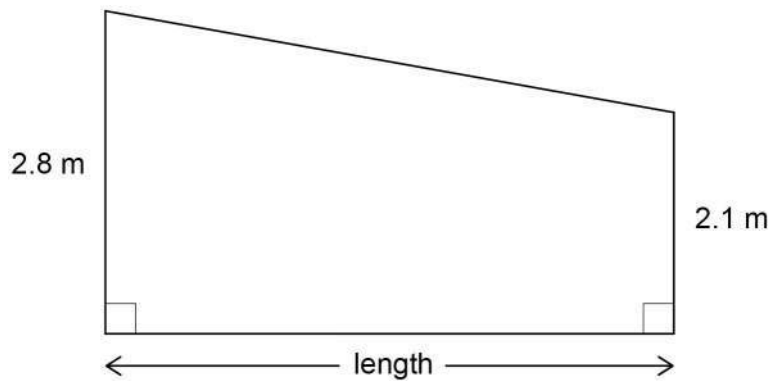
Answer 2

Turn over for the next question



13

The diagram shows a wall.

Not drawn
accuratelyThe area of the wall is 39.2 m^2

Work out the length of the wall.

[3 marks]

$$\frac{1}{2}(2.8+2.1)h$$

The wall is a four-sided shape with one pair of parallel sides so is a trapezium.
Area of trapezium = $\frac{1}{2}(a+b)h$, where a and b are the parallel sides and h is the distance between them. Substituting 2.8 for a and 2.1 for b , h is the length of the wall

$$2.45h = 39.2$$

$\frac{1}{2}(2.8 + 2.1) = 2.45$. Setting the expression of the area of the wall equal to the actual area of 39.2 m^2

Answer _____ 16 _____ m

Dividing both sides by 2.45 to get h on its own

- 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]

$$6500 \times \left(\frac{100+5}{100}\right)^3 = 7525$$

Adding 5% to 100% expresses the percentage it increases to each year. Putting this over 100 converts it into a fraction, which increases the 6500 by 5% when multiplied. Raising the fraction to the power of 3 as it needs to be increased by 5% 3 times. So the prediction is that there will be 7525 runners in 2023

Yes

7525 runners is more than 7500 runners

Turn over for the next question



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 term involving c on its own

$$\frac{c}{b} = \frac{1}{a - 5}$$

Doing the reciprocal of both sides to make c a numerator rather than denominator

Answer

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

Multiplying both sides by b gets c on its own



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]

$$\frac{4}{11} \times 22 = 8$$

This works out that $\frac{4}{11}$ of the 22 main dishes is 8 which are gluten-free

$$\frac{40}{100} \times 5$$

Putting the 40% over 100 converts it into a fraction, which when multiplied by the 5 naan breads finds that 40% of the 5 is 2 naan breads which are gluten-free

$$8 \times 7 \times 2$$

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. There are 8 main dishes which are gluten-free, 7 rice dishes which are gluten-free and 2 naan breads which are gluten-free

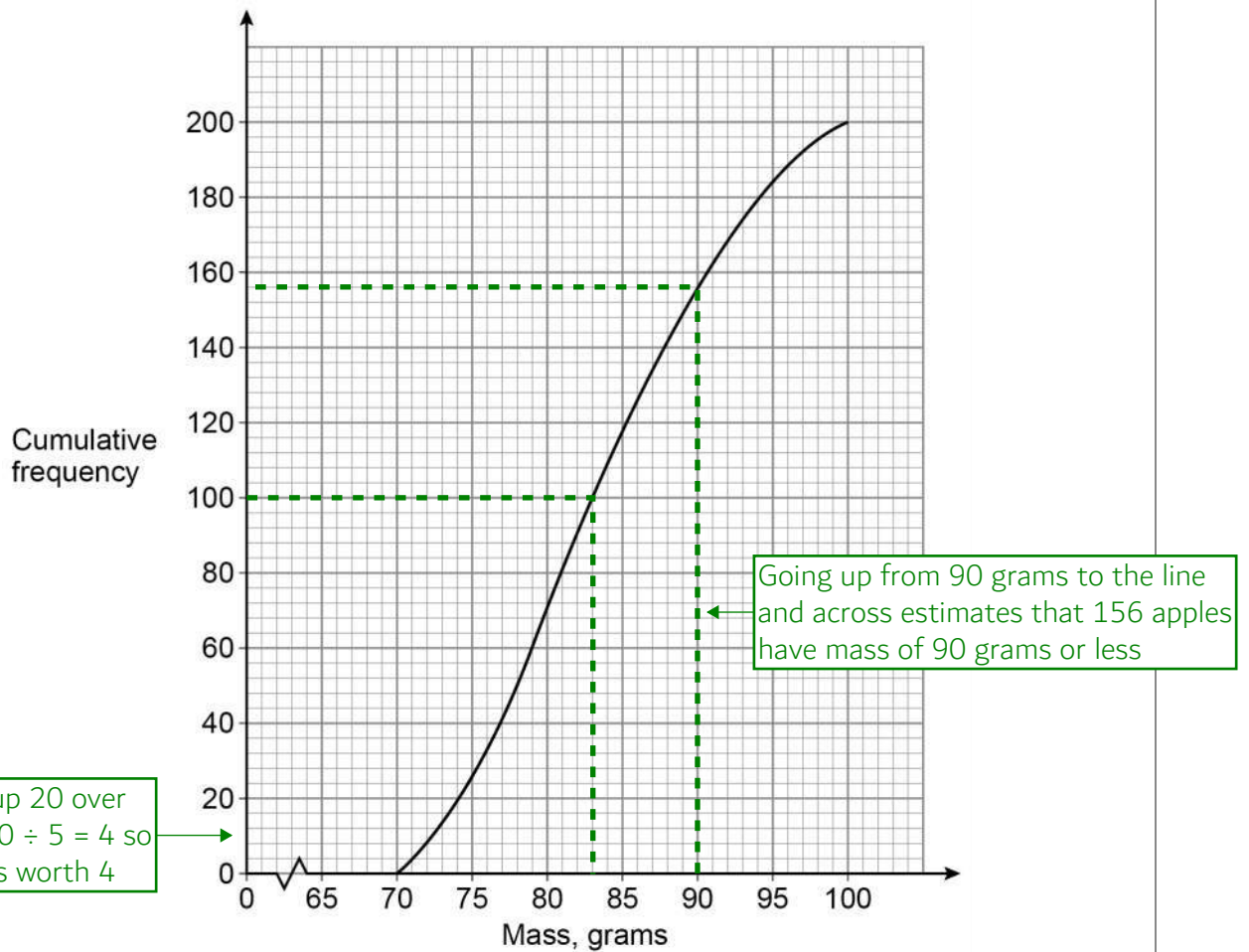
Answer 112

Turn over for the next question



17

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



17 (a) Estimate the median mass.

[1 mark]

Answer 83 grams

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



- 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]

$$156 \times 0.32 = 49.92$$

Multiplying the estimated 156 apples with mass less than 90 grams by the £0.32 they each cost works out that the total cost of the apples less than 90 grams is estimated to be £49.92

$$200 - 156$$

Subtracting the estimated 156 apples with mass less than 90 grams from the total 200 apples estimates that there are 44 apples with mass more than 90 grams

$$44 \times 0.39$$

Multiplying the estimated 44 apples with mass more than 90 grams by the £0.39 they each cost works out that the total cost of the apples more than 90 grams is estimated to be £17.16

$$49.92 + 17.16$$

Adding the estimated costs of the apples less than 90 grams and the apples more than 90 grams estimates the total cost of the 200 apples

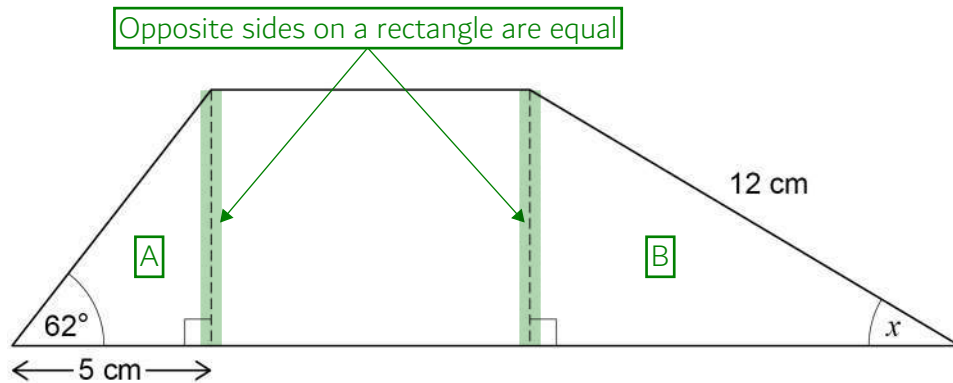
Answer £ 67.08

Turn over for the next question



18

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

Not drawn
accuratelyWork out the size of angle x .

[4 marks]

SOHCAHTOA

Using right-angled trigonometry in triangle A. Ticking O as we are looking for the opposite and ticking A as we have the adjacent. There are two ticks on the TOA formula triangle so this can be used

 $\tan 62 \times 5$

From the TOA formula triangle, opposite = tan of the angle $\times$ adjacent. So the side highlighted green in both triangle A and B is 9.4... cm

SOHCAHTOA

Using right-angled trigonometry in triangle B. Ticking O as we have the opposite and ticking H as we have the hypotenuse. There are two ticks on the SOH formula triangle so this can be used

 $\sin x = \frac{9.4...}{12}$

From the SOH formula triangle, sin of the angle = opposite/hypotenuse

Answer 51.6 degrees

Doing the inverse sin of both sides gets x on its own



19 a and b are positive values.

Show that $\frac{7a + 2b - 3a}{8a + 6b + 2a - b}$ 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

$$\frac{2}{5}$$

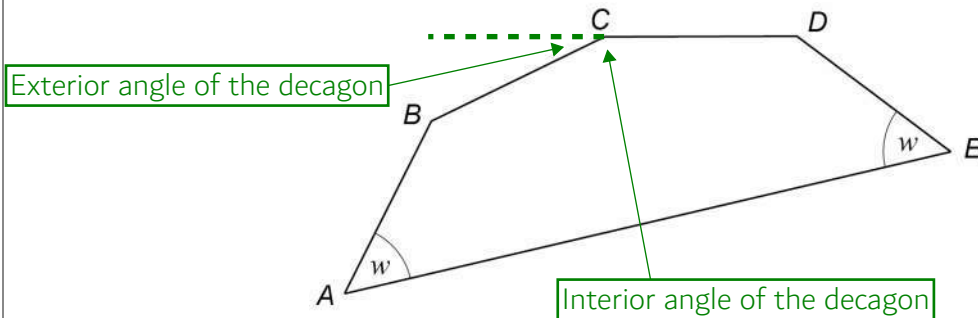
← Cancelling out the $(2a + b)$ from the numerator and denominator as it is a common factor

Turn over for the next question

Turn over ►



20

 AB , BC , CD and DE are four of the sides of a regular decagon.Not drawn
accuratelyWork out the size of angle w .**[3 marks]**

$360 \div 10$

The exterior angles of any polygon add up to 360 degrees. So dividing 360 degrees by the 10 angles of the decagon works out that each exterior angle of the decagon is 36 degrees

$180 - 36$

The exterior and interior angles lie around a point on a straight line so must add up to 180 degrees. Subtracting the exterior angle from 180 degrees works out that the interior angle of the decagon is 144 degrees

$144 \times 3 = 432$

There are 3 interior angles of the decagon in the shape. These total to 432 degrees

$(5 - 2) \times 180$

 $(n - 2) \times 180$, where n is the number of sides, works out the sum of the interior angles in a polygon. The shape is a polygon with 5 sides so it has 540 degrees in it

$540 - 432$

Subtracting the 3 interior angles of the decagon from the sum of the interior angles in the shape works out that there are 108 degrees left in the shape

$108 \div 2$

There are 2 of angle w left in the shape. So dividing the 108 degrees left in the shape by 2 works out that w must be 54 degreesAnswer 54 degrees

- 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)

$$1/-1 = -1$$

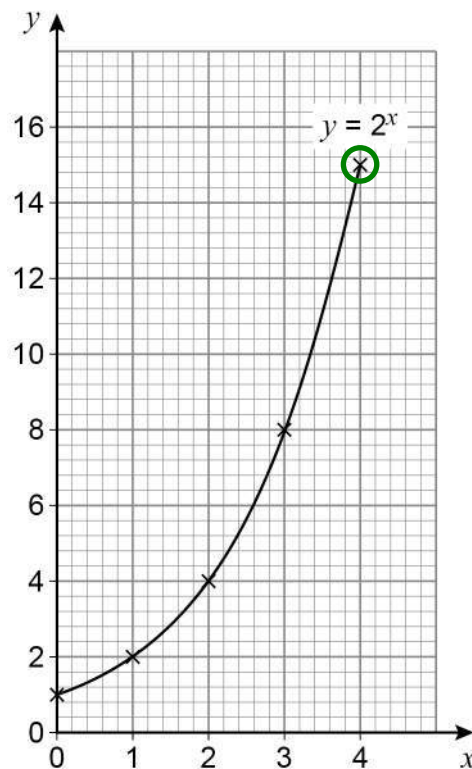
$$1/0.3 = 10/3$$

$$1/0.8 = 1.25$$

$$1/2.5 = 0.4$$

Substituting in the x-coordinate of each point into the equation of the graph to work out what the y-coordinate should be. 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

Using table mode on the calculator. Set $f(x) = 2^x$. Start: 0. End: 4. Step: 1.
This works out what points should be on the graph by giving a table of values

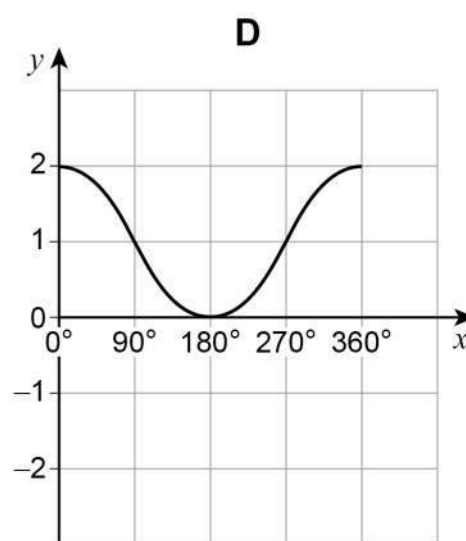
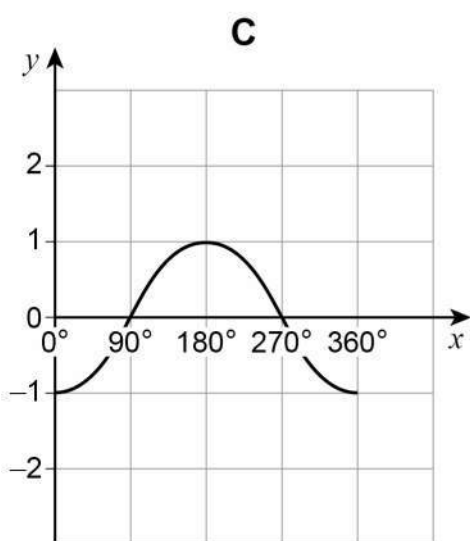
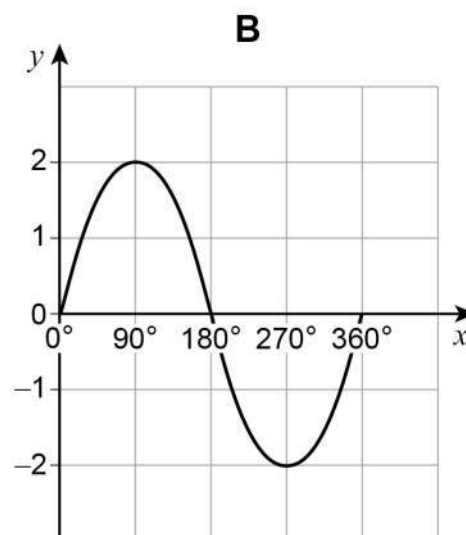
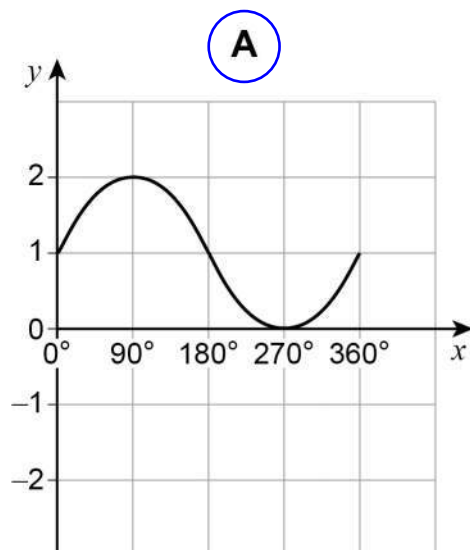


22

One of these is the graph of $y = 1 + \sin x$ for $0^\circ \leq x \leq 360^\circ$

Circle the letter above the correct graph.

[1 mark]



Using table mode on the calculator. Set $f(x) = 1 + \sin(x)$. Start: 0. End: 360. Step: 90. Use the table of values to check which graph goes through the right points



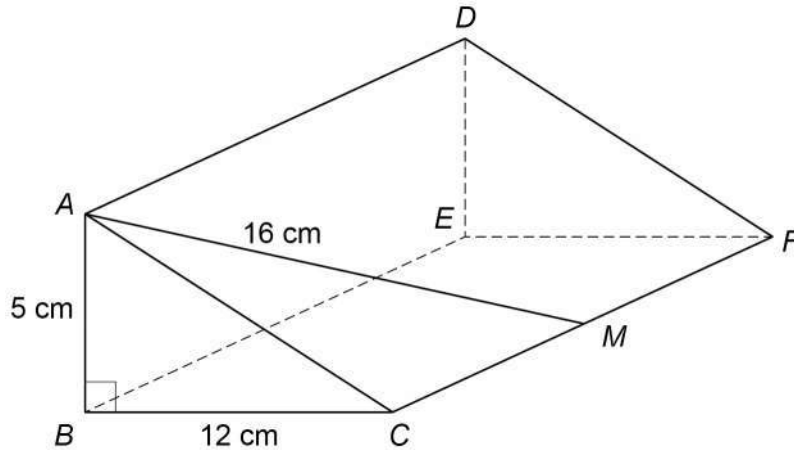
23

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

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

 M is the midpoint of CF .

$$AM = 16 \text{ cm}$$



Work out the volume of the prism.

[4 marks]

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

Pythagoras' Theorem can be used in right-angled triangle ABC . $a^2 + b^2 = c^2$, where a and b are the shorter sides and c is the longest side. Substituting 5 cm for a , 12 cm for b and AC for c

$$AC = \sqrt{169}$$

$5^2 + 12^2 = 169$ then square rooting both sides finds that AC is 13 cm

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

Pythagoras' Theorem can be used in right-angled triangle ACM . $a^2 + b^2 = c^2$, where a and b are the shorter sides and c is the longest side. Substituting 13 cm for a , CM for b and 16 cm for c

$$CM^2 = 87$$

Subtracting 13^2 from both sides to get the CM^2 on its own

$$CM = \sqrt{87}$$

Square rooting both sides finds that CM is $\sqrt{87}$ cm

$$\frac{1}{2} \times 12 \times 5$$

This works out that the area of the cross section, triangle ABC , is 30 cm^2 . Area of triangle = $\frac{1}{2} \times \text{base} \times \text{height}$

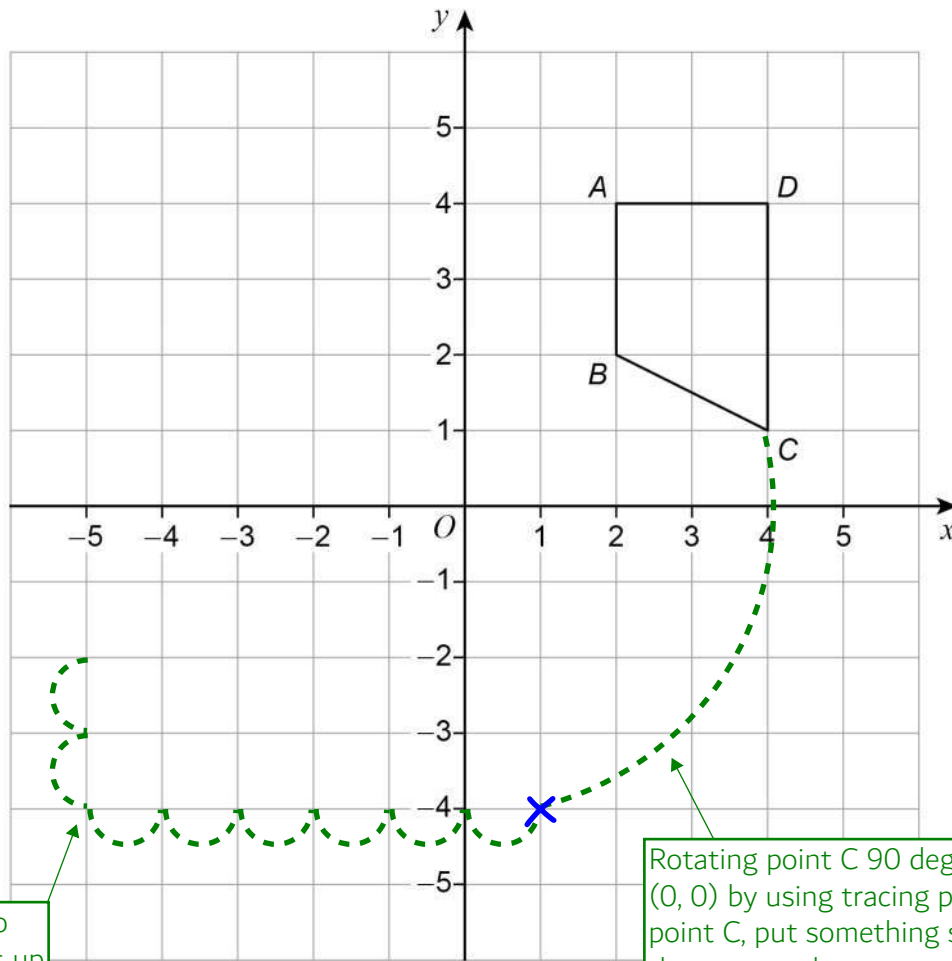
$$30 \times 2\sqrt{87}$$

Volume of prism = area of cross section $\times$ length. The length is 2 lots of CM as M is the midpoint of CF

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



24

Quadrilateral $ABCD$ is shown.

Counting 6 jumps to
the left and 2 jumps up

Rotating point C 90 degrees clockwise about
(0, 0) by using tracing paper: draw on top of
point C, put something sharp in the point (0, 0)
then rotate the paper around that point

- 24 (a)** Work out the coordinates of C when $ABCD$ is
rotated 90° clockwise about O
then

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

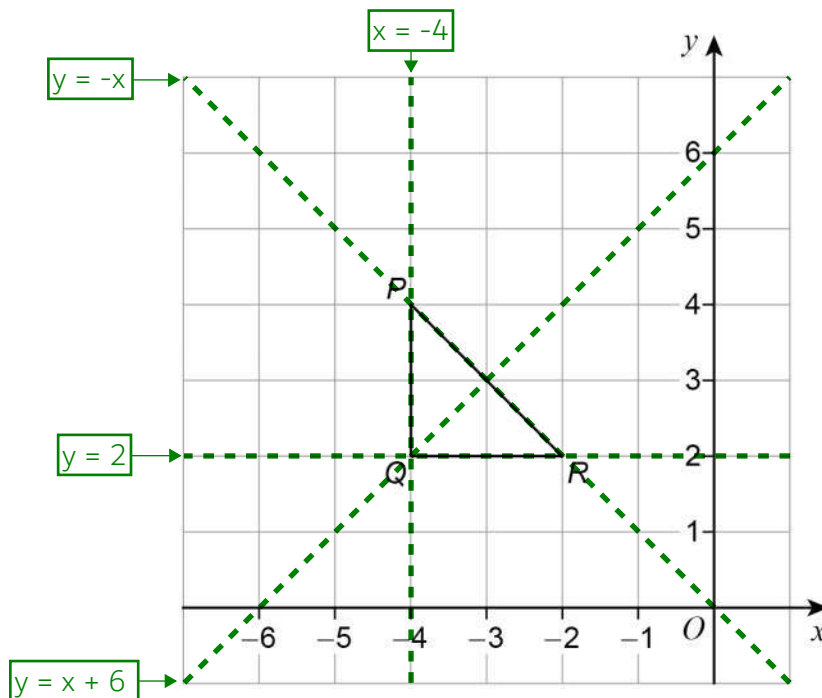
[2 marks]

Only point C needs to be considered and the rest of the shape can be ignored

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.

[1 mark]

$$y = x + 6$$

$$y = -x$$

$$y = 2$$

$$x = -4$$

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]

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

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

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

Factorising the left two terms and right two terms separately

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

Bringing into the factorised form

To find the numbers which multiply to -60 and add to 11 , table mode can be used on the calculator. Set $f(x) = 60/x$. 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



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]

$$25 + \frac{1}{2}$$

The resolution for each sack of potatoes is 1 kg as they are to the nearest kilogram. Adding half of this to the 25 kg works out that the upper bound of a sack of potatoes is 25.5 kg

$$30 \times 25.5 = 765$$

Multiplying the 30 sacks of potatoes by the upper bound of the mass of a sack of potatoes works out that the upper bound of the mass of the 30 sacks of potatoes is 765 kg

$$7.5 + \frac{0.1}{2}$$

The resolution for each sack of carrots is 0.1 kg as they are to 1 decimal place. Adding half of this to the 7.5 kg works out that the upper bound of a sack of carrots is 7.55 kg

$$20 \times 7.55$$

Multiplying the 20 sacks of carrots by the upper bound of the mass of a sack of carrots works out that the upper bound of the mass of the 20 sacks of carrots is 151 kg

$$765 + 151 = 916$$

Adding the upper bound of the mass of the 30 sacks of potatoes and the upper bound of the mass of the 20 carrots works out that the upper bound of the mass which she wants to carry in one journey is 916 kg

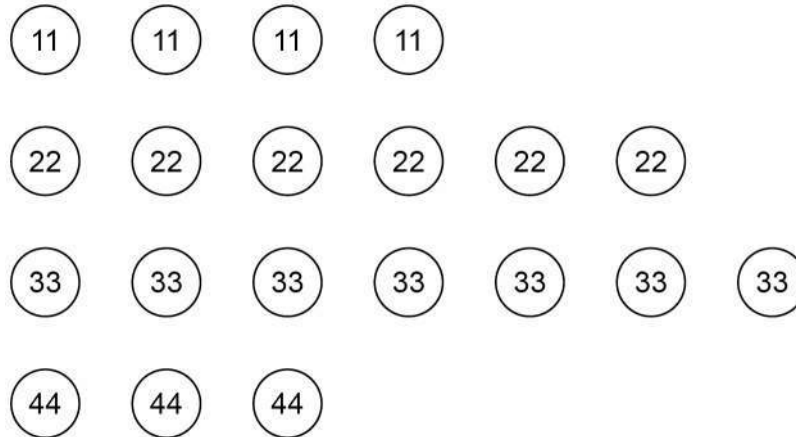
Yes

916 kg is less than the maximum load of 920 kg so she can definitely use her van safely in one journey as the mass cannot be more than 916 kg



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 $\frac{29}{76}$

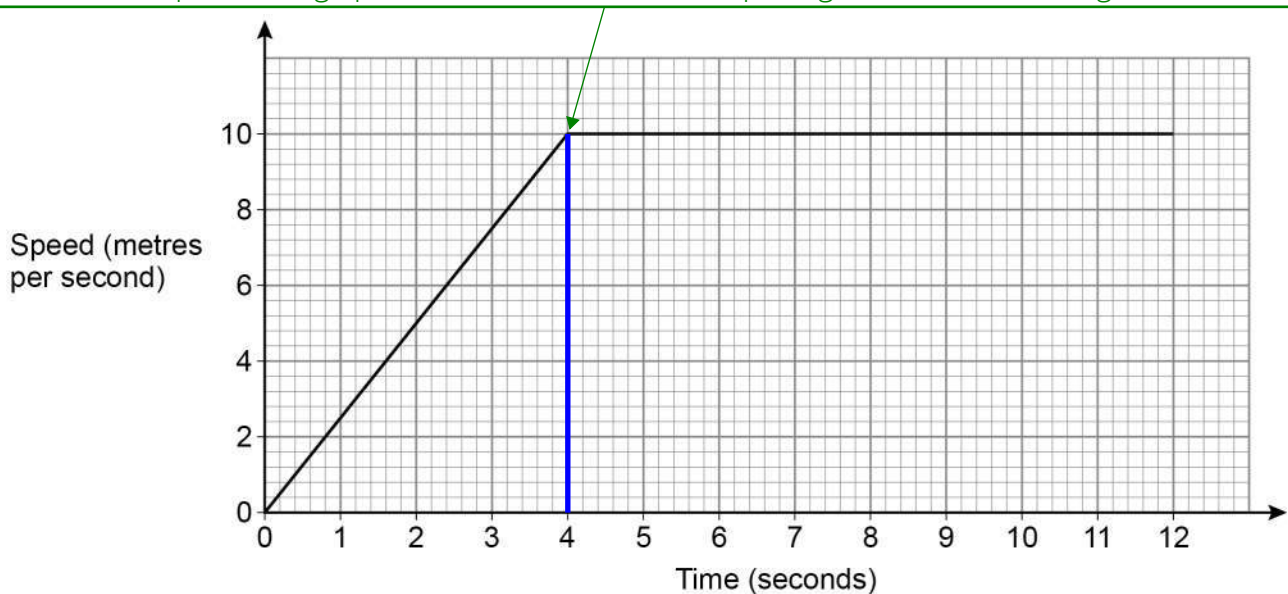


28

A horse runs in a field.

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

Distance on a speed-time graph is the area under the line. Splitting it here forms a triangle and a rectangle



After how many seconds had the horse run a distance of 75 metres?

[3 marks]

$$\frac{1}{2} \times 4 \times 10$$

Area of triangle = $\frac{1}{2} \times \text{base} \times \text{height}$. The base of the triangle is 4 and the height is 10. So the area of the triangle is 20, meaning that 20 metres were run in the first 4 seconds

$$75 - 20$$

Subtracting the 20 metres done in the first 4 seconds from the total 75 metres works out that another 55 metres still need to be run

$$55 \div 10$$

The 55 is the area of the rectangle. Area of rectangle = base $\times$ height, so base = area of rectangle $\div$ height. The height is 10 so the base must be 5.5

$$4 + 5.5$$

The base of 5.5 means that it took 5.5 seconds to do the extra 55 metres. Adding this to the 4 seconds to do the first 20 metres works out how many seconds it took to do 75 metres

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]

$5(x^2+3) = 2x(4x+1)$ ← 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

$x = \frac{-2 \pm \sqrt{2^2 - 4 \times 3 \times -15}}{2 \times 3}$ ← $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ ← It was in the form $ax^2 + bx + c = 0$ so it can be solved using the quadratic formula. $a = 3$, $b = 2$, $c = -15$

Answer 1.93 , -2.59

END OF QUESTIONS

