

Please write clearly in block capitals.

Centre number

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

Candidate number

| | | | |
|--|--|--|--|
| | | | |
|--|--|--|--|

Surname _____

Forename(s) _____

Candidate signature _____

GCSE MATHEMATICS

H

Higher Tier Paper 2 Calculator

Monday 6 November 2017

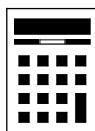
Morning

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.
- 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.
- 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

Answer **all** questions in the spaces provided

- 1 Circle the fraction that is equivalent to 3.875

[1 mark]

$$\frac{15}{4}$$

$$\frac{29}{8}$$

$$\frac{31}{8}$$

$$\frac{15}{8}$$

Typing 3.875 into the calculator, pressing = then the SD button converts it into a fraction in its simplest form

- 2 What is 50 as a percentage of 20?

Circle your answer.

[1 mark]

10%

40%

150%

250%

$$50/20 \times 100 = 250$$

50/20 expresses 50 as a fraction of 20. Multiplying a fraction by 100 converts it into a percentage

- 3 Circle the point that does **not** lie on the curve $y = x^3$

[1 mark]

$$\left(-\frac{1}{2}, -\frac{1}{8}\right)$$

(5, 125)

$$\left(\frac{1}{3}, \frac{1}{9}\right)$$

(-1, -1)

$$\begin{aligned} (-1/2)^3 &= -1/8 \\ 5^3 &= 125 \\ (1/3)^3 &= 1/27 \\ (-1)^3 &= -1 \end{aligned}$$

Substituting the x-coordinate into the equation finds what the y-coordinate should be. 1/27 is not 1/9 so the third option does not lie on the curve



4 Which **one** of these is a unit of density?

Circle your answer.

[1 mark]

kg/m^2

m^2/kg

kg/m^3

m^3/kg

Density = mass/volume. kg is a unit of mass and m^3 is a unit of volume

5 Solve $4(3x - 2) = 2x - 5$

[3 marks]

$$12x - 8 = 2x - 5$$

Expanding the bracket

$$10x - 8 = -5$$

Subtracting $2x$ from both sides to get the x terms on the side with the most x

$$10x = 3$$

Adding 8 to both sides to get the x term on its own

$$x = \frac{3}{10}$$

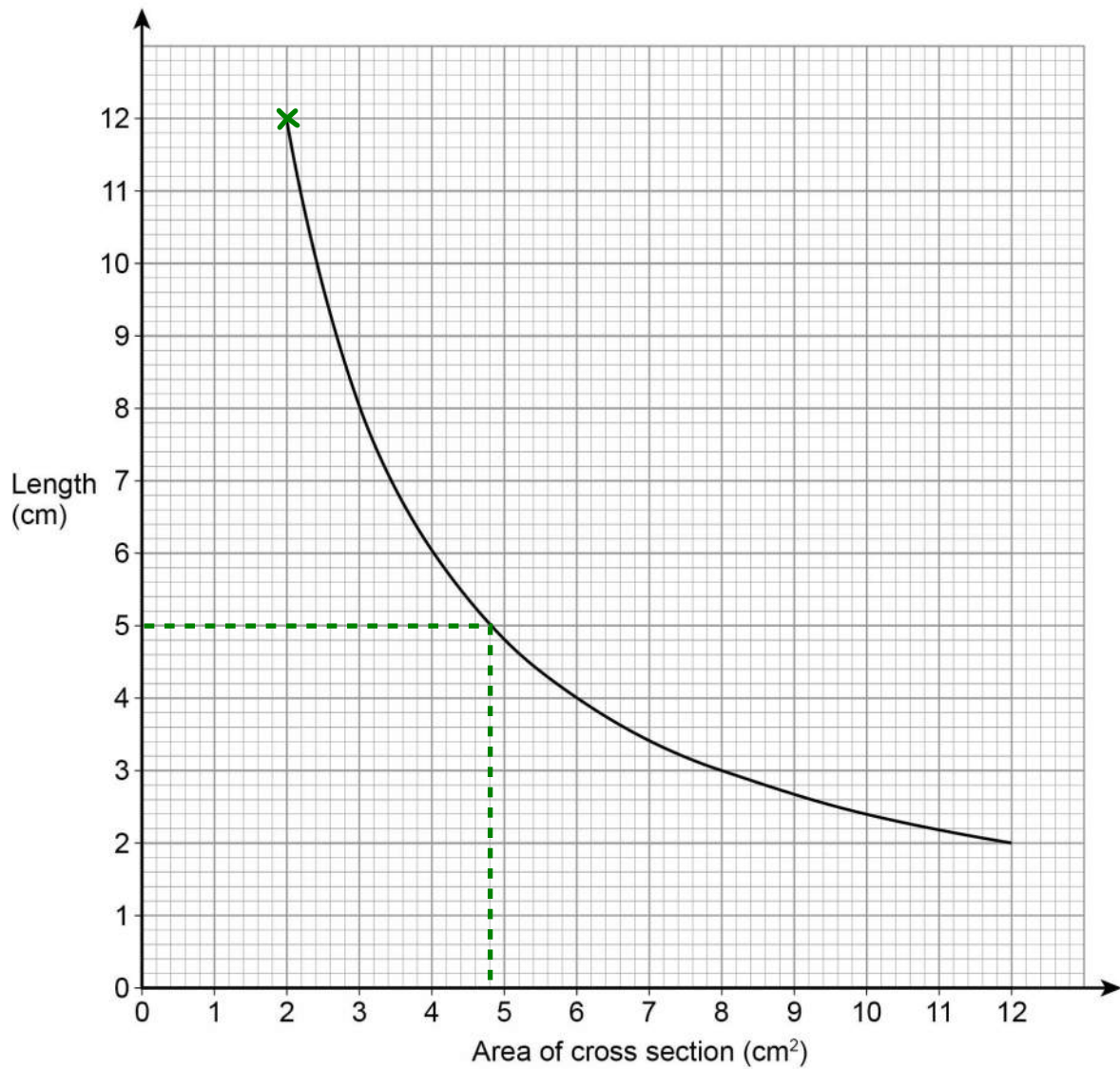
Dividing both sides by 10 makes x the subject and finds x

Turn over for the next question

Turn over ►



- 6 The graph shows information about prisms with the same volume.



- 6 (a) Give **one** example to show the volume is 24 cm^3

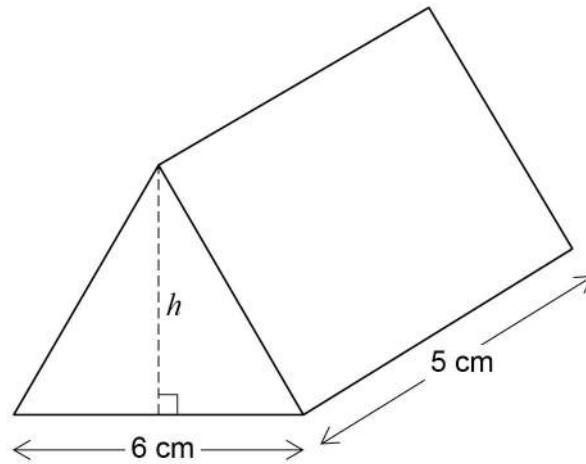
[1 mark]

$$2 \times 12 = 24$$

Volume of prism = area of cross section \times length. At the cross indicated, the area of cross section is 2 and the length is 12



- 6 (b) The diagram shows a prism with volume 24 cm^3
The height of the triangular cross section is h .



Work out the height, h .

[3 marks]

$$\frac{1}{2} \times 6 \times h = 4.8$$

From the graph, a prism with volume 24 cm^3 and length 5 cm has an area of cross section of 4.8 cm^2 . The cross section is a triangle and area of triangle = $\frac{1}{2} \times \text{base} \times \text{height}$. The base is 6 cm and the height is h

$$h = \frac{4.8}{\frac{1}{2} \times 6}$$

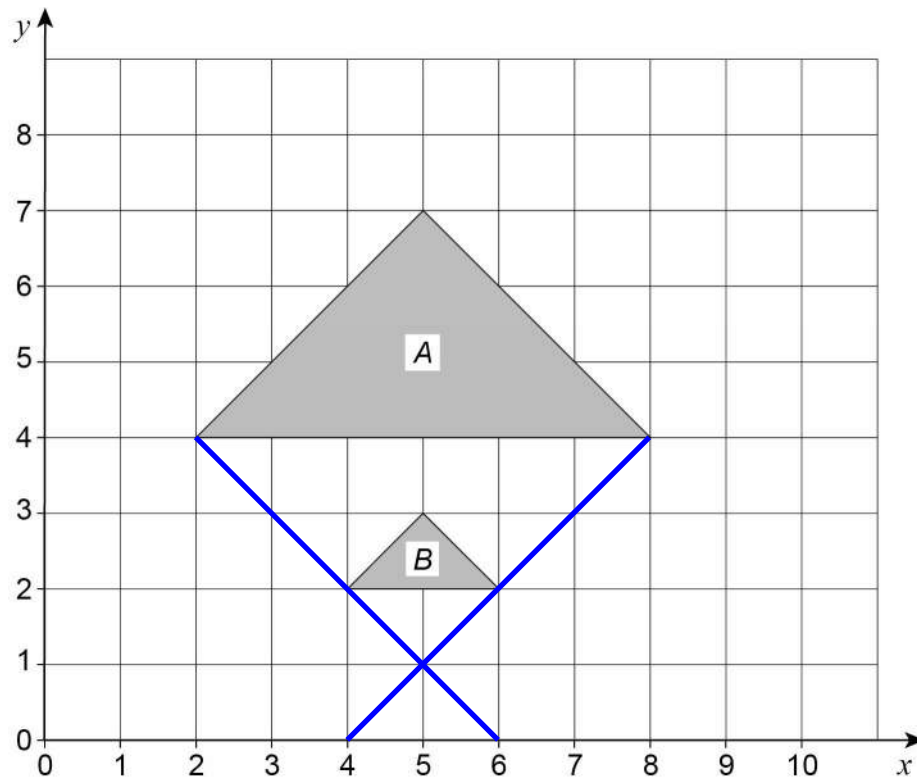
Rearranged to make h the subject by dividing both sides by $(\frac{1}{2} \times 6)$

Answer 1.6 cm

Turn over for the next question



- 7 Describe fully the **single** transformation that maps triangle *A* to triangle *B*.



[3 marks]

Enlargement, scale factor $\frac{1}{3}$, centre (5, 1)

It is an enlargement as it has changed size. The scale factor is $\frac{1}{3}$ as the sides are $\frac{1}{3}$ of the size on B and the shape is the same way up. Drawing lines through the corners of both shapes then finding where they cross works out the centre of enlargement



- 8 The table shows information about the distances walked by 120 students on their way to school one week.

| Distance, x (miles) | Frequency | | |
|-----------------------|-------------|--|--|
| $0 < x \leq 5$ | 20 | | |
| $5 < x \leq 10$ | 48 | | |
| $10 < x \leq 15$ | 30 | | |
| $15 < x \leq 20$ | 22 | | |
| | Total = 120 | | |

Work out an estimate for the mean distance.

[3 marks]

$$\frac{0+5}{2} \times 20 + \frac{5+10}{2} \times 48 + \frac{10+15}{2} \times 30 + \frac{15+20}{2} \times 22$$

$$120$$

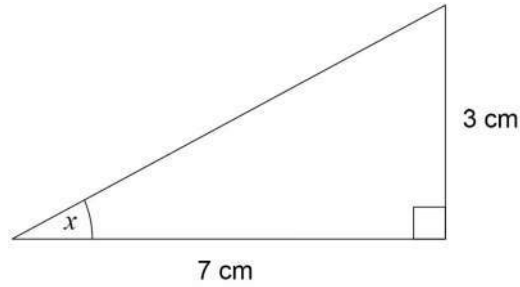
Adding the lowest and highest distance within each category then dividing by 2 works out the midpoint of each category. Multiplying the midpoint by the frequency gives an estimate of the total distance for each category. Adding all of these totals together gives an estimate of the total distance. Dividing this by the total frequency gives an estimate of the mean

Answer 9.75 miles

Turn over for the next question



9

Work out the size of angle x .Not drawn
accurately

[2 marks]

S^Ó H C ^Á H T ^Ó A

Right angled trigonometry can be used. Ticking O as we have the opposite and A as we have the adjacent. There are two ticks on TOA so this formula triangle can be used

$\tan^{-1}\left(\frac{3}{7}\right)$

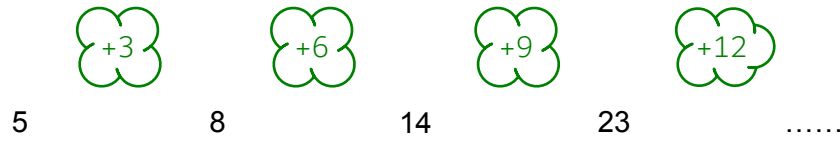
Covering T, which stands for tan of the angle, works out that \tan of the angle = opposite/adjacent. Doing the inverse tan of both sides gives angle = $\tan^{-1}(\text{opposite/adjacent})$. The opposite is 3cm and the adjacent is 7cm

Answer 23.2 degrees



10 Work out the next term of this quadratic sequence.

[2 marks]



The amount added increases by 3 each time

Answer 35

11 Circle the expression that is equivalent to

$$\frac{3x^2}{6x^2 + 3}$$

[1 mark]

$$\frac{x^2}{2x^2 + 3}$$

$$\frac{x^2}{6x^2 + 1}$$

$$\frac{x^2}{2x^2 + 1}$$

$$\frac{1}{2} + x^2$$

The numerator and denominator is divided by 3

Turn over for the next question

Turn over ►



12 The table shows information about the UK and Germany.

| | Population | | Area (square miles) | |
|---------|------------|---|---------------------|-------|
| UK | 64 000 000 | ÷ | 95 000 | = 674 |
| Germany | 82 000 000 | ÷ | 140 000 | = 586 |

$$\text{Population density} = \frac{\text{population}}{\text{area}}$$

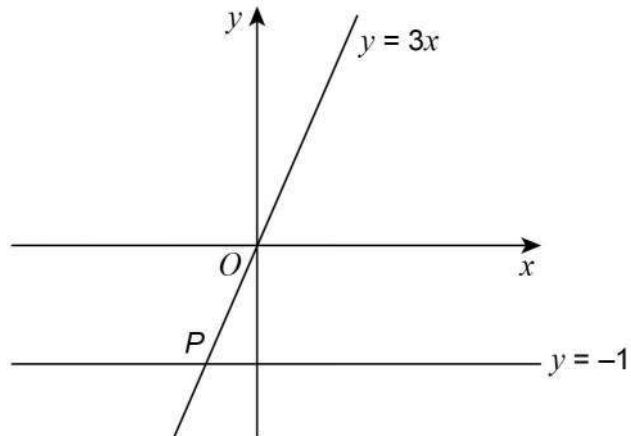
Compare the population densities of the UK and Germany.

[3 marks]

Greater for UK



- 13 Two straight lines intersect at point P .



Not drawn
accurately

Circle the coordinates of P .

[1 mark]

$(-3, -1)$

$\left(-1, -\frac{1}{3}\right)$

$(-1, -3)$

$\left(-\frac{1}{3}, -1\right)$

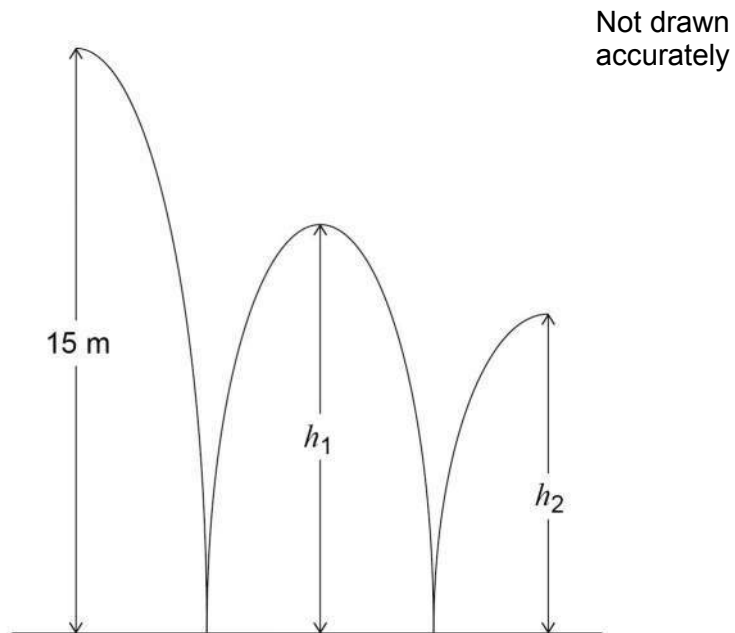
The y-coordinate must be -1 as it is on the line $y = -1$. Substituting -1 for y in the equation of the other line gives $-1 = 3x$. Dividing both sides by 3 finds that $x = -1/3$.

Turn over for the next question

Turn over ►



- 14** A ball is thrown from a height of 15 metres.
It bounces to height h_1 , then to height h_2 as shown.



h_1 is three quarters of the original height.

- 14 (a)** Jack expects h_2 to be three quarters of h_1

Work out the value of h_2 that he expects.

[2 marks]

$$\frac{3}{4} \times \frac{3}{4} \times 15$$

$\frac{3}{4} \times 15$ works out $\frac{3}{4}$ of 15m, which is h_1 . Doing $\frac{3}{4}$ of this by multiplying by $\frac{3}{4}$ works out h_2

Answer 8.4375 metres



14 (b) In fact, h_2 is two thirds of h_1

How does this affect the answer to part (a)?

Tick a box.

The ball bounced higher than he expected

The ball bounced lower than he expected

Show working to support your answer.

[2 marks]

$$\frac{2}{3} \times \frac{3}{4} \times 15 = 7.5$$

$\frac{3}{4} \times 15$ works out $\frac{3}{4}$ of 15m, which is h_1 . Doing $\frac{2}{3}$ of this by multiplying by $\frac{2}{3}$ works out h_2

7.5m is less than the 8.4375m he expected

Turn over for the next question



15

Mirek invests £6000 at a compound interest rate of 1.5% per year.

He wants to earn more than £1000 interest.

Work out the **least** time, in whole years, that this will take.

[3 marks]

Use table mode by pressing MENU then 3. $f(x) = 6000 \times ((100 + 1.5)/100)^x$.
Ignore g(x). Start: 1. End: 30. Step: 1

This lists out the amount of money the investment is worth each year. $100 + 1.5$ expresses the percentage it increases to each year. Dividing this by 100 converts it into a fraction multiplier, which when 6000 is multiplied by it increases by 1.5%. Raising this to the power of x , where x is the number of years. The value of $f(x)$ is the value of the investment, which should be at least 7000 as $6000 + 1000 = 7000$.
When x is 10, $f(x)$ is £6963.24. When x is 11, $f(x)$ is £7067.69.

Answer 11 years



16 (a) Factorise fully $9y^3 - 6y$

[2 marks]

3 is the highest common factor of the numbers. y is the highest common factor of the letters. Both of these are brought out as a factor then the rest is left in a bracket

Answer $3y(3y^2 - 2)$

16 (b) Factorise $3x^2 - 22x + 7$

[2 marks]

$$\begin{array}{l} 3x^2 - 22x + 7 \\ 3x(x - 7) - 1(x - 7) \end{array}$$

Answer $(3x - 1)(x - 7)$

Turn over for the next question

It is in the form $ax^2 + bx + c$. Multiplying a (which is 3) by c (which is 7) gives 21. Looking for two numbers which multiply to 21 and add to b (which is -22)

Using table mode by pressing MENU then 3. $f(x) = 21/x$. Start: 1. End: 30. Step: 1

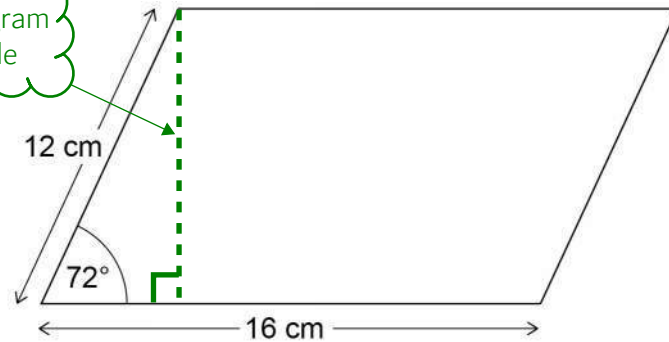
This lists out the factor pairs of 21. Both need to be negative to add to a negative and multiply to a positive. -21 and -1 work, so splitting the middle x term into these amounts of x . Then factorising both halves. -1 is brought out as a factor on the second half as there is no higher common factor and the x term is negative. Bringing together the $3x$ and -1 into a single bracket and writing this multiplied by the other bracket which repeats

Turn over ►



17 Work out the area of the parallelogram.

Drawing the height of the parallelogram here creates a right angled triangle



Not drawn accurately

[3 marks]

SÓHCÁHTÓA

Using right angled trigonometry on the triangle to work out the height of the parallelogram. We have the hypotenuse so H is ticked and we are working out the opposite so O is ticked. There are two ticks on SOH so this formula triangle can be used

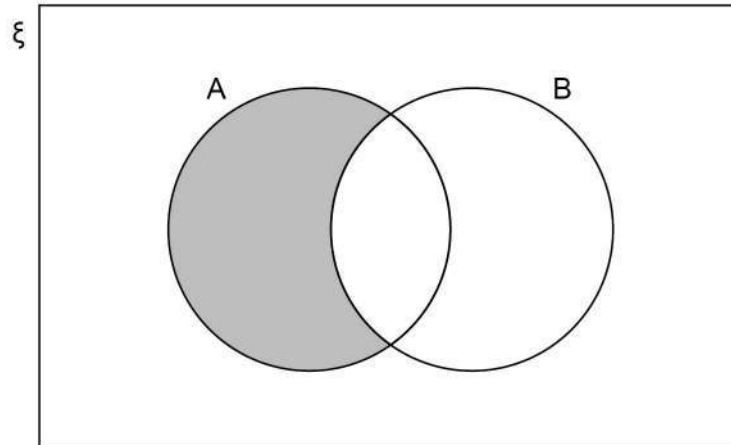
$16 \times \sin 72 \times 12$

Area of parallelogram = base x height. The base is 16. The height is found by working out the opposite in the right angled triangle. From the the formula triangle, opposite = (sin of the angle) x hypotenuse

Answer 182.6 cm²

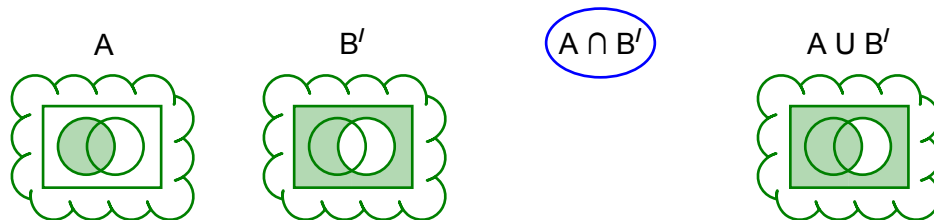


18 (a)

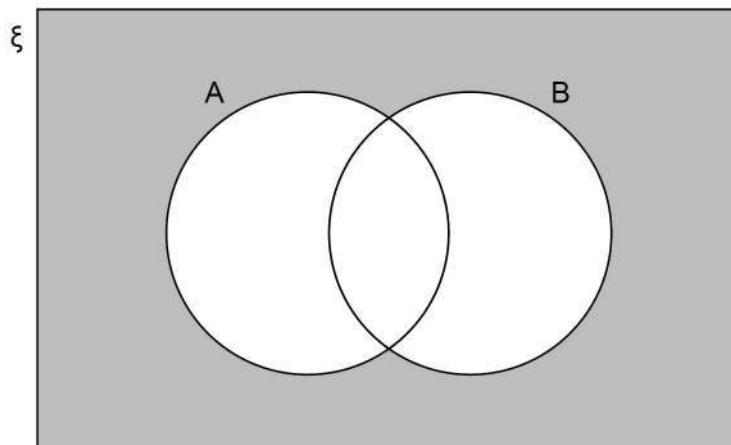


Which of these represents the shaded region?
Circle your answer.

[1 mark]

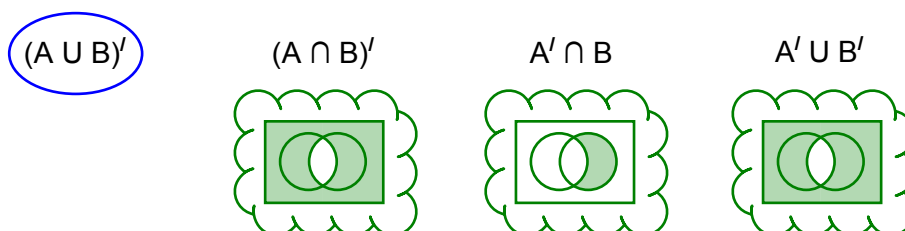


18 (b)



Which of these represents the shaded region?
Circle your answer.

[1 mark]



- 19 The length of a rectangle is five times the width.
The area of the rectangle is 1620 cm^2

Not drawn
accurately



Work out the width of the rectangle.

[3 marks]

$$5w \times w$$

Area of rectangle = length x width. let
w be the width. The length will be 5w

$$5w^2 = 1620$$

$5w \times w = 5w^2$, which is an expression for the
area so must be equal to the area of 1620 cm^2

$$w = \sqrt{\frac{1620}{5}}$$

Dividing both sides by 5 then square rooting to find w, the width

Answer 18 cm



20

A stone is thrown upwards with a speed of v metres per second.

The stone reaches a maximum height of h metres.

h is directly proportional to v^2

When $v = 10$, $h = 5$

Work out the maximum height reached when $v = 24$

[4 marks]

$$h = kv^2$$

$h \propto v^2$. The right side of this can be multiplied by anything and still be directly proportional. So multiplying by k and converting it into an equation

$$k = \frac{h}{v^2}$$

Rearranging to find k by dividing both sides by v^2

$$\frac{5}{10^2} \times 24^2$$

Substituting 5 for h and 10 for v to express k . Multiplying this by v^2 as per the original equation $h = kv^2$ to find h , the height

Answer 28.8 m

Turn over for the next question

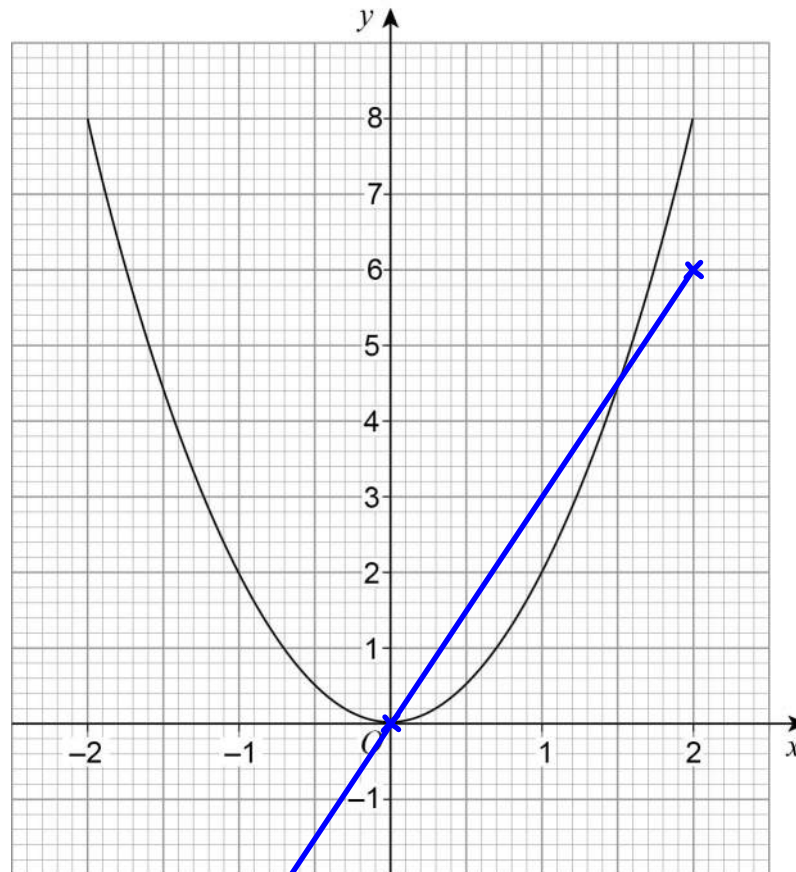
Turn over ►



21 (a) Meera is using a **graphical** method to solve $2x^2 - 3x = 0$

She draws the graph of $y = 2x^2$ and a straight line graph on the same grid.

Here is the graph of $y = 2x^2$



Complete her method to solve $2x^2 - 3x = 0$

[2 marks]

Rearranging $2x^2 - 3x = 0$ to get the $2x^2$ on its own (as it is in the equation $y = 2x^2$) gives $2x^2 = 3x$.

So drawing the graph of $y = 3x$ and working out the x-coordinates where both graphs cross works out the solutions. When $x = 0$, $y = 0$. When $x = 2$, $y = 6$. Plotting both of these points then drawing a straight line through them. The two graphs cross when $x = 0$ and $x = 1.5$

Answer $x=0, x=1.5$



- 21 (b)** Levi is solving $2x^2 + 5x = 0$
He uses this method.

$$2x^2 + 5x = 0 \quad \text{subtract } 5x \text{ from both sides}$$

$$2x^2 = -5x \quad \text{divide both sides by } x$$

$$2x = -5 \quad \text{divide both sides by 2}$$

$$x = -2.5$$

Evaluate his method and his answer.

[2 marks]

Cannot divide by x as it could be zero

Turn over for the next question

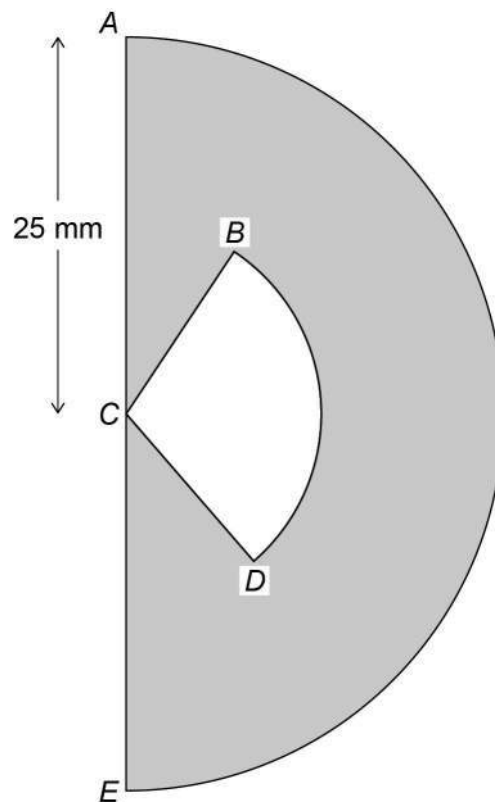


22

The cross section of an earring is a semicircle, centre C , radius 25 mm

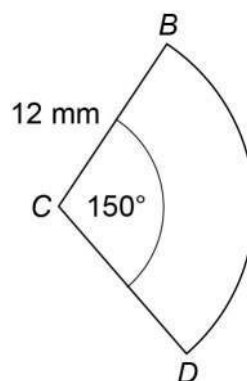
The earring is black and white.

The shaded area is black.



Not drawn
accurately

Sector BCD is white and has radius 12 mm



Not drawn
accurately



Is more than 20% of the semicircle white?

You **must** show your working.

[5 marks]

$$\frac{\frac{150}{360} \times \pi \times 12^2}{\frac{1}{2} \times \pi \times 25^2} \times 100$$

Expressing the area of the white part as a fraction of the area of the whole semicircle then multiplying by 100 to convert it into a percentage. Area of circle = $\pi \times \text{radius}^2$.

Multiplying by the area of the whole circle by the fraction of the circle which the sector is gives the area of the sector. The semicircle is $\frac{1}{2}$ of the full circle. The white sector is $\frac{150}{360}$ of the full circle as it has 150° out of the total 360°

19.2%

19.2% is not more than 20%

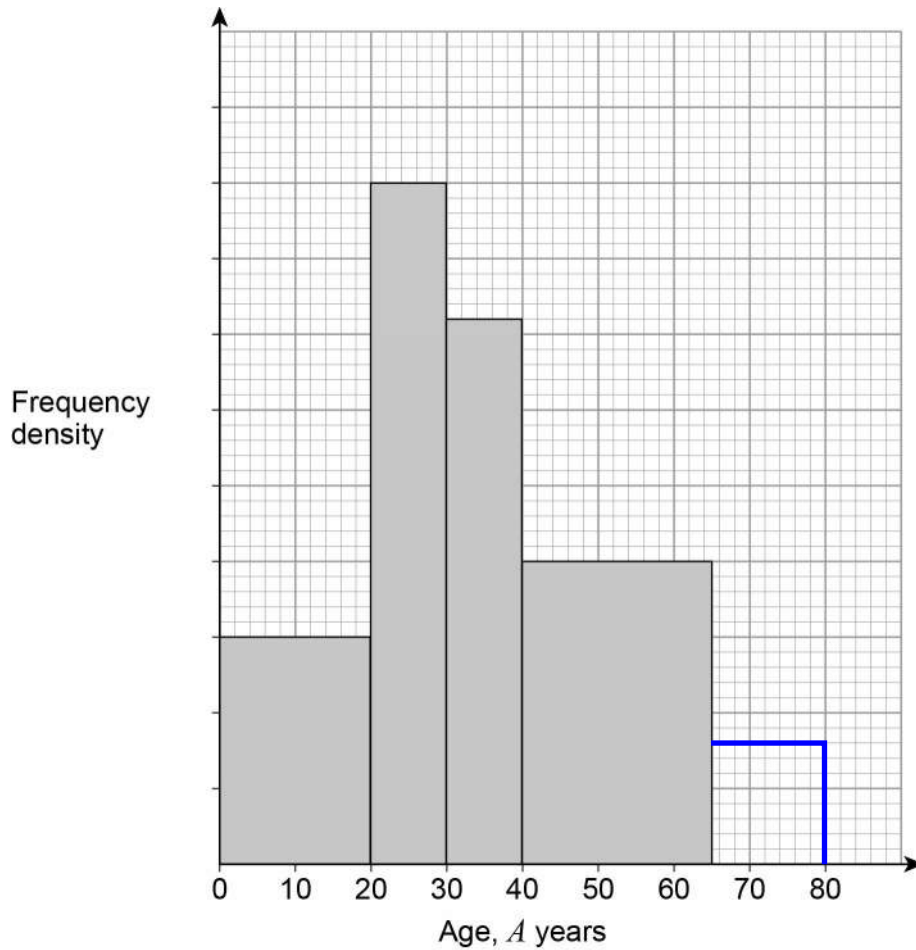
Answer No

Turn over for the next question



23 Here is some information about a tennis club.

Members of a tennis club



There are 30 members with $A < 20$

There are 12 members with $65 \leq A < 80$

There are no members with $A \geq 80$

23 (a) Complete the histogram.

[3 marks]

$c^F d$

The area of each box represents the frequency on a histogram.
Frequency = class width \times frequency density. Making a formula triangle out of this

$$\frac{30}{20} = 1.5$$

From the formula triangle, frequency density = frequency/class width.
So the frequency density of the first bar is 1.5

$$\frac{12}{80-65} = 0.8$$

The frequency density of the last bar is 0.8

The first bar is 15 small boxes tall and has frequency density of 1.5. $1.5/15 = 0.1$ so each small box is worth 0.1



23 (b) Work out the total number of members of the club.

[2 marks]

$$30 + (30 - 20) \times 4.5 + (40 - 30) \times 3.6 + (65 - 40) \times 2 + 12$$

Adding all of the frequencies together. Multiplying the class width by the frequency density to find the frequency for each of the bars where the frequency isn't given

Answer 173

Turn over for the next question



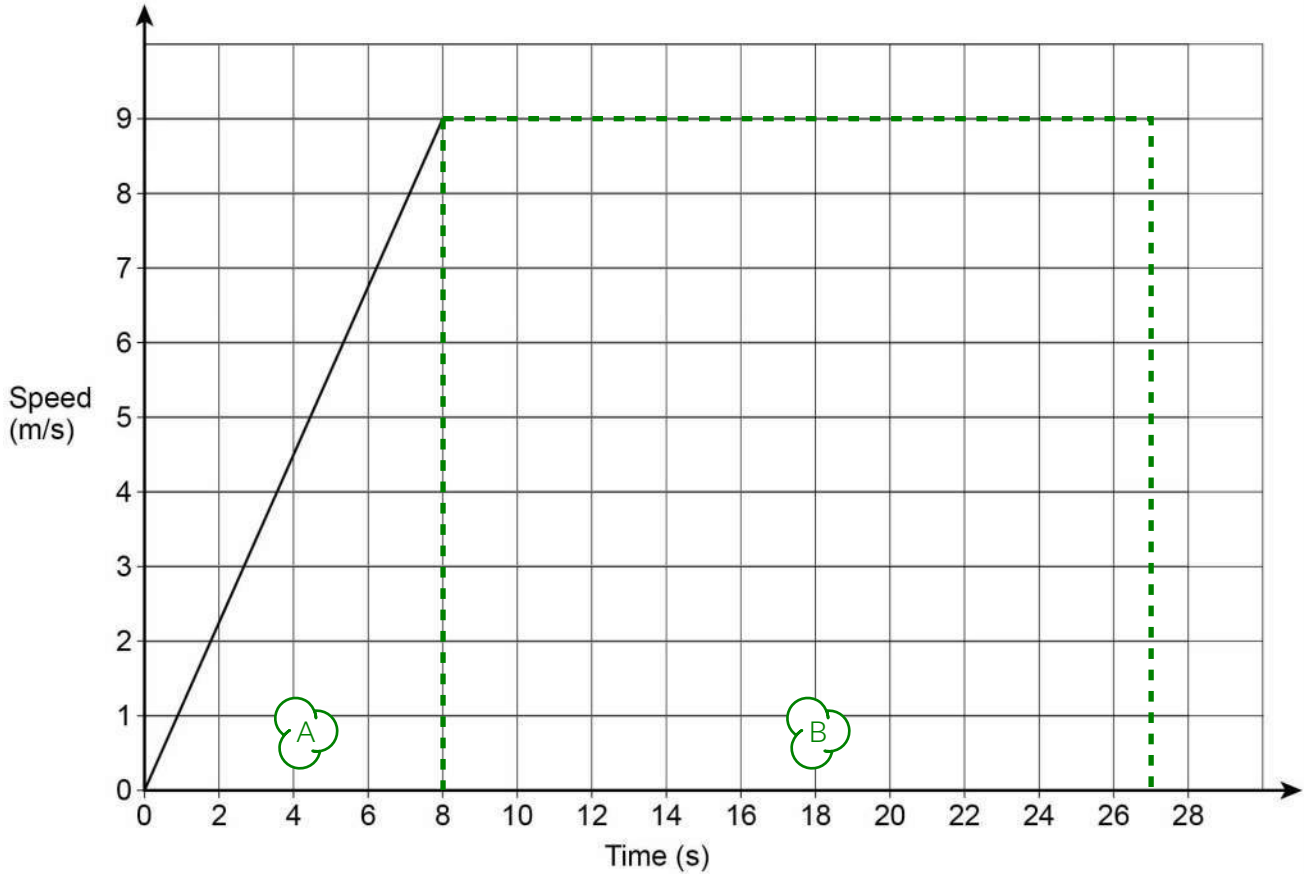
24

Beth ran a 200 metre race.

Here is a graph of the first 8 seconds of her race.

She completed the race at a constant speed of 9 m/s

Speed-time graph for Beth



Amy completed the race in 27 seconds.

Did Beth finish before Amy?

You **must** show your working.**[3 marks]**

$$\frac{1}{2} \times 8 \times 9 + (27 - 8) \times 9$$

Area under a speed-time graph is the distance. Adding the area of triangle A and rectangle B gives the total area

Area of triangle A. Area of triangle = $\frac{1}{2} \times \text{base} \times \text{height}$. The base is 8 and the height is 9Area of rectangle B. Area of rectangle = $\text{base} \times \text{height}$. The base is $(27 - 8)$ and the height is 9

207

Beth would have run 207 metres in the 27 seconds it took Amy to complete the race. Therefore Beth must have completed the 200 metres first

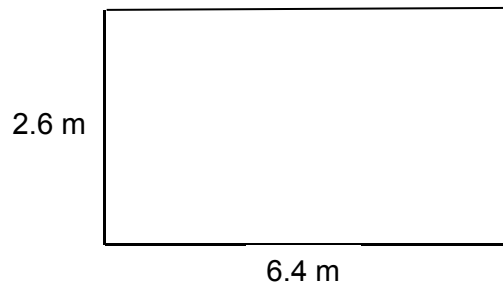
Answer

Yes



25

The dimensions of a rectangular floor are to the nearest 0.1 metres.



Not drawn
accurately

A force of 345 Newtons is applied to the floor.

The force is to the nearest 5 Newtons.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the upper bound of the pressure.

Give your answer to 4 significant figures.

You **must** show your working.

[5 marks]

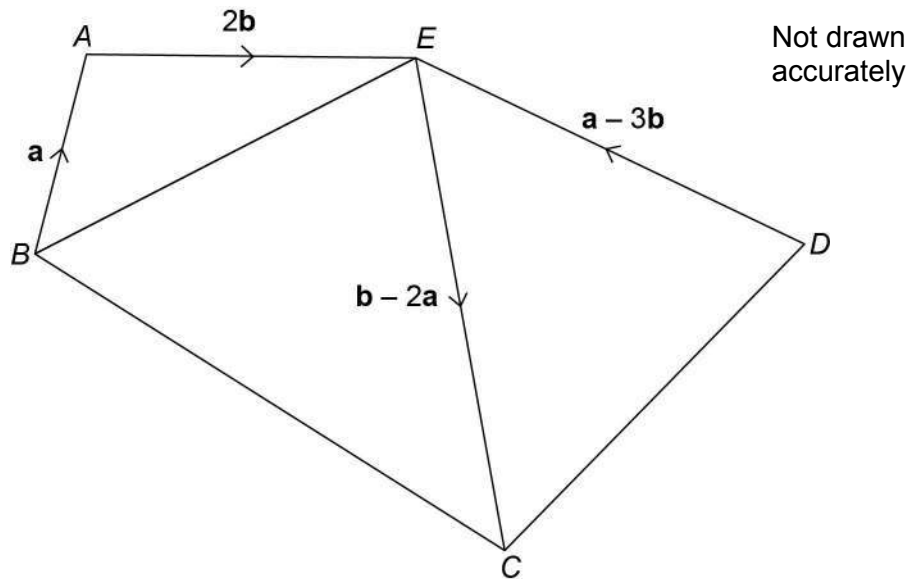
$$\frac{345 + \frac{5}{2}}{(2.6 - \frac{0.1}{2})(6.4 - \frac{0.1}{2})}$$

Dividing the upper bound of the force by the lower bound of the area works out the upper bound of the pressure. The upper bound of the force is found by adding half of the resolution of the measurement, which is 5. The lower bound of the area of the rectangle is found by multiplying the lower bound of the length and the lower bound of the width. The lower bounds of the length and width are found by subtracting half of the resolution of the measurements, which is 0.1

Answer 21.46 N/m²



26

 $ABCDE$ is a pentagon.Show that $BCDE$ is a parallelogram.

[3 marks]

$$\vec{CB} = -b + 2a - 2b - a \leftarrow \vec{CB} = \vec{CE} + \vec{EA} + \vec{AB}$$

$$= a - 3b$$

CB is equal and parallel to DE \leftarrow

Therefore it must be a parallelogram as opposite sides are equal in length and parallel



27

Solve $\frac{x}{4} - \frac{2x}{x+2} = 1$

Give your solutions to 2 decimal places.

You **must** show your working.**[6 marks]**

$$x(x+2) - 4 \times 2x = 4(x+2)$$

Multiplying all terms on both sides by the denominators eliminates the fractions

$$x^2 + 2x - 8x = 4x + 8$$

Expanding the brackets

$$x^2 - 10x - 8 = 0$$

Collecting all the terms on the left to put into the quadratic form

$$x = \frac{-(-10) \pm \sqrt{(-10)^2 - 4 \times 1 \times -8}}{2 \times 1}$$

Using the quadratic formula to solve x

Answer $x = 10.74, x = -0.74$

END OF QUESTIONS

