

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname *StemUp Model Solution*

Forename(s)

Candidate signature

GCSE MATHEMATICS

H

Higher Tier Paper 2 Calculator

Monday 6 November 2017

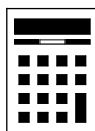
Morning

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	



Answer **all** questions in the spaces provided

- 1 Circle the fraction that is equivalent to 3.875

[1 mark]

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

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

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

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

- 2 What is 50 as a percentage of 20?
Circle your answer.

[1 mark]

10%

40%

150%

250%

- 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)



- 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

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

[3 marks]

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

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

$$10x = 3$$

$$x = 3 \div 10$$

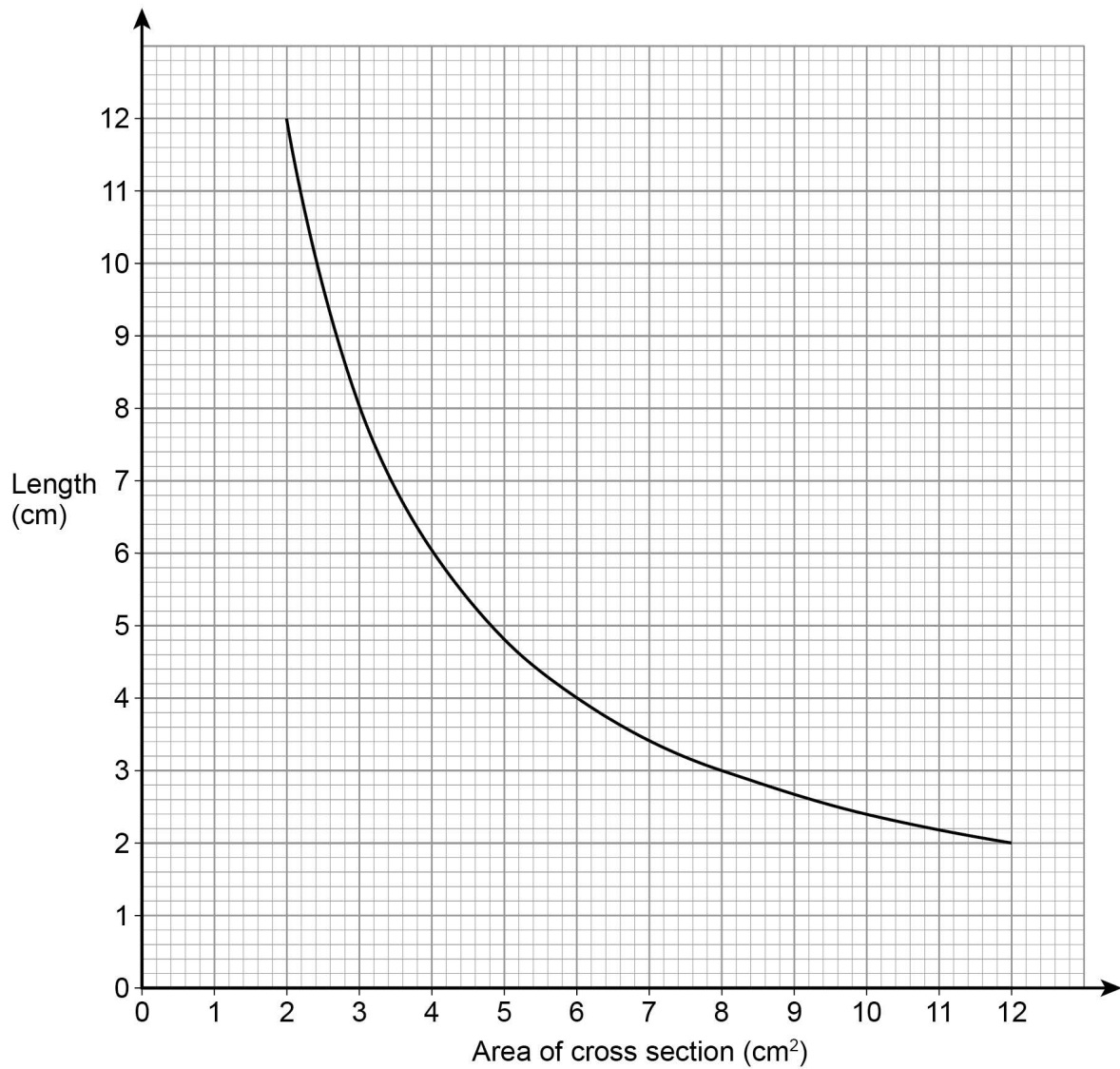
$$x = 0.3$$

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

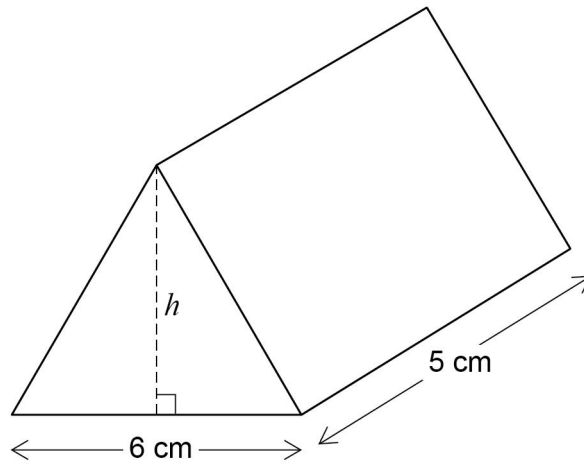
[1 mark]

From the graph: area 2 cm^2 and length 12 cm

Volume = $2 \times 12 = 24 \text{ cm}^3$



- 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]

$$\text{Length } 5 \text{ cm, so area of cross section} = 24 \div 5 = 4.8 \text{ cm}^2$$

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

$$3h = 4.8$$

$$h = 4.8 \div 3 = 1.6$$

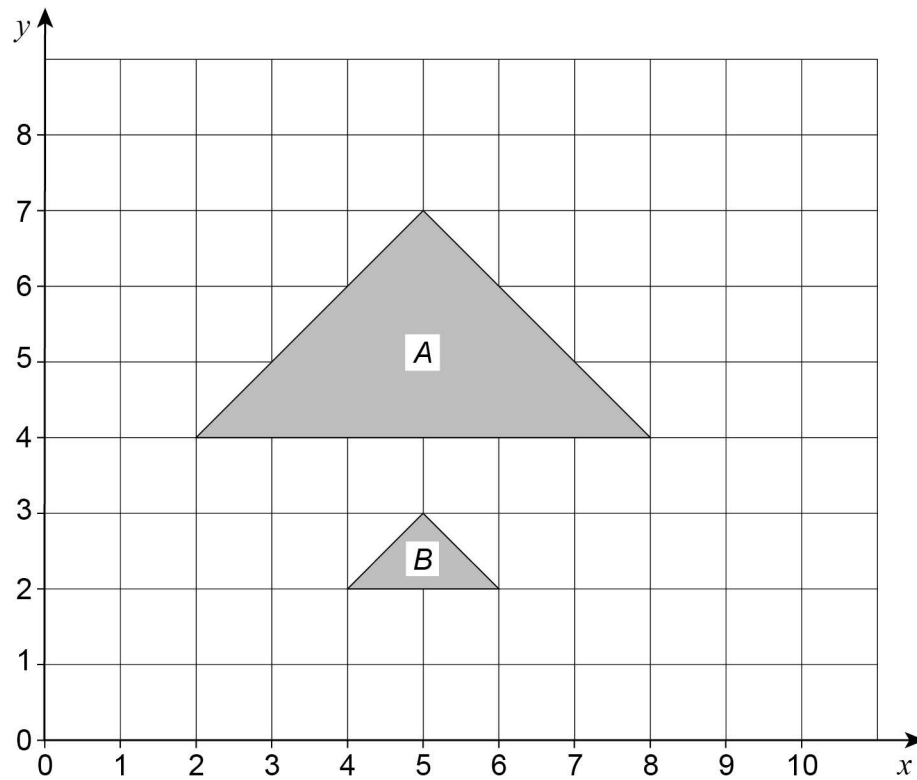
Answer 1.6 cm

Turn over for the next question

Turn over ►



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



[3 marks]

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



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

Distance, x (miles)	Frequency	Midpoint	$f \times x$
$0 < x \leq 5$	20	2.5	50
$5 < x \leq 10$	48	7.5	360
$10 < x \leq 15$	30	12.5	375
$15 < x \leq 20$	22	17.5	385
	Total = 120		1170

Work out an estimate for the mean distance.

[3 marks]

$$\Sigma fx = 50 + 360 + 375 + 385 = 1170$$

$$\text{Mean} = 1170 \div 120$$

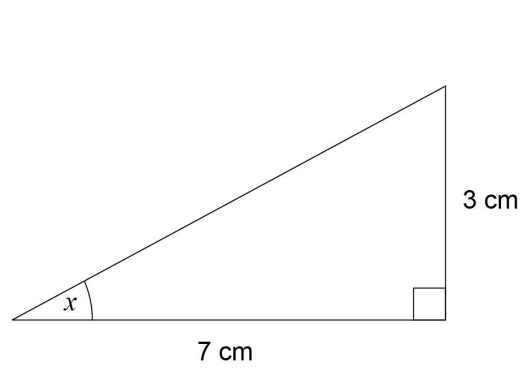
$$= 9.75$$

Answer 9.75 miles

Turn over for the next question



9

Work out the size of angle x .**[2 marks]**

$$\tan x = \frac{3}{7}$$

$$x = \tan^{-1} \frac{3}{7}$$

$$x = 23.198\dots$$

Answer 23.2 degrees

- 10 Work out the next term of this quadratic sequence.

[2 marks]

$$\begin{array}{ccccccc}
 5 & & 8 & & 14 & & 23 & & \dots\dots \\
 & +3 & & +6 & & +9 & & +12 & \\
 & & +3 & & +3 & & +3 & &
 \end{array}$$

$$23 + 12 = 35$$

Answer 35

- 11 Circle the expression that is equivalent to

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

[1 mark]

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

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

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

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

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
Germany	82 000 000	140 000

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

Compare the population densities of the UK and Germany.

[3 marks]

$$\text{UK: } 64\,000\,000 \div 95\,000 = 673.68... \text{ people per square mile}$$

$$\text{Germany: } 82\,000\,000 \div 140\,000 = 585.71... \text{ people per square mile}$$

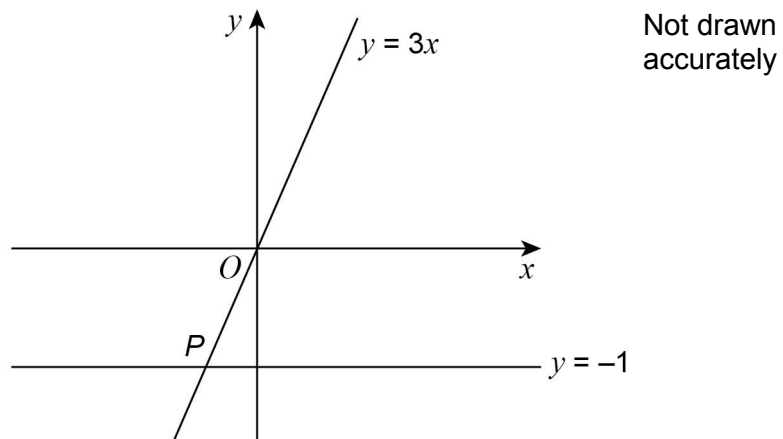
$$\text{UK} \approx 674 \text{ and Germany} \approx 586$$

$$674 > 586, \text{ so the UK has the greater population density}$$

$$(\text{about } 88 \text{ more people per square mile than Germany})$$



- 13 Two straight lines intersect at point P .



Circle the coordinates of P .

[1 mark]

$(-3, -1)$

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

$(-1, -3)$

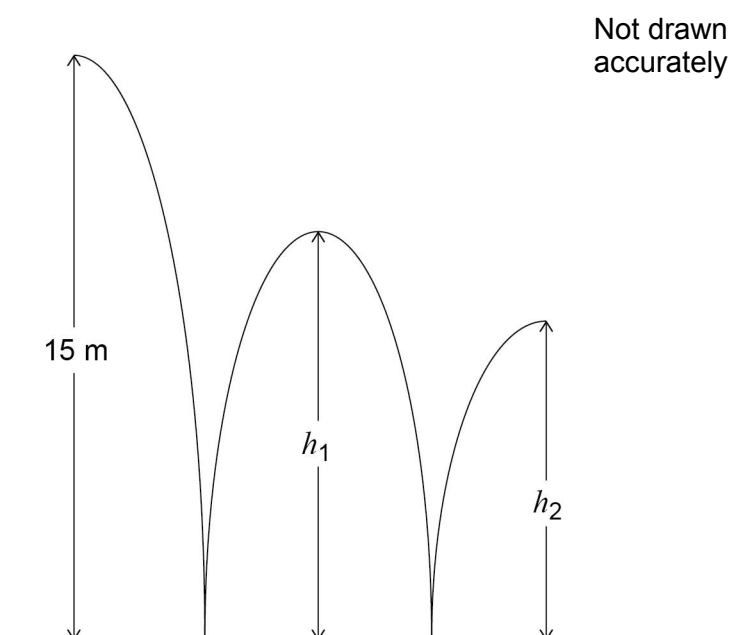
$\left(-\frac{1}{3}, -1\right)$

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]

$$h_1 = \frac{3}{4} \times 15 = 11.25 \text{ m}$$

$$h_2 = \frac{3}{4} \times 11.25$$

$$= 8.4375 \text{ m}$$

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]

$$h_2 = \frac{2}{3} \times 11.25 = 7.5 \text{ m}$$

$$7.5 \text{ m} < 8.4375 \text{ m}$$

so the ball bounced lower than he expected

Turn over for the next question

Turn over ►



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]

$$\text{Multiplier} = 1 + 1.5 \div 100 = 1.015$$

$$\text{Need more than } 6000 + 1000 = \text{£}7000$$

$$6000 \times 1.015^{10} = 6963.24... \text{ (interest £}963.24\text{)}$$

$$6000 \times 1.015^{11} = 7067.69... \text{ (interest £}1067.69\text{)}$$

$$\text{£}963.24 < \text{£}1000 \text{ after 10 years}$$

$$\text{£}1067.69 > \text{£}1000 \text{ after 11 years}$$

Answer 11 years



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

[2 marks]

HCF of $9y^3$ and $6y$ is $3y$

$$9y^3 - 6y = 3y(3y^2 - 2)$$

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

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

[2 marks]

$$3 \times 7 = 21; -21 \text{ and } -1 \quad 3x^2 - 21x - x + 7$$

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

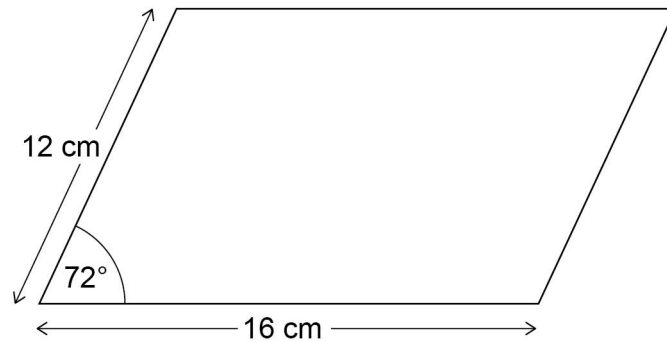
Answer $(3x - 1)(x - 7)$

Turn over for the next question



17

Work out the area of the parallelogram.

Not drawn
accurately

[3 marks]

$$\text{Perpendicular height } h = 12 \times \sin 72^\circ$$

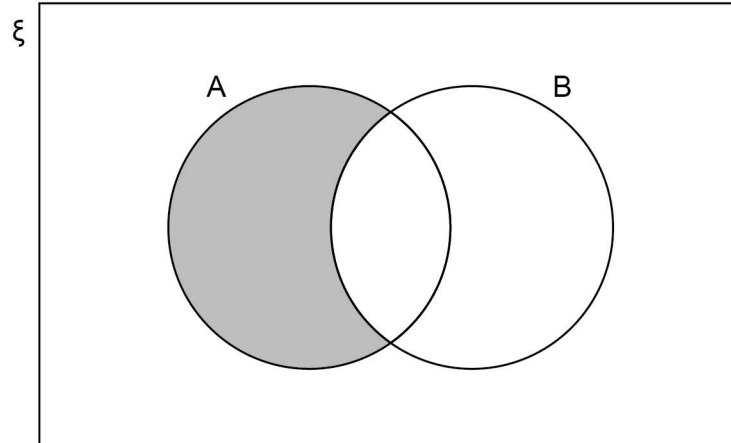
$$h = 11.4126...$$

$$\text{Area} = \text{base} \times \text{height} = 16 \times 11.4126...$$

$$= 182.6029...$$

Answer 182.6 cm²

18 (a)



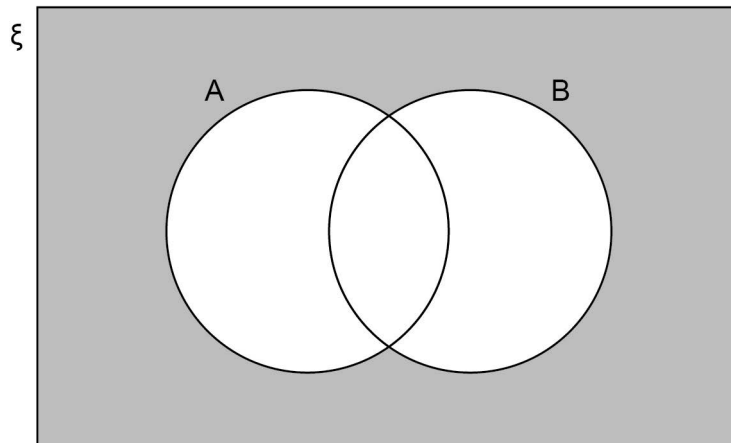
Which of these represents the shaded region?
Circle your answer.

[1 mark]

A

 B' $A \cap B'$ $A \cup B'$

18 (b)



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

[1 mark]

 $(A \cup B)'$ $(A \cap B)'$ $A' \cap B$ $A' \cup B'$ 

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]

$$\text{Width} = w, \text{ length} = 5w$$

$$5w \times w = 1620$$

$$w^2 = 1620 \div 5 = 324$$

$$w = \sqrt{324} = 18$$

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]

$$h = kv^2$$

$$5 = k \times 10^2$$

$$k = 5 \div 100 = 0.05$$

$$h = 0.05v^2$$

$$\text{When } v = 24: h = 0.05 \times 24^2$$

$$= 0.05 \times 576 = 28.8$$

Answer 28.8 m

Turn over for the next question

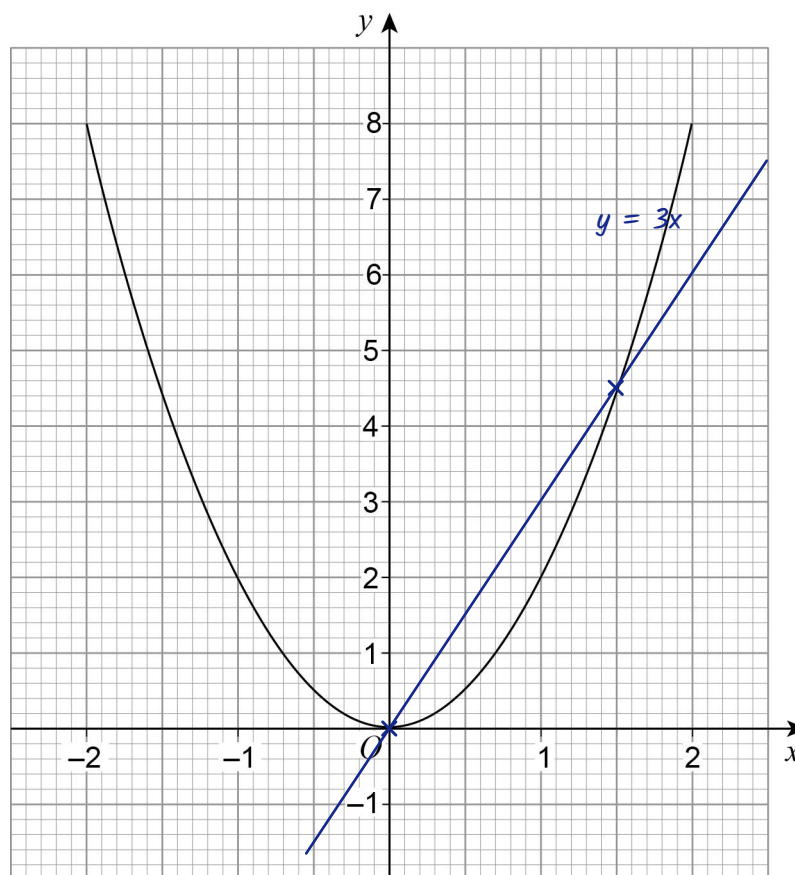
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21 (a) Meera is using a **graphical** method to solve $2x^2 - 3x = 0$

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]

$$2x^2 - 3x = 0 \text{ so } 2x^2 = 3x$$

Draw the straight line $y = 3x$ on the grid

Solutions are where $y = 3x$ crosses $y = 2x^2$

This happens at $x = 0$ and $x = 1.5$

Answer $x = 0$ or $x = 1.5$



- 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]

His method is wrong: he divided both sides by x ,

but x could be 0 and you cannot divide by zero, so he lost a solution.

He should factorise: $x(2x + 5) = 0$

so $x = 0$ or $x = -2.5$

His answer $x = -2.5$ is only one of the two solutions ($x = 0$ is missing).

Turn over for the next question

Turn over ►

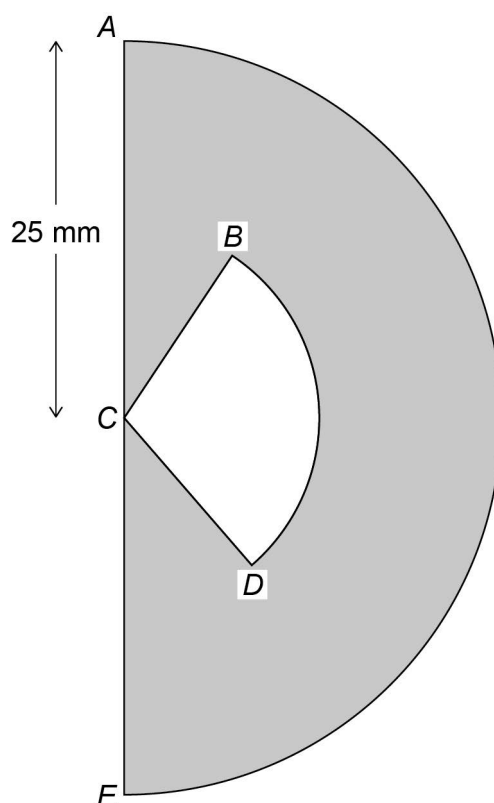


22

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

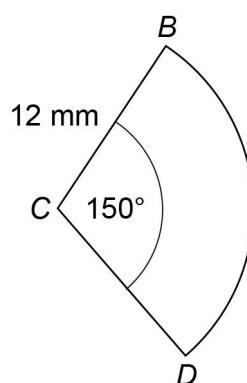
The earring is black and white.

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]

$$\text{Area of semicircle} = \frac{1}{2} \times \pi \times 25^2$$

$$= 312.5\pi = 981.747... \text{ mm}^2$$

$$\text{Area of sector BCD} = \frac{150}{360} \times \pi \times 12^2$$

$$= 60\pi = 188.495... \text{ mm}^2$$

$$\text{Percentage white} = 188.495... \div 981.747... \times 100$$

$$= 19.2\%$$

$$19.2\% < 20\%$$

So less than 20% of the semicircle is white

Answer No (19.2%)

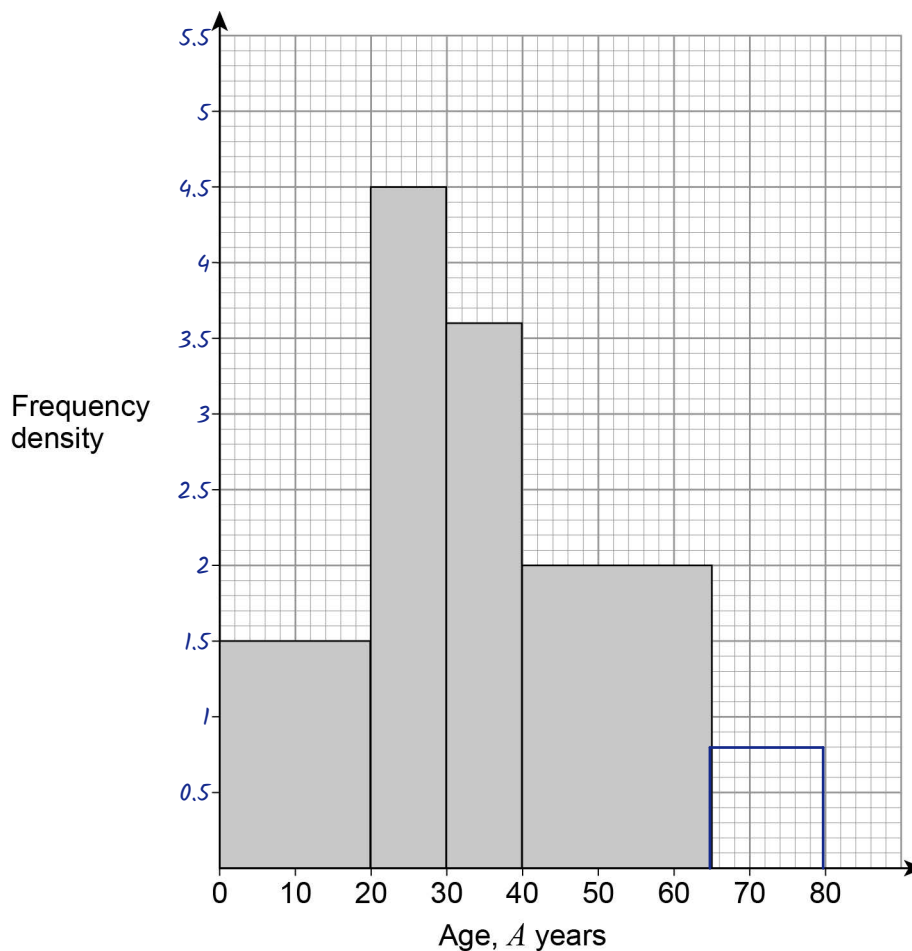
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23

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]

$0 \leq A < 20$: frequency density = $30 \div 20 = 1.5$ (15 small squares)

so 1 small square = 0.1

$65 \leq A < 80$: frequency density = $12 \div 15 = 0.8$

Bar from 65 to 80 with height 0.8 (8 small squares)



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

[2 marks]

$$20 \text{ to } 30: 4.5 \times 10 = 45 \quad 30 \text{ to } 40: 3.6 \times 10 = 36$$

$$40 \text{ to } 65: 2 \times 25 = 50$$

$$\text{Total} = 30 + 45 + 36 + 50 + 12$$

$$= 173$$

Answer 173

Turn over for the next question

Turn over ►



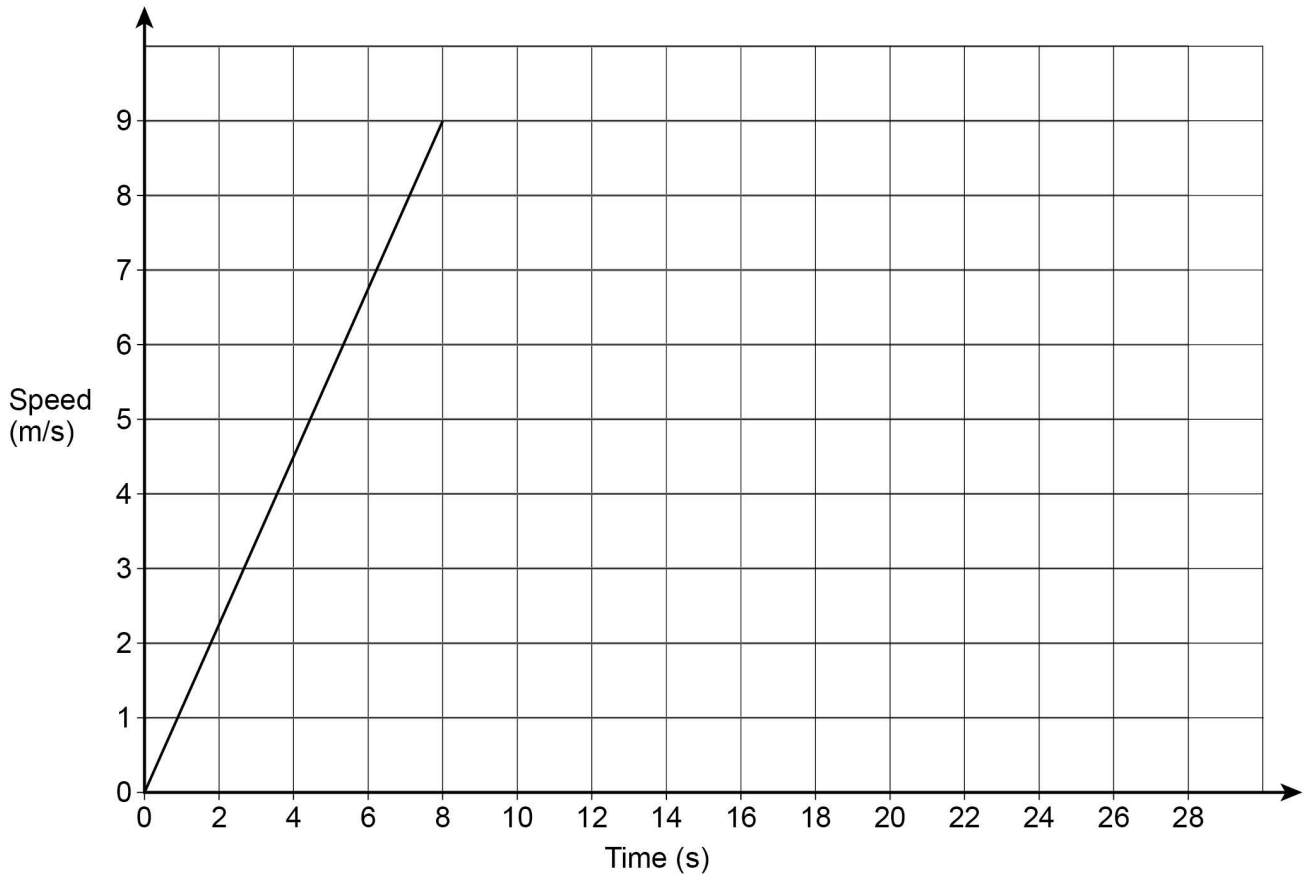
24

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]

$$\text{Distance in first 8 s} = \text{area under graph} = \frac{1}{2} \times 8 \times 9 = 36 \text{ m}$$

$$\text{Distance left} = 200 - 36 = 164 \text{ m}$$

$$\text{Time for the rest} = 164 \div 9 = 18.22... \text{ s}$$

$$\text{Total time} = 8 + 18.22... = 26.22... \text{ s}$$

$$26.2 \text{ s} < 27 \text{ s}$$

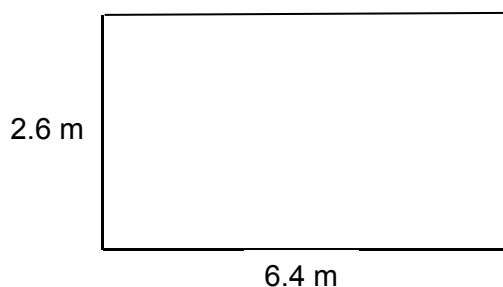
So Beth finished before Amy

Answer Yes (26.2 s)



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]

$$\text{Force: upper bound} = 347.5 \text{ N}$$

$$\text{Length: lower bound} = 6.35 \text{ m} \quad \text{Width: lower bound} = 2.55 \text{ m}$$

$$\text{Least area} = 6.35 \times 2.55 = 16.1925 \text{ m}^2$$

$$\text{Upper bound of pressure} = \text{greatest force} \div \text{least area}$$

$$= 347.5 \div 16.1925$$

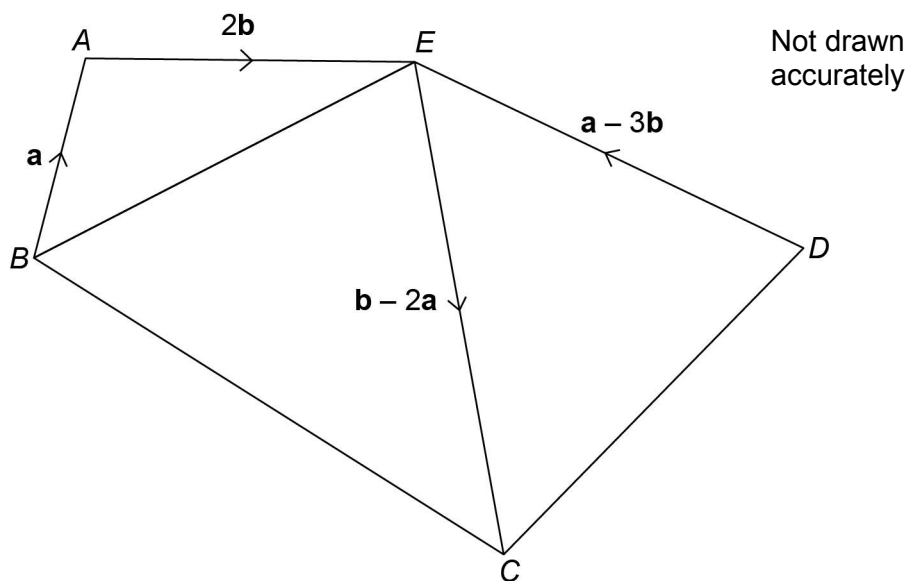
$$= 21.4605\dots$$

$$= 21.46 \text{ (4 s.f.)}$$

Answer 21.46 N/m²



26

 $ABCDE$ is a pentagon.Show that $BCDE$ is a parallelogram.**[3 marks]**

$$\vec{CB} = \vec{CE} + \vec{EA} + \vec{AB}$$

$$= -(b - 2a) - 2b - a$$

$$= -b + 2a - 2b - a = a - 3b$$

$$\vec{DE} = a - 3b \text{ (given)}$$

So $\vec{CB} = \vec{DE}$: CB is equal in length and parallel to DE

$BCDE$ has a pair of opposite sides that are equal and parallel,

so $BCDE$ is a parallelogram.



27

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

Give your solutions to 2 decimal places.

You **must** show your working.**[6 marks]***Multiply every term by $4(x+2)$:*

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

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

$$x^2 - 6x - 4x - 8 = 0$$

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

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

$$x = \frac{10 \pm \sqrt{32}}{2} = 5 \pm \sqrt{8}$$

$$x = 10.7445... \quad \text{or} \quad x = -0.7445...$$

$$x = 10.74 \quad \text{or} \quad x = -0.74$$

Answer $x = 10.74 \quad \text{or} \quad x = -0.74$ **END OF QUESTIONS**

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