

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

GCSE MATHEMATICS

H

Higher Tier

Paper 2 Calculator

Monday 6 November 2017

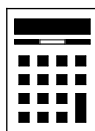
Morning

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	



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%

$$\frac{50}{20} = \frac{5}{2} = 250\%$$

- 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)

$$\left(\frac{1}{3}\right)^3 = \frac{1}{27} \neq \frac{1}{9}$$



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

Circle your answer.

kg/m²

m²/kg

kg/m³

m³/kg

[1 mark]

mass
vol

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

[3 marks]

$$12x - 8 = 2x - 5 \quad (\text{expand})$$

$$10x = 3 \quad (-2x, +8)$$

$$x = \frac{3}{10} \quad (\div 10)$$

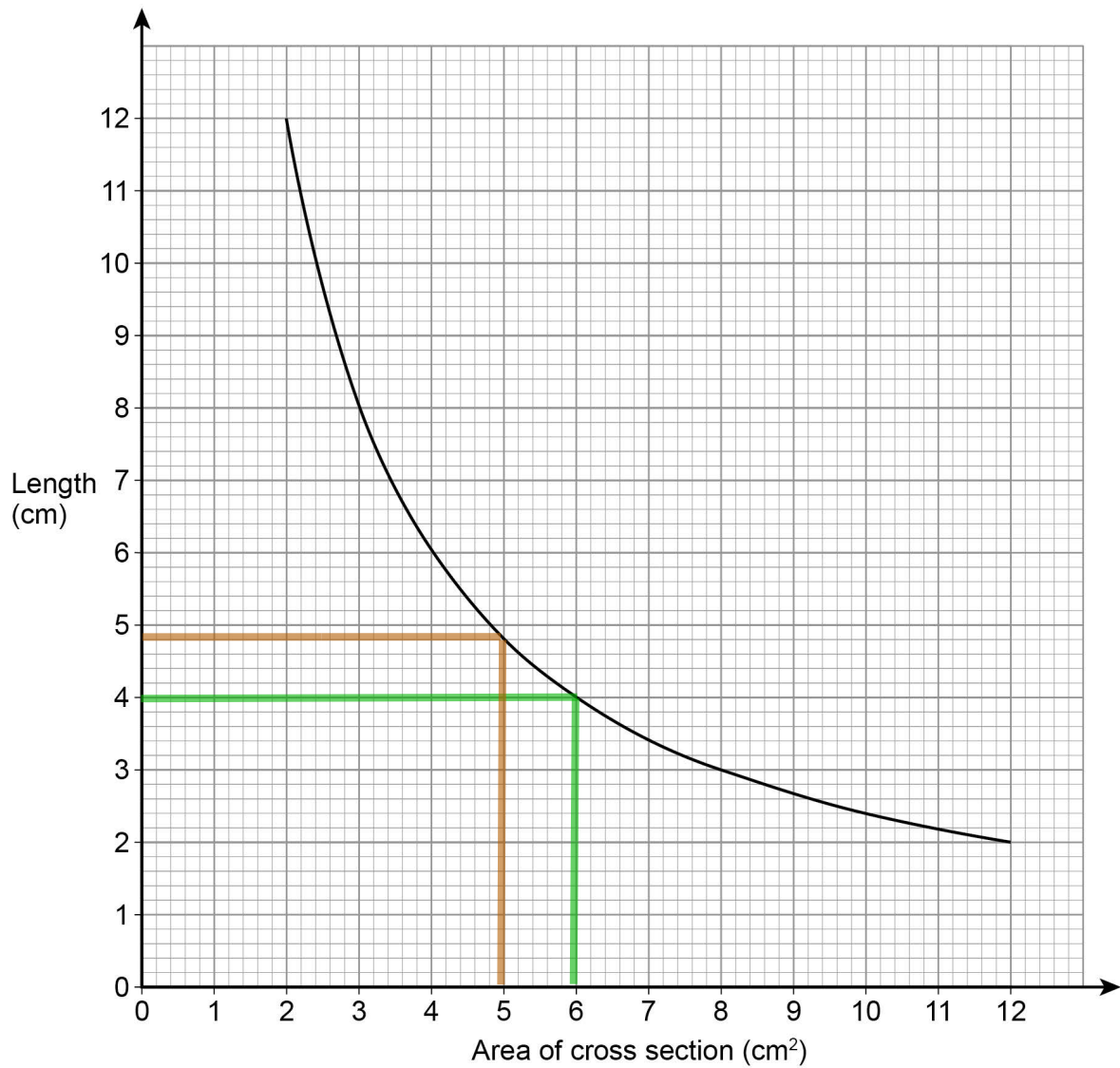
$$x = \frac{3}{10}$$

Turn over for the next question

Turn over ►



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



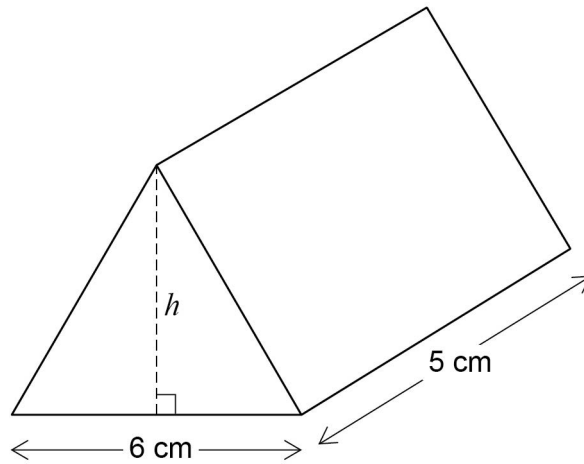
- 6 (a) Give **one** example to show the volume is 24 cm³

[1 mark]

$$6 \times 4 = 24 \text{ cm}^3$$



- 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]

$$5 \text{ cm} \Rightarrow \text{CSA} = 4.8 \text{ cm}^2 \text{ (graph)}$$

$$\frac{1}{2} \times 6 \times h = 4.8 \quad 3h = 4.8 \quad (6 \times \frac{1}{2})$$

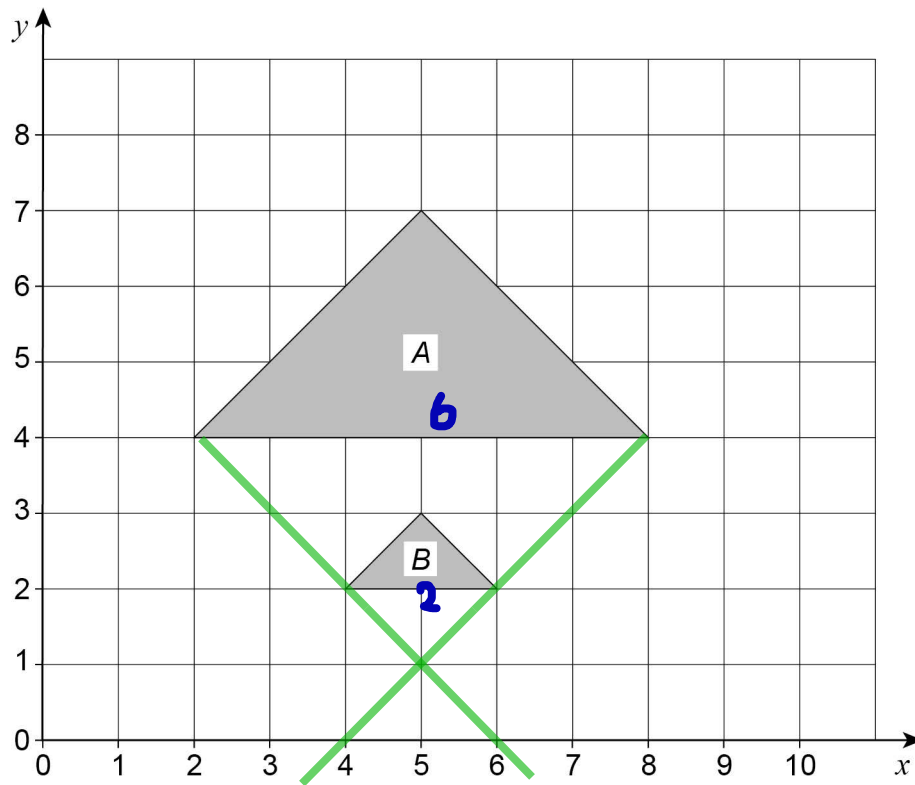
$$h = 1.6 \quad (\div 3)$$

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 sf $\frac{1}{3}$ centre (5,1)

$\frac{2}{6}$



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

Distance, x (miles)	Frequency	mid	mid \times f
$0 < x \leq 5$	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	Total	1170

Work out an estimate for the mean distance.

[3 marks]

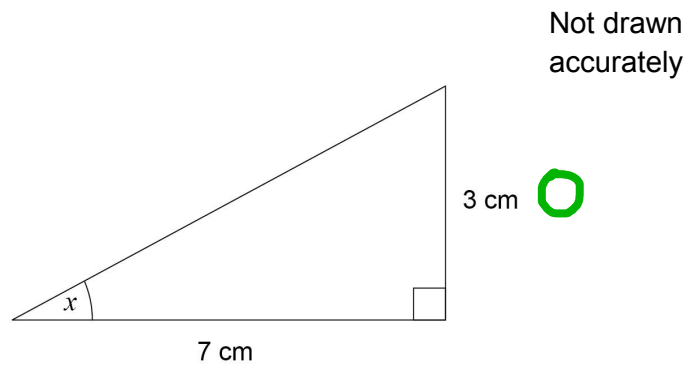
$$\frac{\text{Total est distance}}{\text{total freq}} = \frac{1170}{120} = 9.75$$

Answer 9.75 miles

Turn over for the next question



9

Work out the size of angle x .

[2 marks]

SOH CAH **TOA**

A

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

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

Answer 23.2 degrees



10 Work out the next term of this quadratic sequence.

[2 marks]

$$5 \xrightarrow{+3} 8 \xrightarrow{+6} 14 \xrightarrow{+9} 23 \xrightarrow{+12} 35 \dots$$

Answer 35

11 Circle the expression that is equivalent to

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

[1 mark]

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

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

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

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

($\div 3$)

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
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]

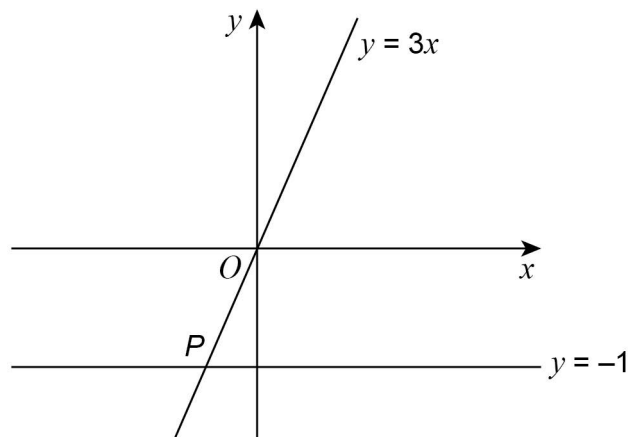
$$\text{UK pd} = \frac{64\,000\,000}{95\,000} \approx 673$$

$$\text{Germany} = \frac{82\,000\,000}{140\,000} \approx 585$$

Greater popⁿ density for UK



- 13 Two straight lines intersect at point P .



Not drawn
accurately

Circle the coordinates of P .

$(-3, -1)$

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

$(-1, -3)$

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

[1 mark]

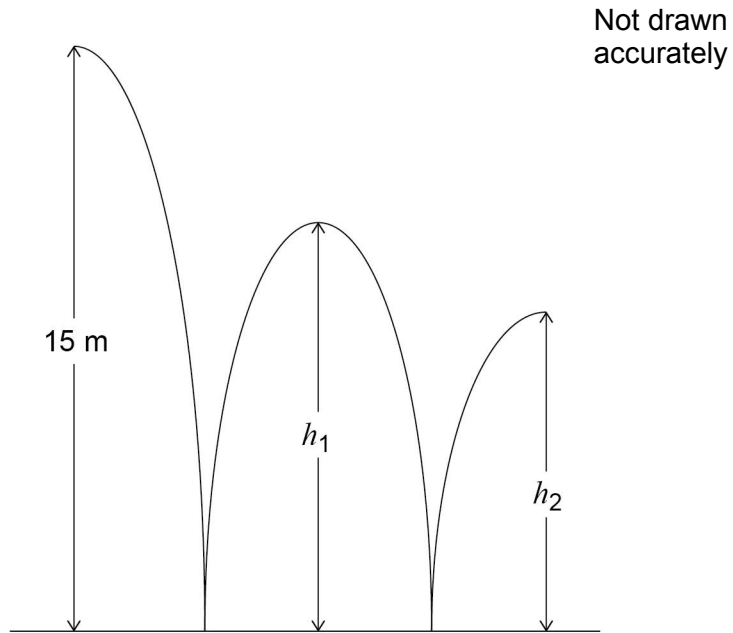
$$y = -1, -1 = 3x \text{ so } x = -\frac{1}{3}$$

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]

$$15 \times \frac{3}{4} \times \frac{3}{4} = 8.4375 \approx 8.4 \text{ m}$$

Answer 8.4 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]

$$15 \times \frac{3}{4} \times \frac{2}{3} = 7.5 \quad \text{lower than} \\ 8.4\text{m in } \textcircled{14a}$$

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]

$$100\% + 1.5\% = 101.5\% \equiv 1.015$$

$$6000 \times 1.015^n > 7000 \leftarrow + £1000$$

$$n=10 \quad 6000 \times 1.015^{10} = 6963\dots$$

$$n=11 \quad 6000 \times 1.015^{11} = 7067\dots$$

so 11 whole years

Answer 11 years



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

[2 marks]

$$3(3y^3 - 2y) \quad (\text{fact } 3)$$

$$3y(3y^2 - 2) \quad (\text{fact } y)$$

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

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

[2 marks]

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

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

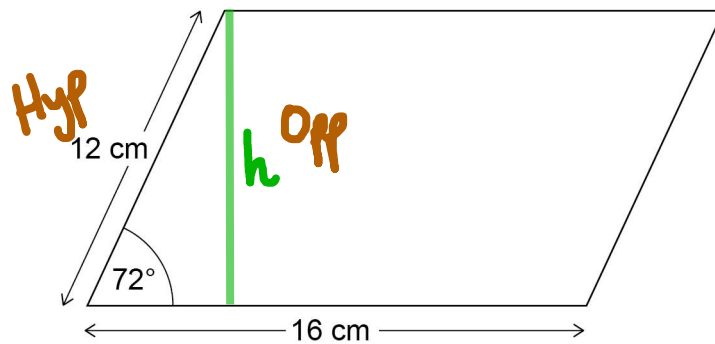
Turn over for the next question

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17

Work out the area of the parallelogram.

Not drawn
accurately

[3 marks]

SO
SH

CA
CH

TA
TA

$$\sin 72 = \frac{h}{12} \quad h = 12 \sin 72$$

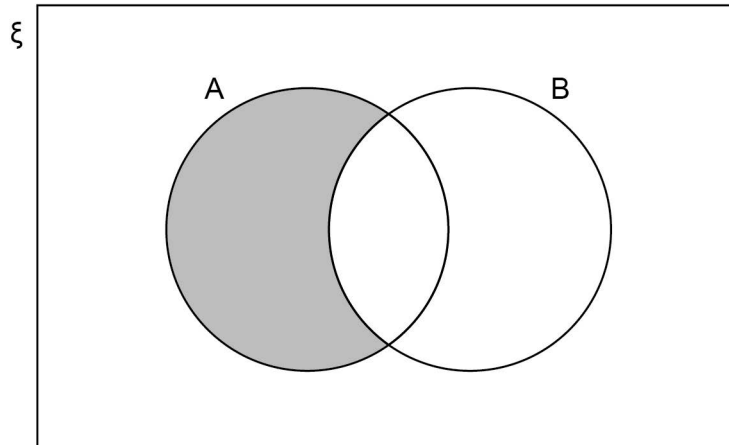
$$h \approx 11.4$$

$$\text{Area} = 16 \times 11.4 = 182.4$$

Answer 182.4 cm²



18 (a)



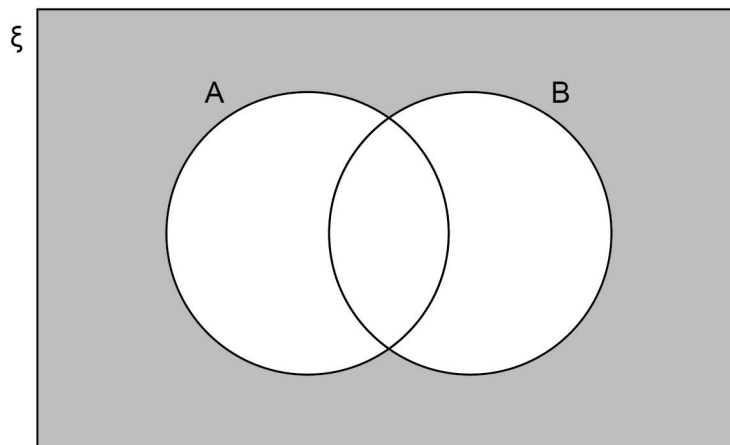
Which of these represents the shaded region?
Circle your answer.

[1 mark]

A

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

18 (b)



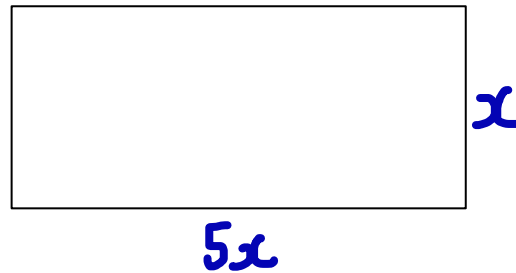
Which of these represents the shaded region?
Circle your answer.

[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]

$$5x \times x = 1620$$

$$5x^2 = 1620$$

$$x^2 = 324 \quad (\div 5)$$

$$x = 18 \quad (\sqrt{\quad})$$

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]

$$h \propto v^2 \Rightarrow h = kv^2$$

$$5 = 100k \quad (10^2)$$

$$k = \frac{5}{100} = 0.05 \quad (\div 100)$$

$$h = 0.05v^2 \quad \text{so} \quad h = 0.05(24)^2$$

$$h = 28.8$$

Answer 28.8 m

Turn over for the next question

Turn over ►



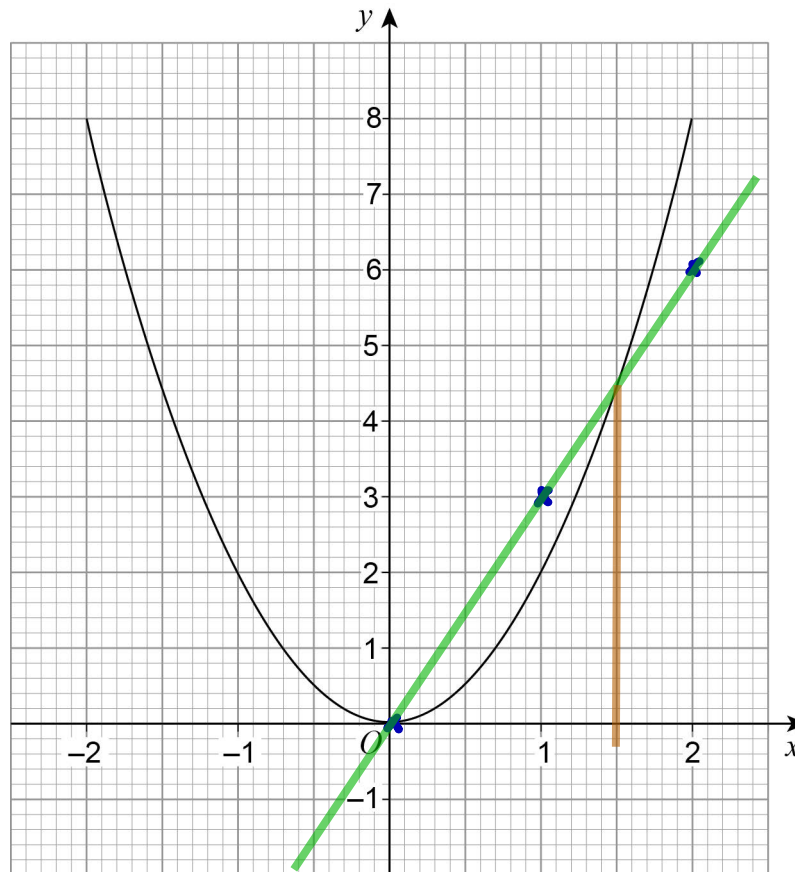
21 (a) Meera is using a **graphical** method to solve $2x^2 - 3x = 0$

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

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

$y = 3x$

x	y
0	0
1	3
2	6



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

[2 marks]

Answer $x = 0, 1.5$



21 (b) Levi is solving $2x^2 + 5x = 0$

He uses this method.

① $2x^2 + 5x = 0$ subtract $5x$ from both sides

② $2x^2 = -5x$ divide both sides by x

$2x = -5$ divide both sides by 2

$x = -2.5$

Evaluate his method and his answer.

[2 marks]

Should factorise at ①

Cannot divide by x - it could be zero ②

$x(2x+5)=0$ so $x=0$, $x=-\frac{5}{2}$
 x was omitted

Turn over for the next question

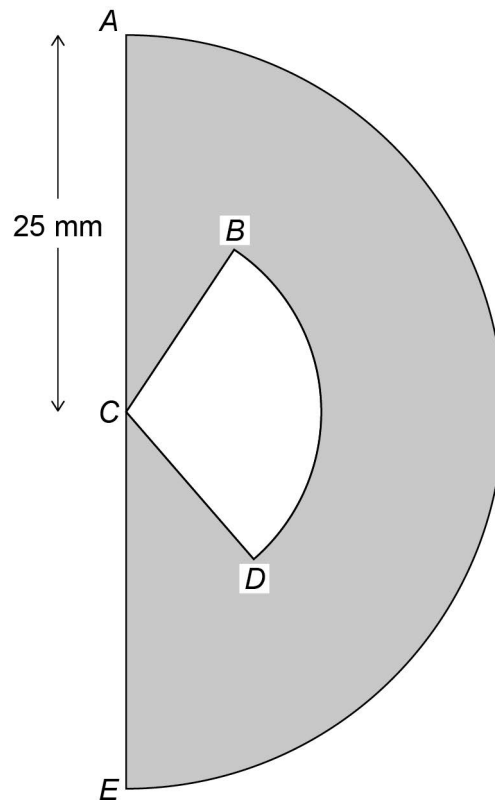


22

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

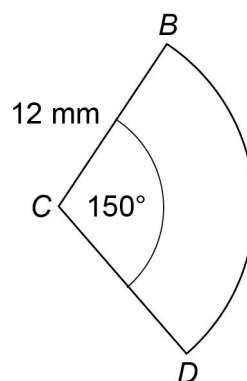
The earring is black and white.

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]

$$\text{Shaded area: } \frac{1}{2} \pi r^2$$

$$\frac{1}{2} (25)^2 \pi$$

$$312.5\pi \approx 981.7$$

$$\text{Sector area: } \frac{150}{360} \times \pi (12^2)$$

$$60\pi \approx 188.5$$

$$\% : \frac{188.5}{981.7} \times 100 \approx 19.2\%$$

No not more than
20%.

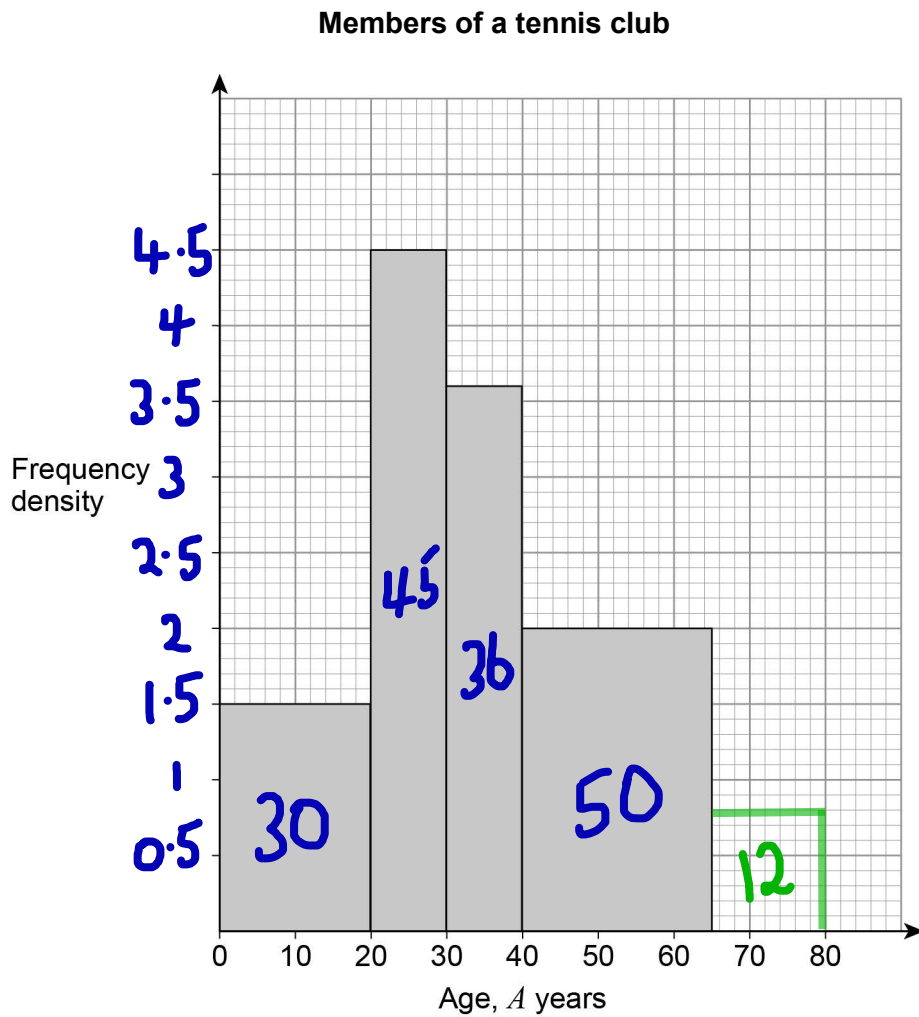
Answer No

Turn over for the next question



23

Here is some information about 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]

$$12 \div 15 = 0.8$$



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

[2 marks]

See histogram, width \times fd = freq

$$30 + 45 + 36 + 50 + 12 = 173$$

Answer 173

Turn over for the next question

Turn over ►



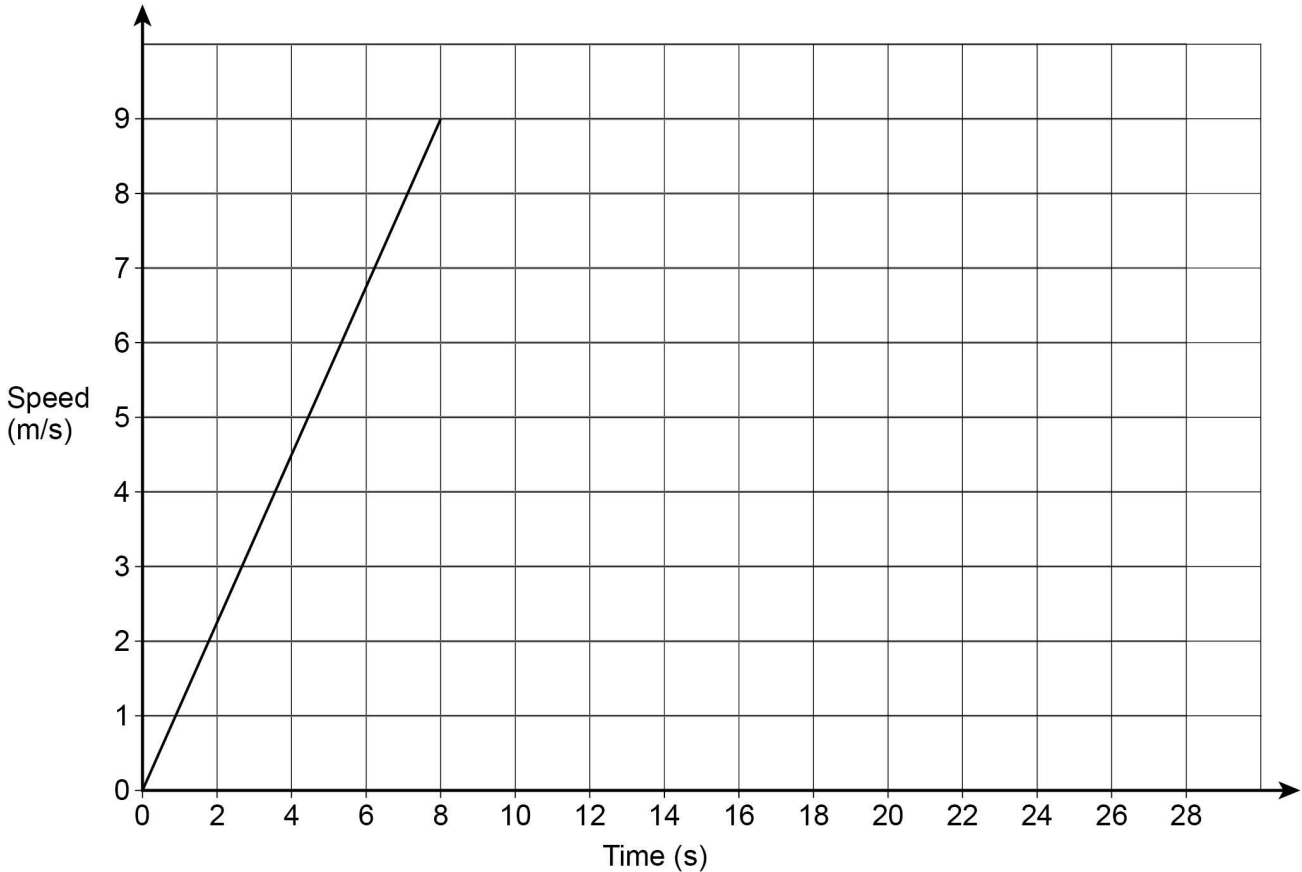
24

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]

$$\begin{aligned} \text{Distance} &= \text{area under curve} \\ &= \frac{1}{2} \times 9 \times 8 = 36 \end{aligned}$$

$$200 - 36 = 164 \text{ m remain}$$

$$t = \frac{D}{S} = \frac{164}{9} = 18.2$$

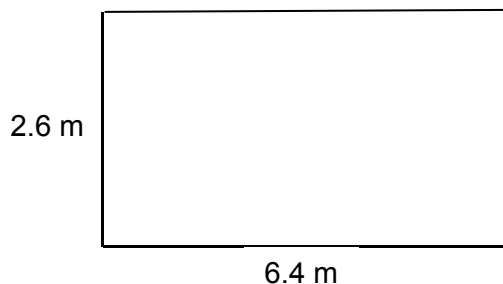
$$\begin{aligned} &18.2 + 8 \\ &= 26.2 \end{aligned}$$

Answer

Yes Beth finishes
first

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]

$$342.5 \leq 345 < 347.5$$

$$2.55 \leq 2.6 < 2.65$$

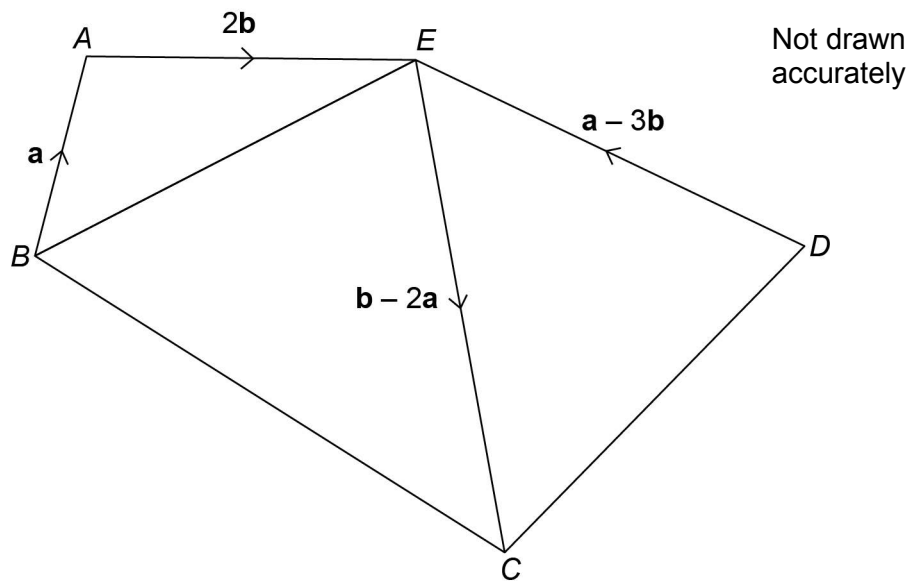
$$6.35 \leq 6.4 < 6.45$$

$$P_{\text{upper}} = \frac{F_{\text{upper}}}{A_{\text{low}}} = \frac{347.5}{2.55 \times 6.35} = 21.46$$

Answer 21.46 N/m²



26

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

[3 marks]

$$\vec{CB} = -(\underline{b} - 2\underline{a}) - 2\underline{b} - \underline{a}$$

$$= -3\underline{b} + \underline{a} \quad \text{so } CB \text{ parallel to } ED$$

$$\vec{BE} = \underline{a} + 2\underline{b}$$

$$\vec{CD} = -(\underline{b} - 2\underline{a}) - (\underline{a} - 3\underline{b})$$

$$= 2\underline{b} + \underline{a} \quad \text{so } BE \text{ parallel to } CD$$

$$\Rightarrow \text{parallelogram}$$


27

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

Give your solutions to 2 decimal places.

You **must** show your working.

[6 marks]

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

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

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

$$\frac{-(-10) \pm \sqrt{(-10)^2 - 4 \times 1 \times -8}}{2 \times 1} = \frac{10 \pm \sqrt{132}}{2}$$

$$x = 5 \pm \sqrt{132}$$

$$x = 10.74, -0.74 \text{ (2dp)}$$

Answer 10.74, -0.74

END OF QUESTIONS



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