



Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

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Forename(s)

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Candidate signature

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# GCSE

# Model Solutions

# MATHEMATICS

# H

Higher Tier

Paper 2 Calculator

Monday 6 November 2017

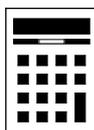
Morning

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	
<b>TOTAL</b>	



N 0 V 1 7 8 3 0 0 2 H 0 1

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.

$$\frac{50}{20} \times 100 = 2.5 \times 100 = 250\%$$

[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)

$$x = \frac{1}{3}, y = \left(\frac{1}{3}\right)^3 = \frac{1}{27}$$

$$\left(\frac{1}{3}, \frac{1}{27}\right)$$

so the point  $\left(\frac{1}{3}, \frac{1}{9}\right)$  does not lie on the line.



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

Circle your answer.

$$\text{density} = \frac{\text{mass}}{\text{volume}} = \frac{\text{kg}}{\text{m}^3} \text{ so } \text{kg/m}^3$$

[1 mark]

$\text{kg/m}^2$

$\text{m}^2/\text{kg}$

$\text{kg/m}^3$

$\text{m}^3/\text{kg}$

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

[3 marks]

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

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

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

$$10x = 3$$

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

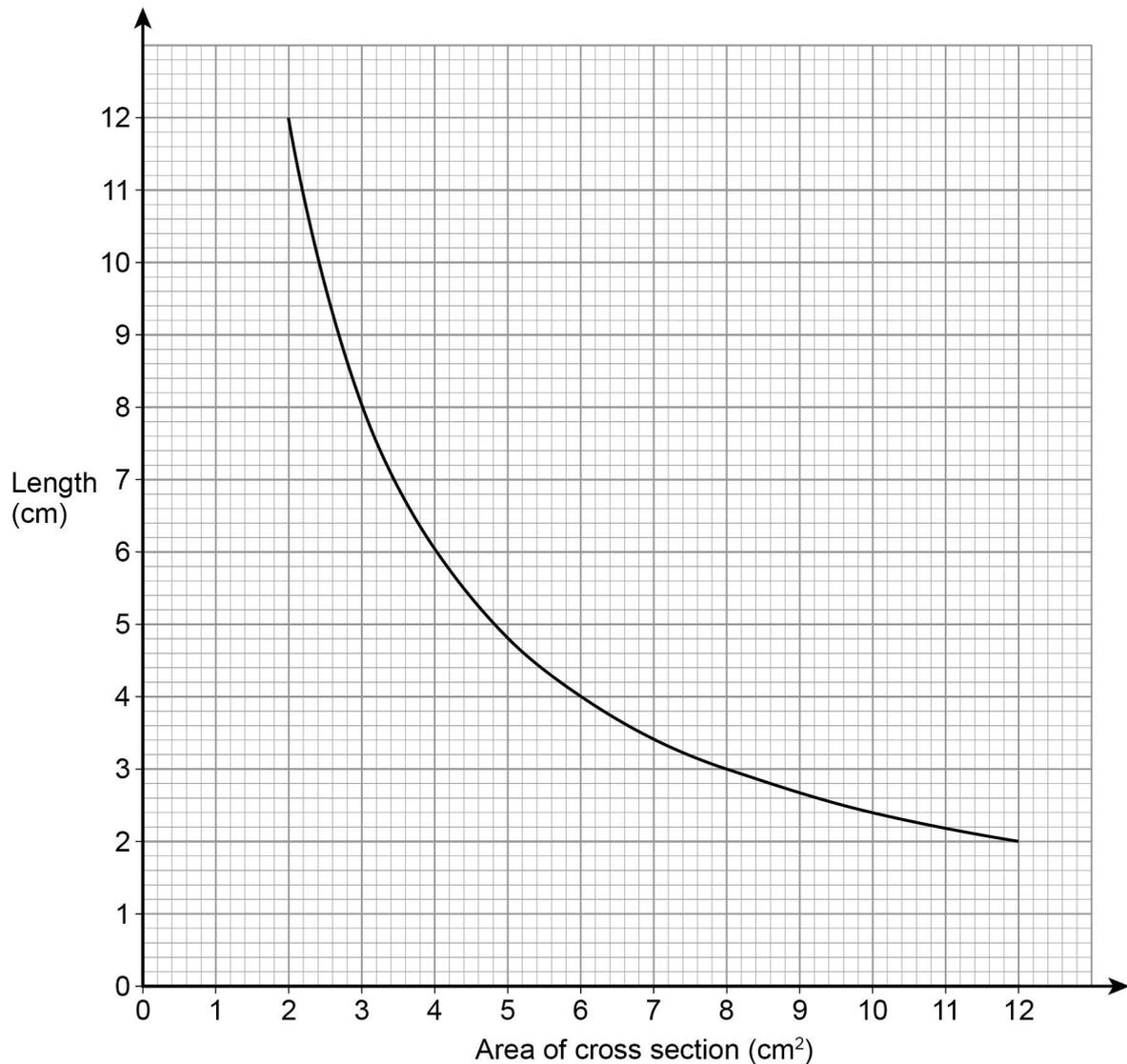
$$x = \frac{3}{10}$$

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  $24 \text{ cm}^3$

[1 mark]

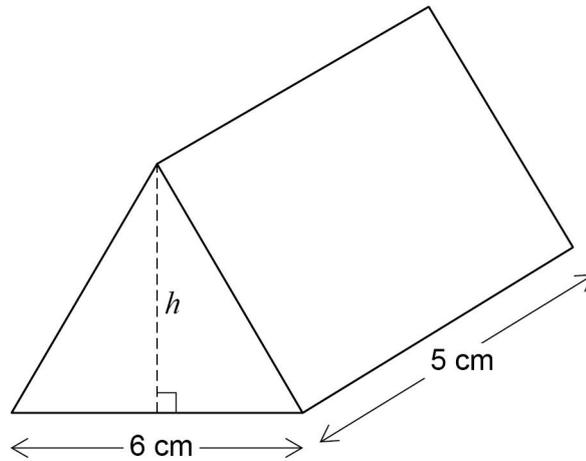
$$\text{Volume} = \text{length} \times \text{area}$$

take the point (2, 12)

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



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



Work out the height,  $h$ .

Volume of prism = area of triangle  $\times$  length

[3 marks]

$$\text{area of triangle} = \frac{6 \times h}{2} = 3h$$

$$\text{volume : } 24 = 3h \times 5$$

$$\frac{24}{3 \times 5} = h$$

$$h = 1.6 \text{ cm}$$

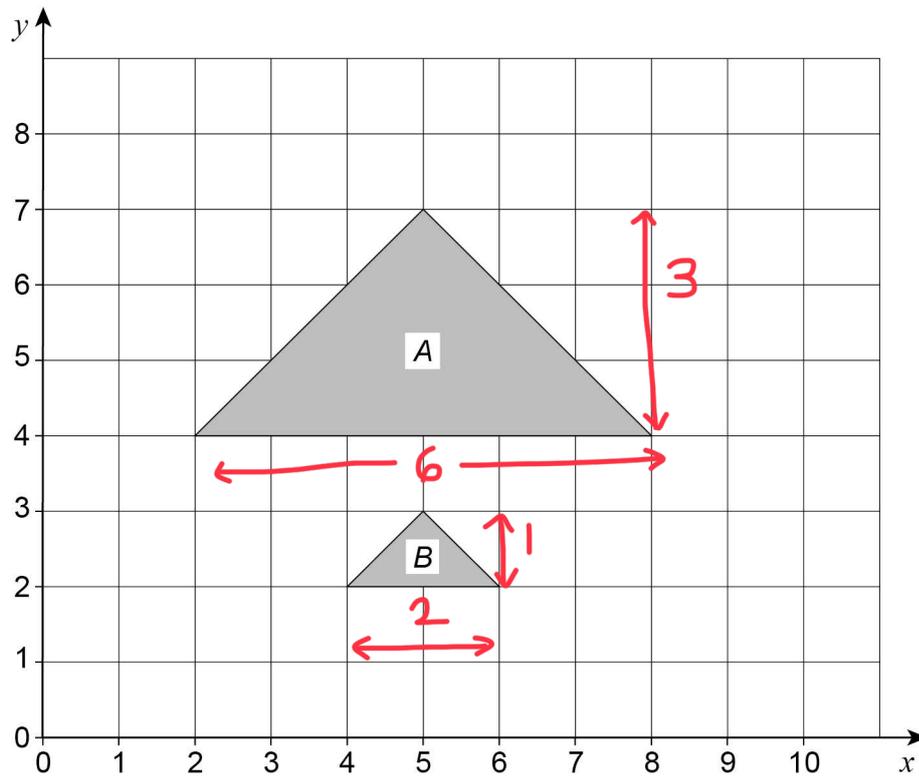
Answer

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)



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

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

Work out an estimate for the mean distance.

[3 marks]

total distance :

$$50 + 360 + 375 + 385 = 1170$$

$$\text{mean} = \frac{1170}{120} = 9.75 \text{ miles}$$

Answer 9.75 miles

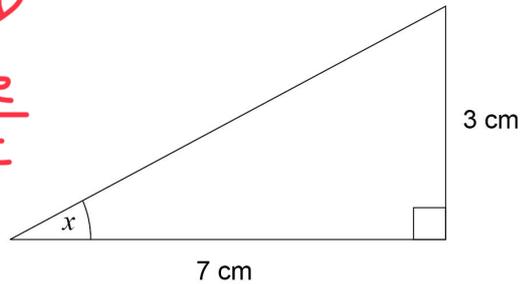
Turn over for the next question



9 Work out the size of angle  $x$ .

SOH CAH(TOA)

$$\tan x = \frac{\text{opposite}}{\text{adjacent}}$$



[2 marks]

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

$$x = \tan^{-1}\left(\frac{3}{7}\right) = 23.2^\circ$$

Answer 23.2 degrees





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.

$$\text{UK population density} = \frac{64\,000\,000}{95\,000} \quad [3 \text{ marks}]$$

$$= 673.7$$

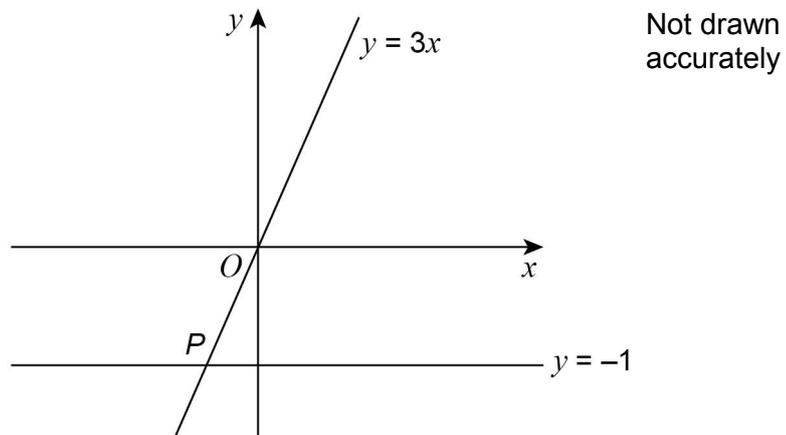
$$\text{Germany population density} = \frac{82\,000\,000}{140\,000}$$

$$= 585.7$$

$673.7 > 585.7$ , so population density is greater in the UK.



- 13 Two straight lines intersect at point  $P$ .



Circle the coordinates of  $P$ .

$$y = 3x = -1$$

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

[1 mark]

$(-3, -1)$

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

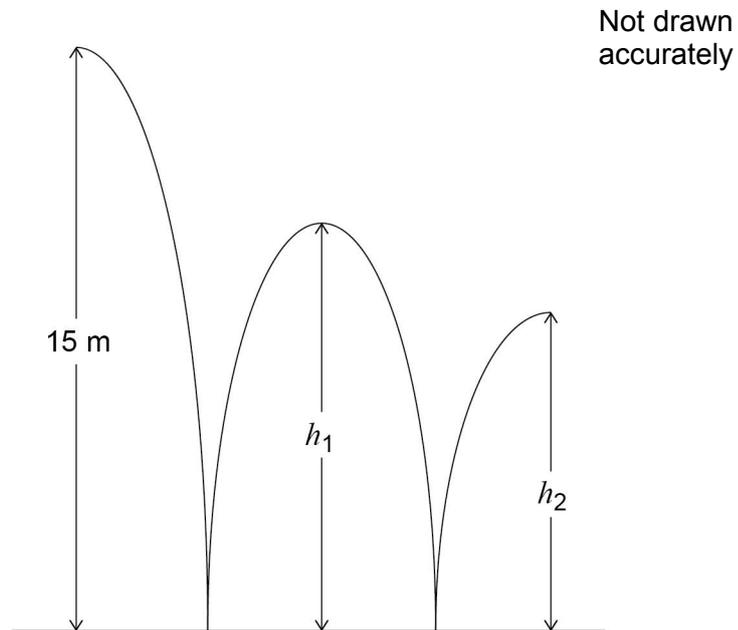
$(-1, -3)$

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

Turn over for the next question



- 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]

$$h_2 = 15 \times \frac{3}{4} \times \frac{3}{4}$$

$$h_2 = 15 \times \frac{9}{16}$$

$$= 8.4375 \text{ m}$$

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]

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

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

$$7.5 < 8.4375$$

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]

Compound interest of 1.5% per year

so multiply by 1.015

$$6000 \times 1.015^n > 7000$$

$$n = 10 \rightarrow 6963.24 < 7000$$

$$n = 11 \rightarrow 7076.69 > 7000$$

so takes 11 years

Answer 11 years



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

[2 marks]

$$9y^3 - 6y$$

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

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

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

[2 marks]

$$3x^2 - 22x + 7$$

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

$$ax^2 + bx + c$$

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

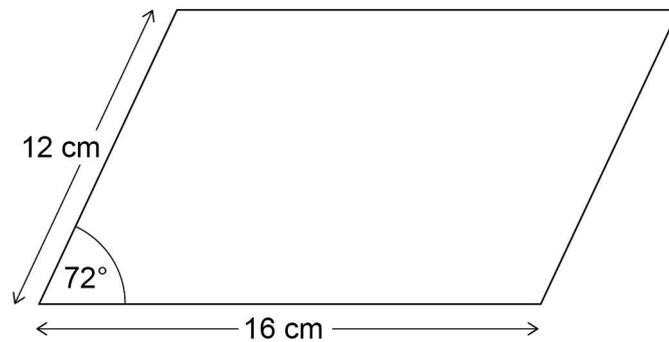
$$\text{check: } 3x^2 - 21x - x + 7 = 3x^2 - 22x + 7$$

Turn over for the next question

Turn over ►



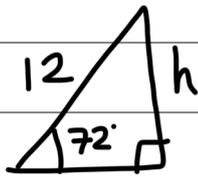
17 Work out the area of the parallelogram.



Not drawn  
accurately

[3 marks]

area of parallelogram = base  $\times$  vertical height



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

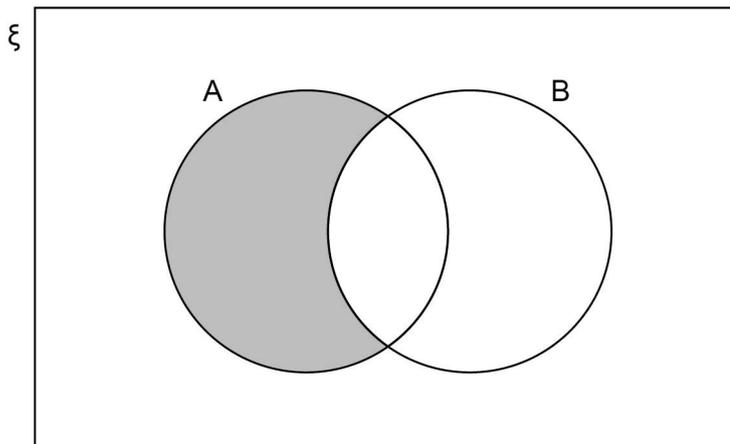
$$h = 12 \sin 72 = 11.4 \text{ cm}$$

$$\text{area} = 11.4 \times 16 = 182.6 \text{ cm}^2$$

Answer 182.6 cm<sup>2</sup>



18 (a)



Which of these represents the shaded region?

Circle your answer.

*shaded area is A and not B.  $\cap$  → and*

[1 mark]

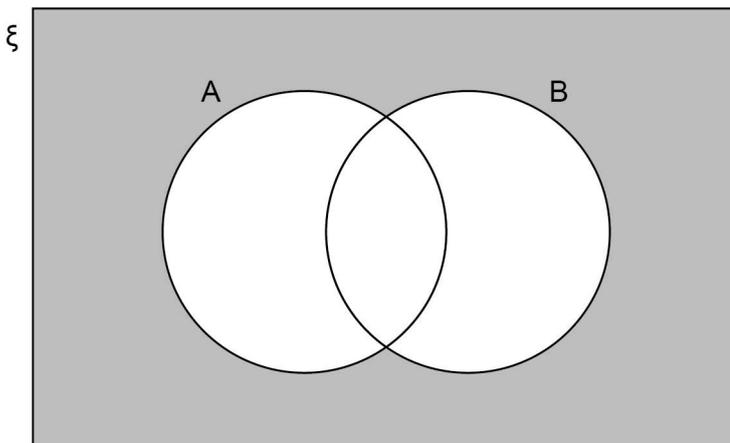
A

B'

$A \cap B'$

$A \cup B'$

18 (b)



Which of these represents the shaded region?

Circle your answer.

*$\cup$  → or shaded area is not (A or B) [1 mark]*

$(A \cup B)'$

$(A \cap B)'$

$A' \cap B'$

$A' \cup B'$

5

Turn over ►



- 19 The length of a rectangle is five times the width.  
The area of the rectangle is  $1620 \text{ cm}^2$

Not drawn  
accurately



Work out the width of the rectangle.

[3 marks]

$$\text{area} = \text{length} \times \text{width}$$

$$1620 = 5w \times w$$

$$1620 = 5w^2$$

$$324 = w^2$$

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

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]

$$h \propto v^2 \text{ and } h = kv^2$$


---


$$\text{when } v = 10, h = 5 \rightarrow 5 = k \times 10^2$$


---


$$\frac{5}{100} = k$$


---


$$k = \frac{1}{20}$$


---


$$\text{So } h = \frac{v^2}{20}$$


---


$$\text{when } v = 24 \rightarrow h = \frac{24^2}{20} = 28.8 \text{ m}$$

Answer 28.8 m

Turn over for the next question

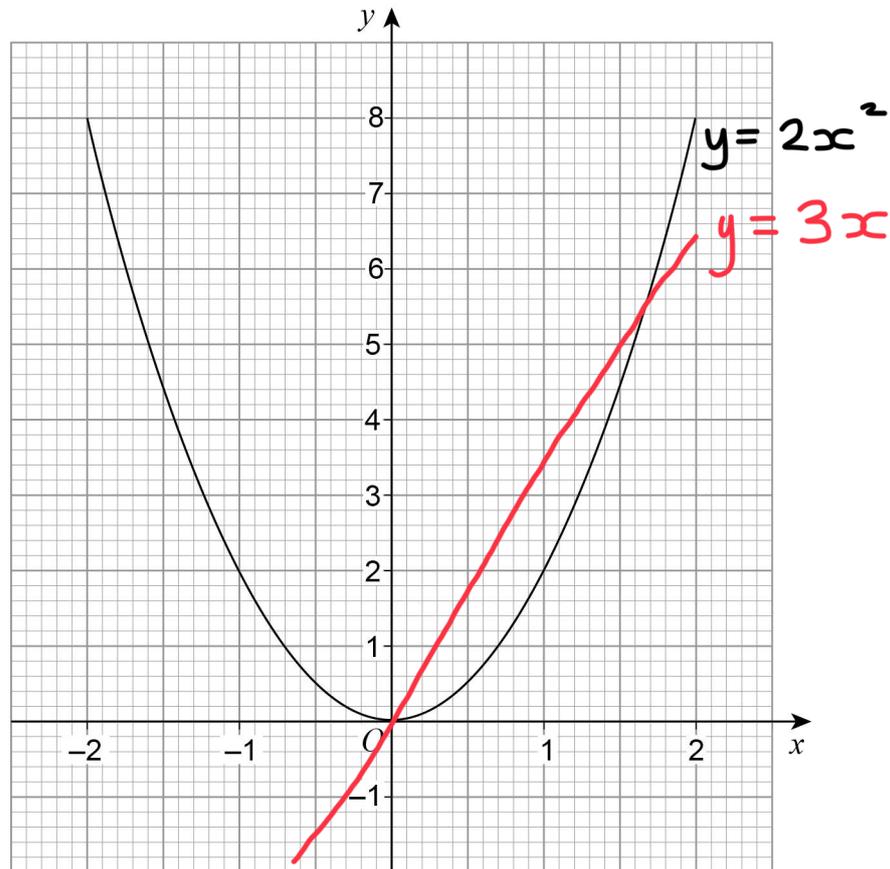
Turn over ►



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]

Draw the graph of  $y = 3x$

$x = 0$  and  $x = 1.5$

Answer  $x = 0$  and  $x = 1.5$



- 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  $x$  because it could  
be 0  
→ he should have factorised and he  
would have found that  $x = 0$   
as well as  $x = -2.5$

Turn over for the next question

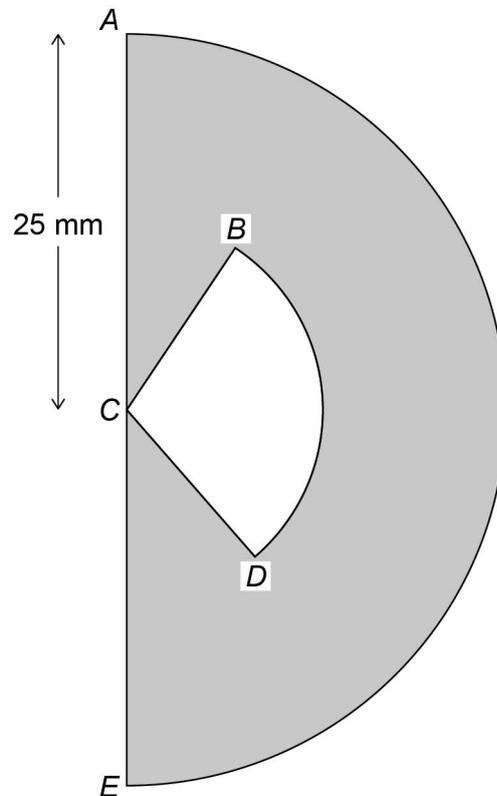


**22**

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

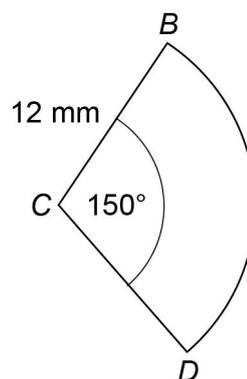
The earring is black and white.

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]

$$\begin{aligned} \text{area of whole semicircle} &= \frac{1}{2} \pi r^2 \\ &= \frac{1}{2} \pi \times 25^2 = 312.5 \pi \end{aligned}$$

$$\begin{aligned} \text{area of white sector:} \\ \frac{150}{360} \times \pi \times 12^2 &= 60 \pi \end{aligned}$$

$$\begin{aligned} \text{percentage of semicircle} \\ \text{that is white} &= \frac{60 \pi}{312.5 \pi} = 0.192 \end{aligned}$$

$$0.192 \times 100 = 19.2\%$$

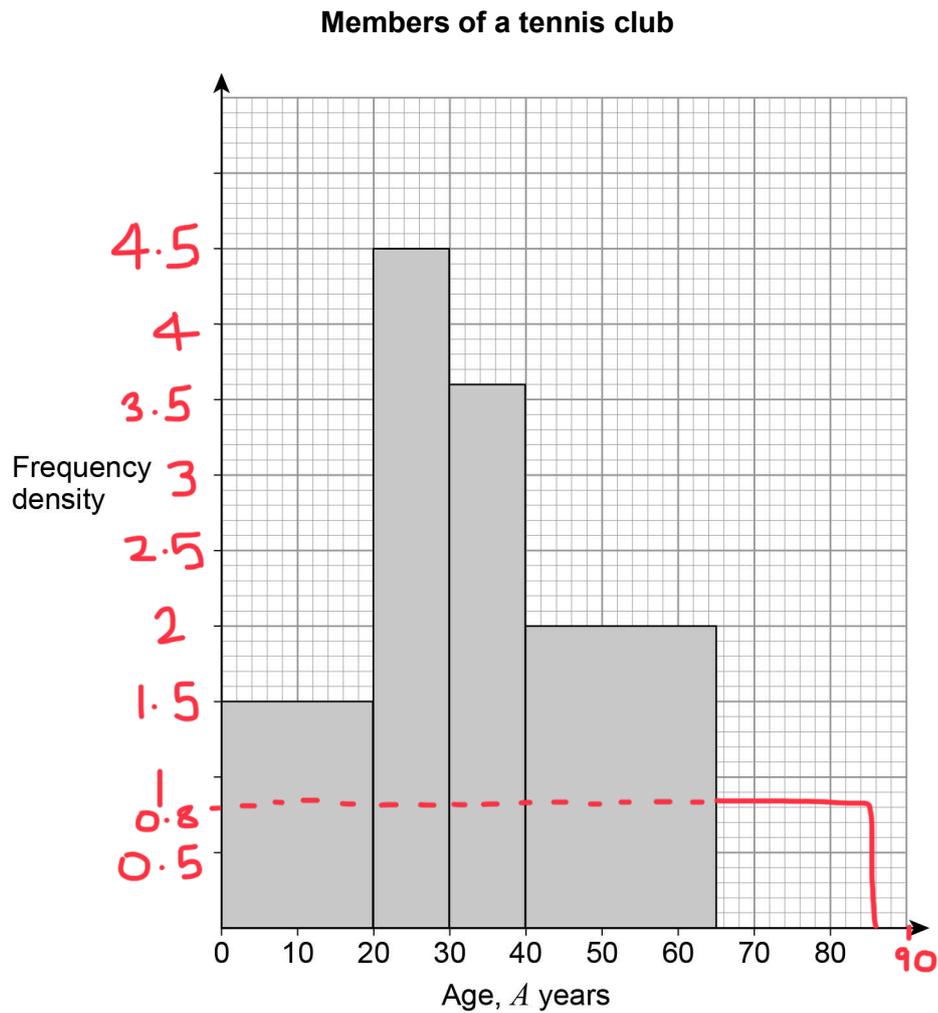
Answer No because 19.2% is less than 20%.

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]

for the  $0 < A < 20$  bar,

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

for the  $65 \leq A < 80$  bar,

$$\frac{12}{15} = 0.8$$



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

[2 marks]

$$\begin{aligned} & 30 + (10 \times 4.5) + (10 \times 3.6) + \\ & (25 \times 2.0) + 12 \\ = & 30 + 45 + 36 + 50 + 12 \\ = & 173 \end{aligned}$$

Answer 173

Turn over for the next question

Turn over ►



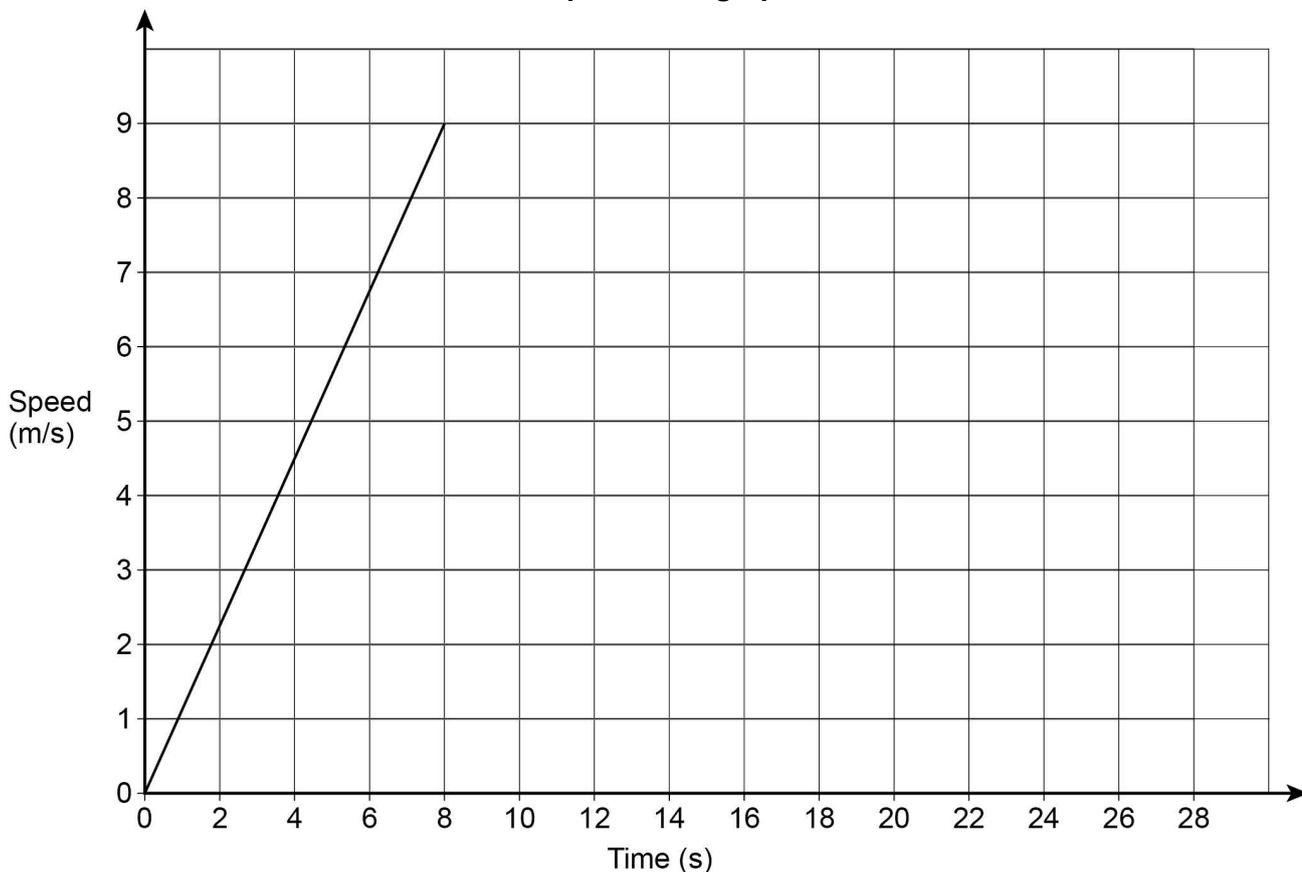
24

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.

distance run by Beth in first 8s :  
 area under graph =  $\frac{9 \times 8}{2}$  [3 marks] = 36m

distance left to run =  $200 - 36 = 164$  m

speed =  $\frac{\text{distance}}{\text{time}}$  time =  $\frac{164}{9} = 18.22$

Beth's total time =  $8 + 18.22 = 26.22$  s  
 $26.22 < 27$

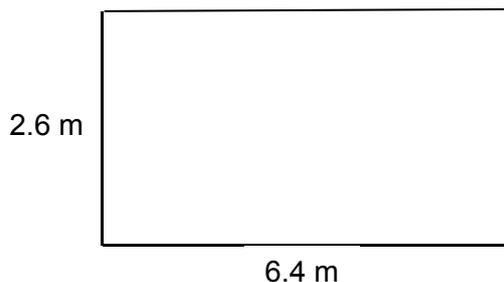
Answer

So, yes Beth finishes before Amy.



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]

$$342.5 \leq \text{force} < 347.5$$

to get upper bound of pressure,  
biggest force  
smallest area

$$\text{smallest area} = 2.55 \times 6.35$$

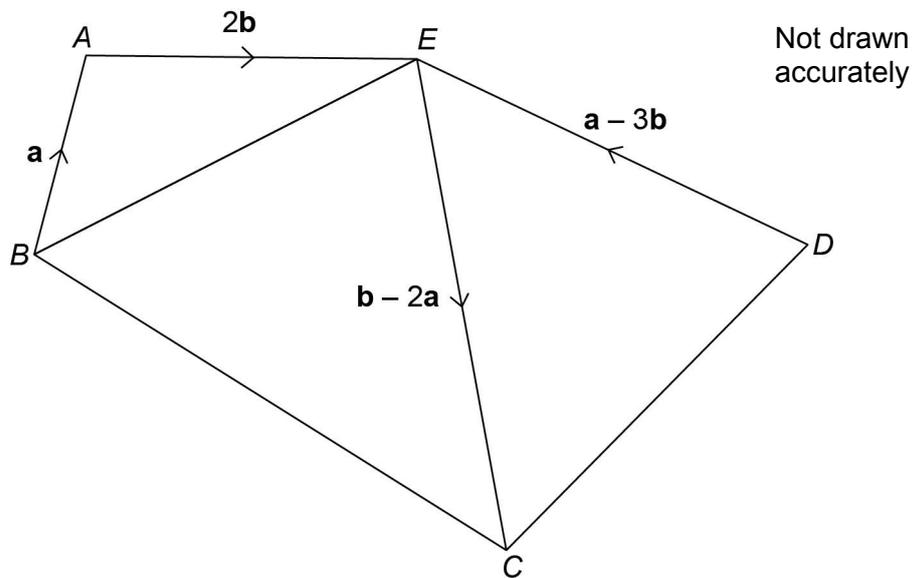
$$= 16.1925$$

$$\text{pressure} = \frac{347.5}{16.1925} = 21.46 \text{ N/m}^2$$

Answer 21.46 N/m<sup>2</sup>



26

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

[3 marks]

$$\begin{aligned}\vec{CB} &= \vec{CE} + \vec{EA} + \vec{AB} \\ &= -(\underline{b} - \underline{2a}) - \underline{2b} - \underline{a} \\ &= \underline{a} - \underline{3b} \\ \vec{CB} &= \vec{DE}\end{aligned}$$

$CB$  is equal and parallel to  $DE$   
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]

$$\frac{x}{4} - \frac{2x}{x+2}$$

$$= \frac{x(x+2)}{4(x+2)} - \frac{8x}{4(x+2)}$$

$$= \frac{x(x+2) - 8x}{4(x+2)} = \frac{x^2 + 2x - 8x}{4(x+2)}$$

$$1 = \frac{x^2 - 6x}{4(x+2)}$$

$$4(x+2) = x^2 - 6x$$

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

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

quadratic formula:  $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

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

$$x = \frac{10 \pm 2\sqrt{33}}{2} = 5 \pm \sqrt{33}$$

Answer  $x = 10.74$  and  $x = -0.74$

END OF QUESTIONS



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