

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

Monday 3 June 2024

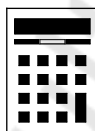
Morning

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a calculator
- mathematical instruments
- the Formulae Sheet (enclosed).



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.

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	
TOTAL	

Advice

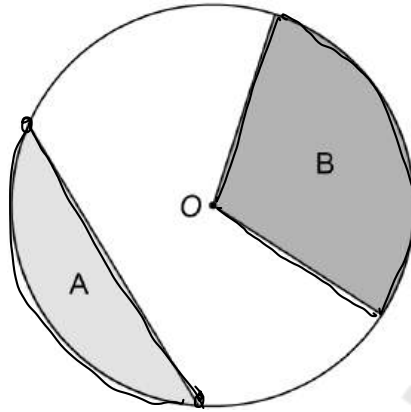
In all calculations, show clearly how you work out your answer.



J U N 2 4 8 3 0 0 2 H 0 1

Answer **all** questions in the spaces provided.

- 1 The diagram shows a circle, centre O , and three straight lines.



Use **one** word to describe each shaded region.

Choose from

arc chord sector segment tangent

[2 marks]

Region A Segment

Region B Sector



2

The mass of an iceberg is 2 200 000 kg

This value is a 12% reduction from the **original** mass of the iceberg.

Work out the **original** mass of the iceberg.

Give your answer in standard form.

[3 marks]

$$100\% - 12\% = 88\% \quad 0.88$$

$\div 100$

$$0.88 \times x = 2\,200\,000$$

$\div 0.88$

$$x = 2\,500\,000$$

Answer 2.5×10^6 kg

Turn over for the next question

Turn over ►



- 3** A chef has a tub of blueberries.
She wants to
use all the blueberries
put the same number of blueberries on each dessert.

$$D = \frac{k}{b}$$

D is the number of desserts.

b is the number of blueberries on each dessert.

$$k = D \times b$$

$$\frac{k}{D} = b$$

- 3 (a)** What does the constant k represent?

Tick the correct box.

[1 mark]

The number of blueberries in the tub

The number of desserts

The number of blueberries on each dessert

None of the above

- 3 (b)** Complete the table.

[2 marks]

b	2	6	8
D	120	40	30

$$b = \frac{240}{30}$$

$$b = 8$$

$$k = 120 \times 2 = 240$$

$$D = \frac{240}{6} = 40$$

$$D = \frac{240}{b}$$

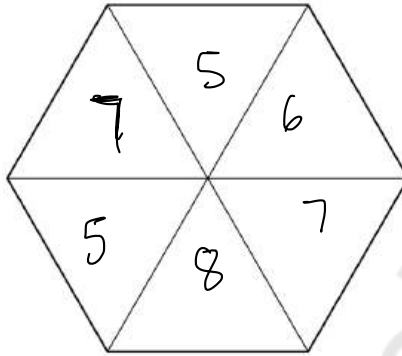


- 4 (a) A fair spinner has six equal sections, each with the number 5, 6, 7 or 8
Each number appears at least once.
 $P(\text{even number}) = P(7)$

Work out $P(5)$

You may use the blank spinner to help you.

[3 marks]



Answer $\frac{2}{6}$

- 4 (b) A different spinner has ten sections, each labelled A, B, C or D.

	A	B	C	D
Probability	0.1	0.5	0.2	0.3

Give **one** reason why there **must** be a mistake in the table.

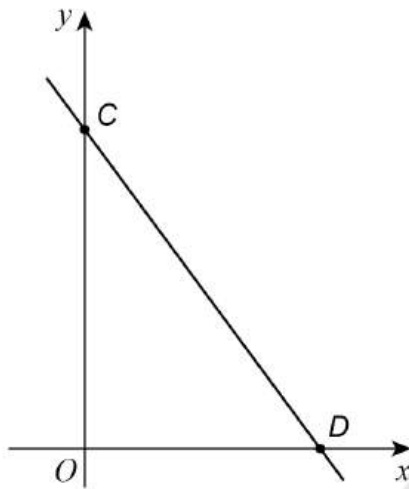
[1 mark]

$$0.1 + 0.5 + 0.2 + 0.3 = 1.1$$

$1.1 > 1$ which is not possible as all probabilities
add up to 1.



- 5 (a) Here is a sketch of the graph $y = -2x + 6$



$$y = -2(0) + 6$$

$$y = 6$$

$$0 = -2x + 6$$

$$2x = 6$$

$$\div 2 \quad \div 2$$

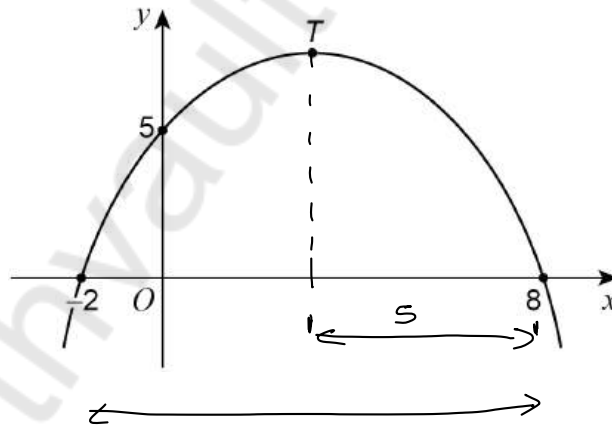
$$x = 3$$

Complete the coordinates of C and D.

[2 marks]

$$C(0, 6) \quad D(3, 0)$$

- 5 (b) Here is a sketch of a quadratic graph.



$$8 - 5 = 3$$

Complete the following statements.

$$8 - (-2)$$

$$8 + 2$$

$$10$$

[2 marks]

The value of the **y-intercept** is 5

The **x-coordinate** of the turning point, T, is 3



- 6 Work out $(2.5 \times 10^4)^{-3}$
Give your answer in standard form. [1 mark]

$$(2.5)^{-3} \times 10^{4 \times -3}$$

$$100 \times 0.064 \times 10^{-12} \times 10^{-2}$$

Answer 6.4×10^{-14}

- 7 Archie flips a biased coin 200 times.
Here is some information about the outcomes after each 50 flips.

Total number of flips	50	100	150	200
Number of heads	10	27	37	52

Work out the best estimate for the probability of flipping a head.

Give a reason for your answer.

[2 marks]

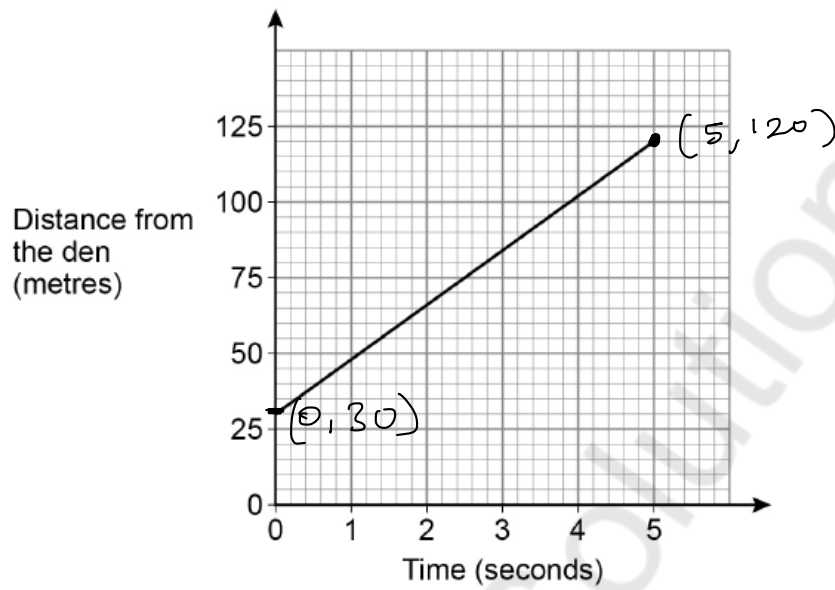
Answer $\frac{52}{200}$

Reason 200 is the highest number of flips.



8

A lion is sprinting in a straight line away from its den.
The graph shows the lion's distance from the den.



Work out the speed of the lion in metres per second.

[3 marks]

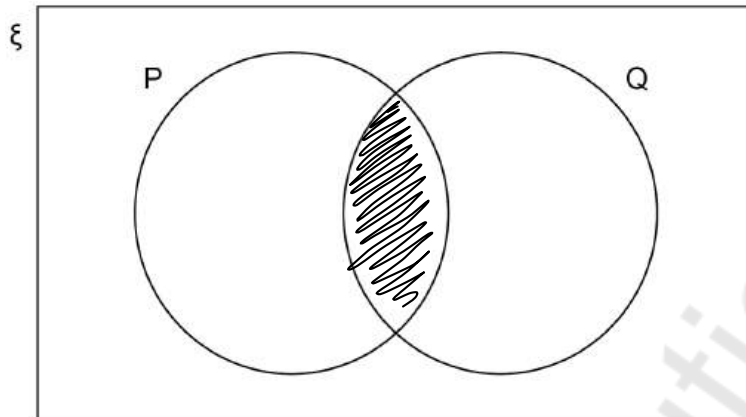
$$\text{Speed} = \frac{120 - 30}{5 - 0} = \frac{90}{5}$$

Answer 18 m/s



- 9 On the Venn diagram, shade the section represented by $P \cap Q$

[1 mark]



- 10 A bus route had 90 000 passengers last year.
The number of passengers was predicted to increase
by 3% this year
and then
by 8% next year.

$$3\% \text{ increase} = 1.03$$

$$8\% \text{ increase} = 1.08$$

Is the predicted number of passengers for **next** year more than 100 000 ?

You **must** show your working.

[3 marks]

$$\text{Last year} = 90,000$$

$$\text{This year} = 1.03 \times 90,000 = 92,700$$

$$\text{Next year} = 1.08 \times 92,700 = 100,116$$

$100,116 > 100,000$ so the predicted number of passengers for next year is more than 100,000.

Turn over ►



- 11 A map has a scale of 1:20 000
Two churches are 15 cm apart on the map.
Work out the actual distance between them.
Give your answer in **kilometres**.

Map : Real

[3 marks]

$$\frac{1}{15 \text{ cm}} = \frac{20,000}{x}$$

$$1000 \text{ m} = 1 \text{ km}$$

$$100 \text{ cm} = 1 \text{ m}$$

$$1 \times x = 20,000 \times 15$$

$$100 \times 100 \text{ cm} = 1 \text{ km}$$

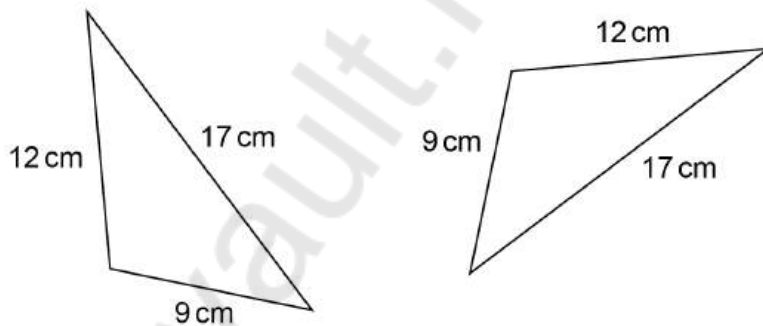
$$x = 300\,000 \text{ cm} \rightarrow \div$$

$$100,000 \text{ cm} = 1 \text{ km}$$

$$300,000 \text{ cm} = 3 \text{ km}$$

Answer 3 km

12



Not drawn
accurately

Circle the reason why these triangles are congruent.

[1 mark]

ASA

RHS

SAS

SSS



13

Liam takes part in long jump competitions.

Here is some information about 40 of his jumps.

Length of jump, d metres	Number of jumps	Midpoint	SubTotal
$7.0 \leq d < 7.4$	15	7.2	108
$7.4 \leq d < 7.8$	18	7.6	136.8
$7.8 \leq d < 8.2$	7	8.0	56
Total = 40		Total = 300.8	

Work out an estimate of the mean distance of these 40 jumps.

Give your answer as a decimal.

[3 marks]

$$\bar{d} = \frac{300.8}{40}$$

Answer 7.52 m



14 A graph passes through the points (3, 15) and (7, w)

14 (a) Assume that the equation of the graph has the form $y = x^2 + c$

Work out the value of w that this would give.

[3 marks]

$$15 = (3)^2 + c$$

$$15 = 9 + c$$

$$6 = c$$

$$y = x^2 + 6$$

$$w = (7)^2 + 6$$

$$w = 49 + 6$$

$$w = 55$$

$$w = \underline{\quad 55 \quad}$$

14 (b) In fact, the graph is a straight line.

What does this mean about the actual value of w ?

Tick **one** box.

[1 mark]

It must be the same as the value in part (a)

It must be different to the value in part (a)

It is impossible to tell



- 15 Concrete from a truck is poured at 10.9 kg per second for 30 minutes.

$$1000 \text{ kg} = 1 \text{ tonne}$$

Is more than 20 tonnes of concrete poured?

Tick a box.

Yes

No

You **must** show your working.

[4 marks]

$$\begin{array}{l} \times 30 \left\{ \begin{array}{l} 60 \text{ s} = 1 \text{ minute} \\ 1800 \text{ s} = 30 \text{ minutes} \end{array} \right. \times 30 \end{array}$$

$$\begin{array}{l} \times 1800 \left\{ \begin{array}{l} 10.9 \text{ kg} \Rightarrow 1 \text{ s} \\ 19620 \text{ kg} \Rightarrow 1800 \text{ s} \end{array} \right. \times 1800 \end{array}$$

$$1000 \text{ kg} \xrightarrow{\div 1000} 1 \text{ Tonne}$$

$$19620 \text{ kg} = 19.62 \text{ Tonnes}$$

$$\div 1000$$

$$19.62 < 20$$



16

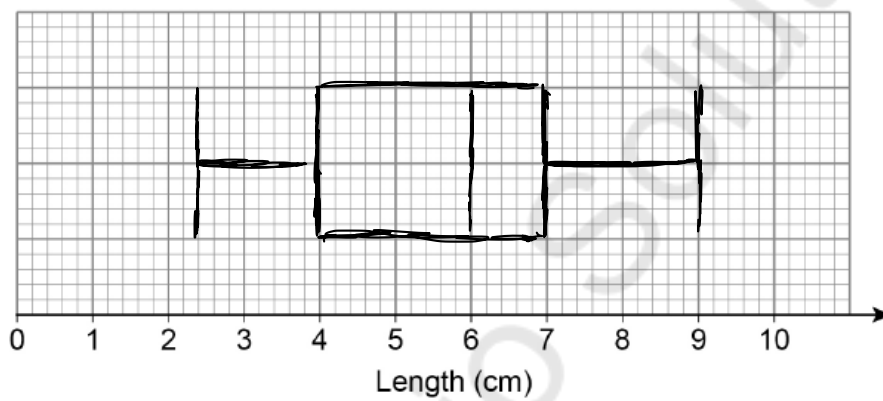
Here is some information about the lengths, in cm, of leaves.

- Shortest length = 2.4
- Longest length = 9
- Upper quartile = 7
- Median length = 6
- Interquartile range = 3

$$\text{lower quartile} = 7 - 3 = 4$$

Draw a box plot to show this information.

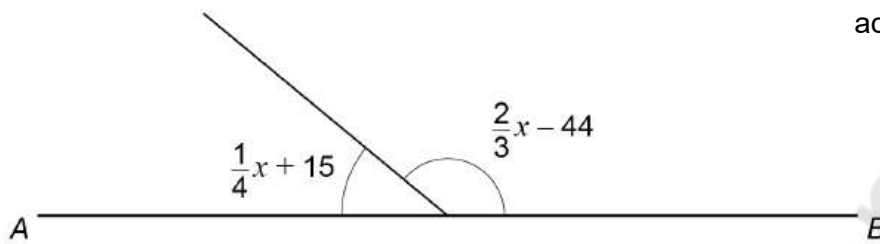
[3 marks]



17

 AB is a straight line.

Both angles are given in degrees.

Not drawn
accuratelyBy working out the value of x ,

work out the ratio smaller angle : larger angle

[4 marks]

$$\frac{1}{4}x + 15 + \frac{2}{3}x - 44 = 180^\circ \quad (\text{Angles on a straight line sum to } 180^\circ)$$

$$\frac{1}{4}x + \frac{2}{3}x = 180 - 15 + 44$$

$$\frac{11}{12}x = 209$$

$$x = 209 \times \frac{12}{11}$$

$$x = 228$$

$$\frac{1}{4}(228) + 15 = 72^\circ$$

$$180 - 72 = 108^\circ$$

$$72 : 108$$

Answer 72 : 108

Turn over ►



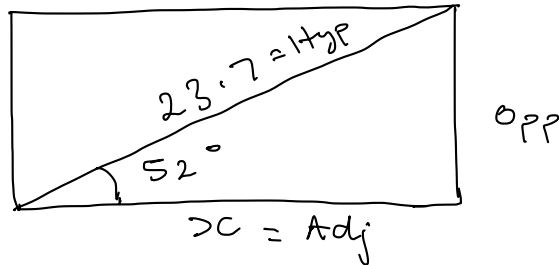
18

A diagonal of a rectangle is 23.7 cm long.

The diagonal makes an angle of 52° with a side of length x cm

Work out the value of x .

[3 marks]



SO H CAH TO A

$$\cos 52^\circ = \frac{A}{H}$$

$$\cos 52 = \frac{x}{23.7}$$

$$23.7 \cos 52 = x$$

$$x = 14.59$$



- 19 (a) Show that $4x(3x+2) - 2x^2\left(6 - \frac{5}{x}\right) - 6x\left(3 + \frac{7}{x}\right)$ simplifies to an integer.

[3 marks]

$$12x^2 + 8x - 12x^2 + 10x - 18x - 42$$

$$\underline{\underline{-42}}$$

- 19 (b) Factorise $8x^2 - 18x - 35$

$$8x - 35 = -280$$

[2 marks]

$$8x^2 - 28x + 10x - 35$$

$$4x[2x - 7] + 5[2x - 7]$$

$$(4x + 5)(2x - 7)$$

-280, 1
-140, 2
-70, 4
-35, 5
-28, 7
-20, 8
-14, 10
-10, 14
-7, 20
-5, 35
-4, 70
-2, 140
-1, 280

Answer $(4x + 5)(2x - 7)$



20

$$(x-9) = \frac{2(6-x^2)}{x+3} \quad \text{and} \quad x = \frac{d \pm \sqrt{e}}{f}$$

Work out one set of possible values for d , e and f .

[4 marks]

$$(x+3)(x-9) = 2(6-x^2)$$

x	$+$	3
x	x^2	$+3x$
-9	$-9x$	-27

$$x^2 + 3x - 9x - 27$$

$$x^2 - 6x - 27 = 12 - 2x^2$$

$$3x^2 - 6x - 27 = 12$$

$$3x^2 - 6x - 39 = 0$$

$$x^2 - 2x - 13 = 0$$

$$a = 1 \quad b = -2 \quad c = -13$$

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

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-13)}}{2(1)}$$

$$x = \frac{2 \pm \sqrt{56}}{2}$$

$$x = \frac{2 \pm 2\sqrt{14}}{2}$$

$$x = \frac{1 \pm \sqrt{14}}{1}$$

$$d = \underline{1}$$

$$e = \underline{14}$$

$$f = \underline{1}$$



21

People in a stadium are in the North Stand, East Stand, South Stand or West Stand.

Of the people in the stadium,

$$\left. \begin{array}{l} \frac{1}{4} \text{ are in the North Stand} = \frac{1}{4}x \\ \frac{3}{10} \text{ are in the East Stand} = \frac{3}{10}x \end{array} \right\} \frac{11}{20}x$$

$$\text{number in South Stand : number in West Stand} = 2 : 7$$

There are 4480 people in the West Stand.

How many people are in the stadium?

$$\left. \begin{array}{l} x - \frac{11}{20}x \\ \frac{9}{20}x \end{array} \right\}$$

[4 marks]

let total people = x

South :

West :

$$\left. \begin{array}{l} \\ \\ \end{array} \right\} \frac{9}{20}x$$

$$\text{Each part} = \frac{9}{20}x \div 9 = \frac{9}{20}x \times \frac{1}{9} = \frac{1}{20}x$$

$$\text{West : } 7 \times \frac{1}{20}x = \frac{7}{20}x$$

$$\frac{7}{20}x = 4480$$

$$7x = 4480 \times 20$$

$$x = \frac{4480 \times 20}{7}$$

Answer 12 800

Turn over for the next question

Turn over ►



22

$$x_{n+1} = 5 - \frac{1}{x_n}$$

Use $x_1 = 1$ to work out an approximate solution to $x = 5 - \frac{1}{x}$

Give your answer to 4 significant figures.

[3 marks]

$$x_2 = 5 - \frac{1}{1} = 5 - 1 = 4$$

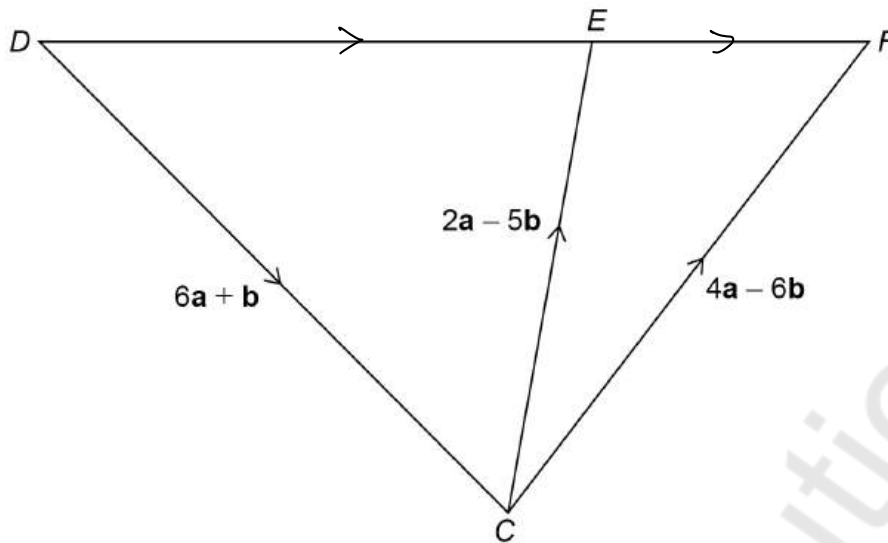
$$x_3 = 5 - \frac{1}{4} = 4.75$$

$$x_4 = 5 - \frac{1}{4.75} = 4.789473684$$

$$x = 4.789$$



23

Not drawn
accuratelyProve that DEF is a straight line.

[4 marks]

$$\vec{DE} = \vec{DC} + \vec{CE}$$

$$\vec{DE} = 6a + b + 2a - 5b$$

$$\vec{DE} = 8a - 4b$$

$$\vec{EF} = \vec{EC} + \vec{CF}$$

$$\vec{EF} = -\vec{CE} + \vec{CF}$$

$$\vec{EF} = -(2a - 5b) + 4a - 6b$$

$$= -2a + 5b + 4a - 6b$$

$$\vec{EF} = 2a - b$$

$$\vec{DE} = 4\vec{EF}$$

$\therefore \vec{DE}$ and \vec{EF} are parallel.

\vec{DE} and \vec{EF} also share the same point E

Thus DEF is a straight line.

Turn over ►

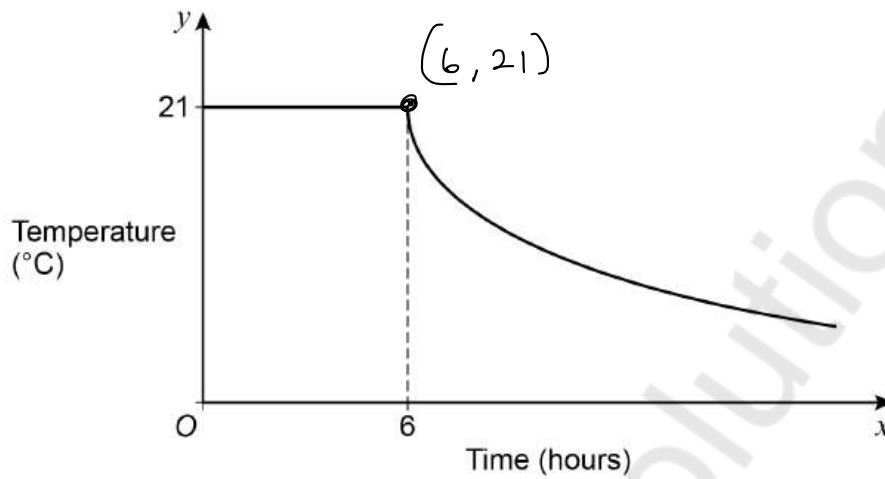


24

A room is kept at a constant temperature of 21°C for 6 hours.

The heating is then turned off and the room begins to cool.

Here is a sketch graph showing the temperature, $y^{\circ}\text{C}$, of the room at time x hours.



- 24 (a) Assume the equation of the curved part is $y = \frac{k}{x}$ where k is a constant.

Work out the value of y when $x = 12$

[2 marks]

$$21 = \frac{k}{6} \qquad y = \frac{126}{20}$$

$$21 \times 6 = k \qquad y = \frac{126}{12}$$

$$126 = k$$

$$y = 10.5$$



24 (b) In fact,

the equation of the curved part is $y = A \times \left(\frac{1}{3}\right)^{\frac{1}{6}x}$ where A is a **different** constant.

How does this affect the value of y when $x = 12$?

Tick **one** box.

You **must** show working to support your answer.

[2 marks]

The value of y is greater than the answer to part (a).

The value of y is less than the answer to part (a).

The value of y is the same as the answer to part (a).

$(6, 21)$
 x, y

$$21 = A \left(\frac{1}{3}\right)^{\frac{1}{6}(6)}$$

$$y = 63 \left(\frac{1}{3}\right)^{\frac{1}{6}x}$$

$$21 = A \left(\frac{1}{3}\right)$$

$$y = 63 \left(\frac{1}{3}\right)^{\frac{1}{6} \times 12}$$

$$3 \times 21 = A$$

$$y = 63 \left(\frac{1}{3}\right)^2$$

$$63 = A$$

$$y = 63 \left(\frac{1}{9}\right)$$

$$y = 7$$

$$7 < 10.5$$

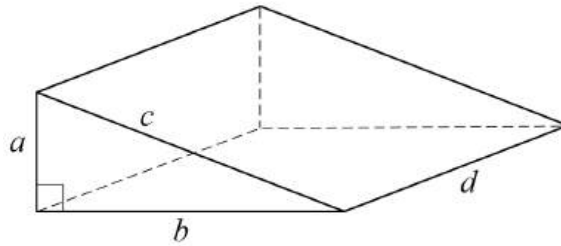
Turn over for the next question

Turn over ►



25

Here is a right-angled triangular prism.

The ratio of the edges is $a : b : c : d = 3 : 4 : 5 : 12$ The **volume** of the prism is 1125 cm^3 Work out the total length of **all** of the edges of the prism.**[5 marks]**

$$V = A \times \text{length}$$

$$1125 = \frac{b \times a}{2} \times d$$

$$1125 = \frac{abd}{2}$$

$$2250 = [abd] \times c^3$$

$$2250 = [3 \times 4 \times 12] \times c^3$$

$$2250 = 144c^3$$

$$\frac{125}{8} = c^3$$

$$\left(\frac{125}{8}\right)^{1/3} = c$$

$$2.5 = c$$

$$2(a) + 2(b) + 2(c) + 3(d)$$

$$2\left(3 \times \frac{5}{2}\right) + 2\left(4 \times \frac{5}{2}\right) + 2\left(5 \times \frac{5}{2}\right) + 3\left(12 \times \frac{5}{2}\right)$$

$$150 \text{ cm}$$

Answer 150 cm**END OF QUESTIONS**

There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

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