Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2025

Mathematics

StemUp Model Solution

Unit M3
(With calculator)
Higher Tier



[GMC31]

GMC31

THURSDAY 15 MAY, 9.15am – 11.15am

TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Questions which require drawing or sketching should be completed using an HB pencil.
All working **must** be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions.
You **may** use a calculator for this paper.
Answer **all twenty-six** questions.

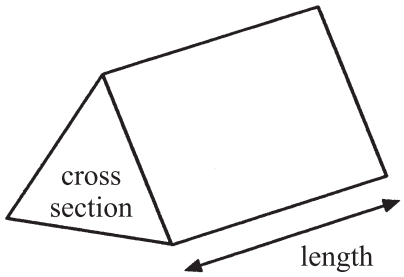
INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You should have a calculator, ruler, compasses and a protractor.
The Formula Sheet is on page 2.

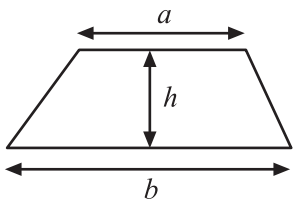
15854

Formula Sheet

Volume of prism = area of cross section × length

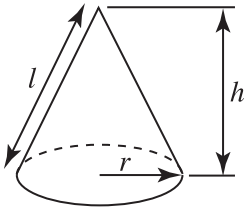


Area of trapezium = $\frac{1}{2}(a+b)h$



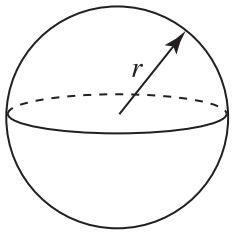
Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = πrl

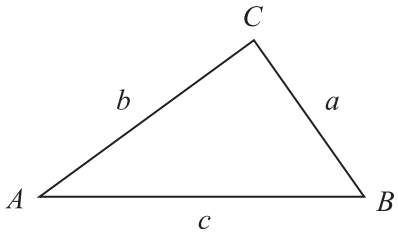


Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



In any triangle *ABC*



Quadratic Equation

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$, are given by

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

Sine Rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine Rule: $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle = $\frac{1}{2}ab\sin C$

15854

1 Engine oil costs £14.80 per litre.

Jason buys 6.5 litres of engine oil.

He also buys 5 identical spark plugs.

The total cost is £113

How much does each spark plug cost?

Oil: 6.5 × 14.80 = £96.20

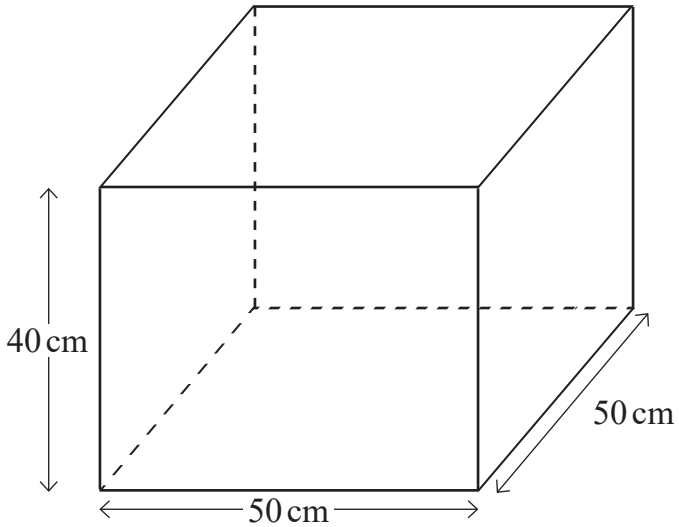
Spark plugs: 113 − 96.20 = £16.80

Each: 16.80 ÷ 5 = £3.36

Answer £ 3.36 [3]

[Turn over

2 A container, in the shape of a cuboid, has dimensions as shown in the diagram.



60 litres of liquid are poured into the container.

How deep will the liquid be?

60 litres = 60 000 cm^3

Base area = 50 × 50 = 2500 cm^2

Depth = 60 000 ÷ 2500 = 24 cm

Answer 24 cm [3]

3 At the start of the year, Sue's caravan was worth £9 600

By the end of the year, Sue's caravan had lost 26% of its value.

At the start of the year, John's caravan was worth £9 975

By the end of the year, John's caravan had lost $\frac{2}{7}$ of its value.

Whose caravan was worth more by the end of the year and by how much more?

Sue: 26% of 9600 = 9600 ÷ 100 × 26 = £2496

9600 − 2496 = £7104

John: $\frac{2}{7}$ of 9975 = 9975 ÷ 7 × 2 = £2850

9975 − 2850 = £7125

7125 > 7104, so John's caravan is worth more

7125 − 7104 = £21

Answer John by £ 21 [5]

[Turn over

4 **(a)** Simplify $4c + 5d + c - 7d$

$4c + c + 5d - 7d$

Answer $5c - 2d$ [2]

(b) Expand $5(2t + 5)$

Answer $10t + 25$ [1]

5

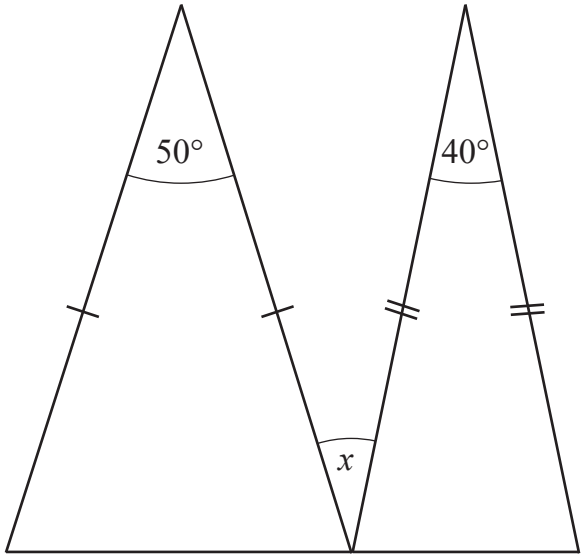


diagram not drawn accurately

Calculate the size of the angle marked x

Left triangle is isosceles: (180 − 50) ÷ 2 = 65°

Right triangle is isosceles: (180 − 40) ÷ 2 = 70°

Angles on a straight line: x = 180 − (65 + 70) = 45°

Answer 45 ° [3]

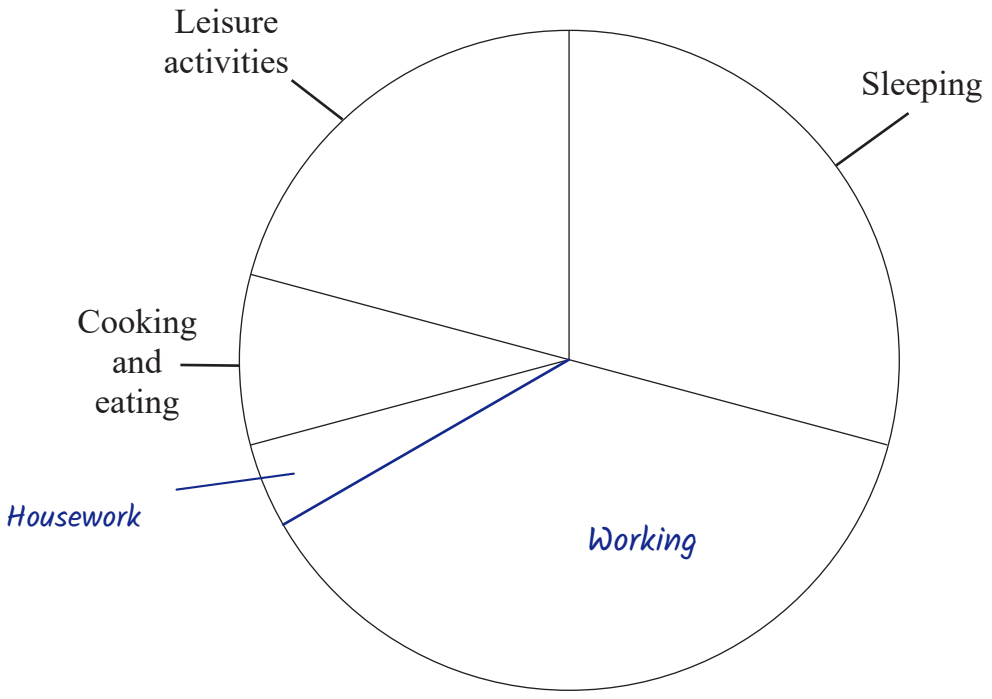
[Turn over

6 Philip wanted to draw a pie chart to display the results of a study on how adults spend their time each day.

He used the information in the table to start drawing the pie chart.

Activity	No. of hours	Angle
Sleeping	7	105°
Leisure activities	5	75°
Cooking and eating	2	30°
Working	9	135°
Housework	1	15°
Total	**24**	**360°**

360 ÷ 24 = 15° per hour



(a) Complete the table. [2]

(b) Complete the pie chart. [2]

(c) Philip says, "The angle for leisure activities is 75°. This means adults spend 75% of their time on leisure activities."

Is Philip correct? Explain your answer clearly.

No. The pie chart angle is out of 360°, not 100.

75 ÷ 360 × 100 = 20.8%, so it is only 20.8%, not 75%

[2]

7 What is the difference in size between the largest and smallest of these numbers?

$$2 \qquad 2\frac{1}{2} \qquad 0.02 \qquad \frac{2}{10}$$

Show your working out clearly.

$2 = 2, \quad 2\frac{1}{2} = 2.5, \quad 0.02, \quad \frac{2}{10} = 0.2$

Largest = 2.5, smallest = 0.02

2.5 − 0.02 = 2.48

Answer 2.48 [3]

[Turn over

8 Last season 103 750 people watched the Belfast Giants.

This season 8300 more people watched.

What was the percentage increase?

8300 ÷ 103 750 × 100 = 8%

Answer 8 % [2]

9 A charity holds a collection day.

During the collection day, 200 notes are donated to the charity.

25% of the notes are £10 notes.

$\frac{3}{5}$ of the notes are £5 notes.

There are eighteen £20 notes.

The rest of the notes are £50 notes.

What is the total value of all the notes donated?

Show your working out clearly.

£10 notes: 25% of 200 = 50, 50 × £10 = £500

£5 notes: $\frac{3}{5}$ of 200 = 120, 120 × £5 = £600

£20 notes: 18 × £20 = £360

£50 notes: 200 − 50 − 120 − 18 = 12, 12 × £50 = £600

Total = 500 + 600 + 360 + 600 = £2060

Answer £2060 [4]

[Turn over

10 A pencil cost x pence.

Bernie bought 3 pencils.

Bernie paid with a £2 coin.

Write an expression, in terms of x, for her change in **pence**.

£2 = 200p, 3 pencils cost 3x pence

Change = 200 − 3x

Answer 200 − 3x [2]

11 Solve $3(y - 7) = 18$

3y − 21 = 18

3y = 39

y = 13

Answer $y =$ 13 [3]

stemup.co.uk

12 Simplify $\frac{y}{3} + \frac{y}{5}$

$\frac{y}{3} + \frac{y}{5} = \frac{5y}{15} + \frac{3y}{15} = \frac{8y}{15}$

Answer $\frac{8y}{15}$ [3]

[Turn over

13 Mia asked each person in her class how many devices they owned that could connect to the internet.

She recorded the results as follows.

3	2	2	1	4
1	1	3	4	2
2	2	3	3	2
4	3	1	2	2

(a) Complete the frequency table below.

Number of devices	Number of pupils (frequency)	Total number of devices
1	4	4
2	8	16
3	5	15
4	3	12

[2]

(b) Calculate the mean number of devices per pupil.

Total = 4 + 16 + 15 + 12 = 47 devices, 20 pupils

Mean = 47 ÷ 20 = 2.35

Answer 2.35 [2]

(c) What was the range of the number of devices?

4 − 1 = 3

Answer 3 [1]

BLANK PAGE

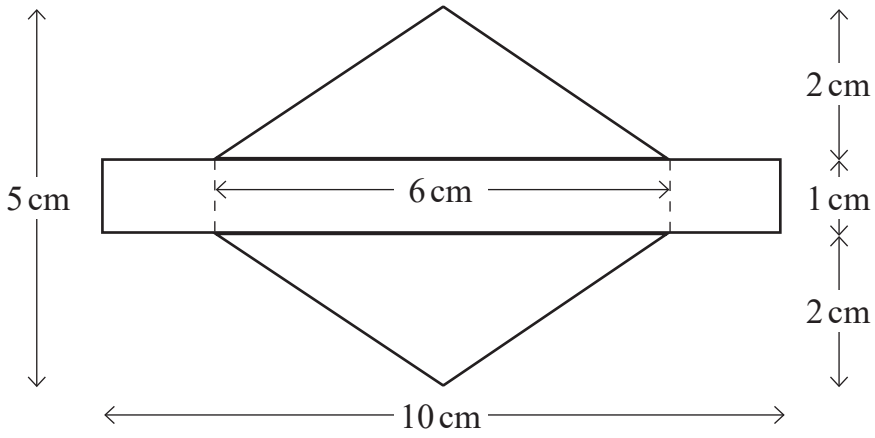
DO NOT WRITE ON THIS PAGE

(Questions continue overleaf)

[Turn over

14 A badge is in the shape of two identical triangles and a rectangle, as shown in the diagram.

diagram not drawn accurately



The badges are cut from a square sheet of metal, of side 1 metre, in rows as shown.

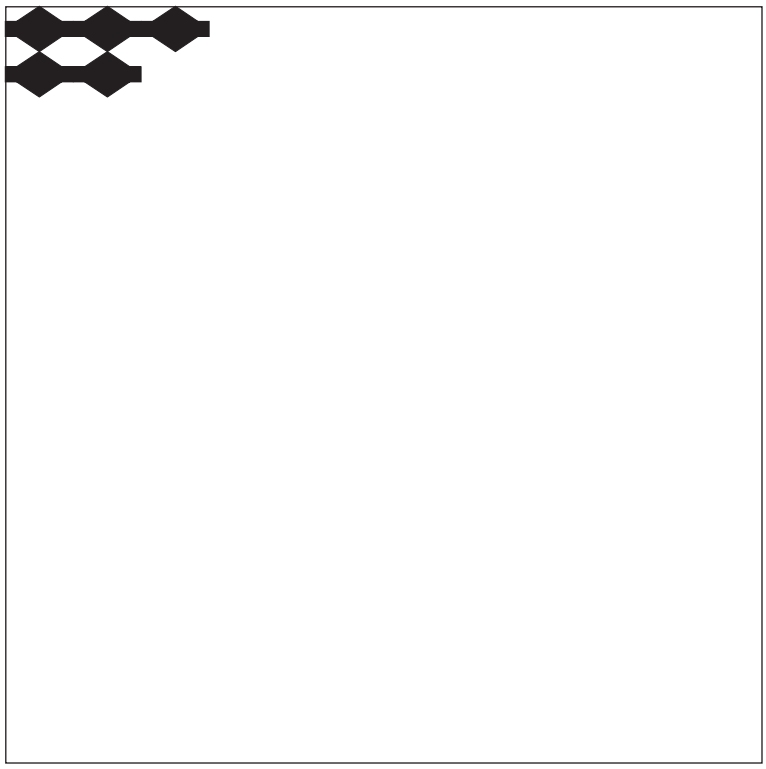


diagram not drawn accurately

stemup.co.uk

What is the total **area** of the metal left over after the **maximum** number of badges have been cut from the sheet in rows as shown?

Area of one triangle = $6 \times 2 \div 2 = 6$ cm^2

Area of rectangle = $10 \times 1 = 10$ cm^2

Area of badge = $10 + 6 + 6 = 22$ cm^2

1 metre = 100 cm

Badges per row: $100 \div 10 = 10$

Number of rows: $100 \div 5 = 20$

Number of badges = $10 \times 20 = 200$

Area of badges = $200 \times 22 = 4400$ cm^2

Area of sheet = $100 \times 100 = 10\,000$ cm^2

Left over = $10\,000 - 4400 = 5600$ cm^2

Answer 5600 cm^2 [6]

[Turn over

15 ABCD is a square of side 60 cm.

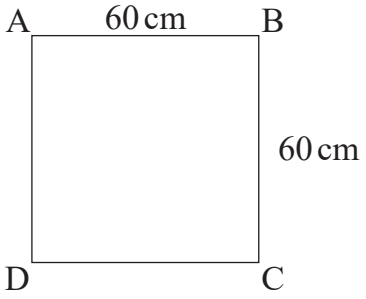


diagram not drawn accurately

The lengths of AB and DC are **increased** by 15%
and the lengths of BC and AD are **decreased** by 20%
to form a rectangle.

State whether the **perimeter** has increased or decreased, and by what percentage.

15% of 60 = 9, AB = DC = 60 + 9 = 69 cm

20% of 60 = 12, BC = AD = 60 − 12 = 48 cm

Original perimeter = 4 × 60 = 240 cm

New perimeter = 69 + 48 + 69 + 48 = 234 cm

Change = 240 − 234 = 6 cm decrease

$\%\ \text{change} = \frac{6}{240} \times 100 = 2.5\%$ decrease

Answer Perimeter has decreased by 2.5 % [6]

16 **(a)** Calculate the midpoint of the line joining the points (0, 6) and (2, 14).

$\left(\frac{0+2}{2}, \frac{6+14}{2}\right) = (1, 10)$

Answer (1 , 10) [2]

(b) Find the equation of the straight line joining the points (0, 6) and (2, 14).

$\text{gradient} = \frac{14-6}{2-0} = \frac{8}{2} = 4$

$y = mx + c$

$c = 6$ since the line passes through (0, 6)

Answer $y = 4x + 6$ [3]

[Turn over

17 Solve $\frac{4a-2}{3} = 8$

$4a - 2 = 8 \times 3 = 24$

$4a = 26$

$a = 26 \div 4 = 6.5$

Answer $a =$ 6.5 [3]

18 Expand and simplify $m^2 + (m + 7)(m - 2)$

$(m + 7)(m - 2) = m^2 - 2m + 7m - 14 = m^2 + 5m - 14$

$m^2 + m^2 + 5m - 14$

Answer $2m^2 + 5m - 14$ [3]

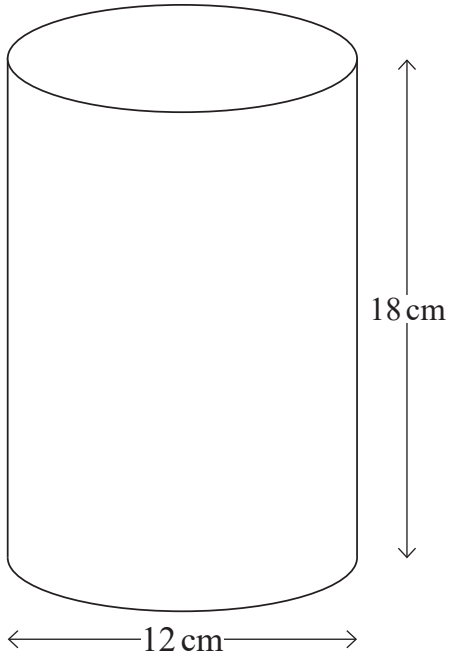
BLANK PAGE

DO NOT WRITE ON THIS PAGE

(Questions continue overleaf)

[Turn over

19 (a) Calculate the volume of the cylinder.



radius = 12 ÷ 2 = 6 cm

$V = \pi r^2 h = \pi \times 6^2 \times 18$

= 2035.752...

Answer 2035.75 cm^3 [3]

(b) The pressure exerted by the cylinder on the floor is 0.3 N/cm^2

Find the force exerted by the cylinder on the floor.

Give your answer to the nearest whole number.

Area of base = $\pi \times 6^2 = 113.0973...cm^2$

Force = pressure × area

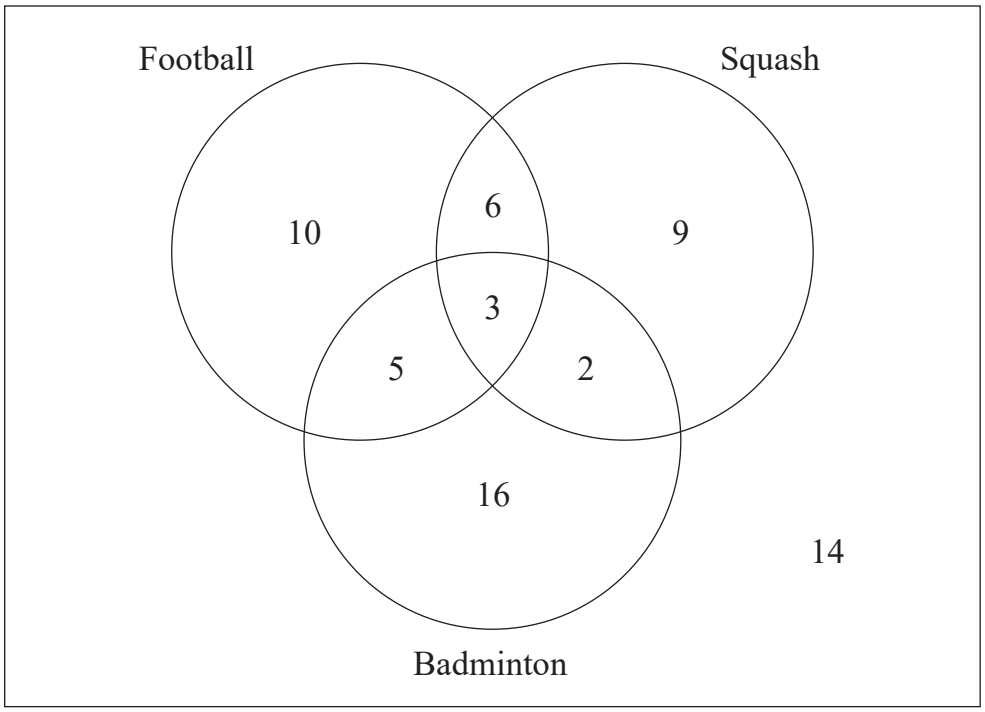
= 0.3 × 113.0973... = 33.929...

= 34 N (nearest whole number)

Answer 34 N [3]

[Turn over

20 The Venn diagram shows which sports members play at a leisure centre.



(a) How many members play Squash?

6 + 9 + 3 + 2 = 20

Answer 20 [1]

(b) How many members play both Football and Badminton?

5 + 3 = 8

Answer 8 [1]

21 Find the area of the triangle ABC.

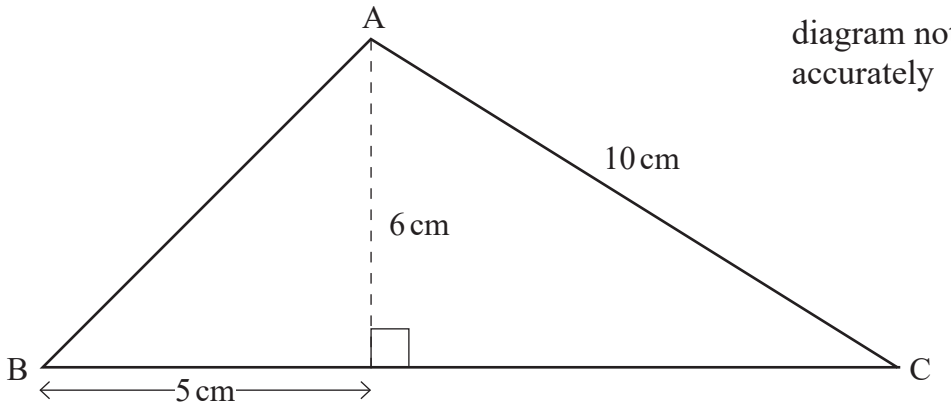


diagram not drawn accurately

Pythagoras in the right-hand triangle:

$x^2 = 10^2 - 6^2 = 100 - 36 = 64$

$x = \sqrt{64} = 8$ cm

$BC = 5 + 8 = 13$ cm

$\text{Area} = \frac{1}{2} \times 13 \times 6 = 39 \text{ cm}^2$

Answer 39 cm^2 [4]

[Turn over

22 A first class ticket is 24% more expensive than an economy ticket.

The difference in price between a first class ticket and an economy ticket is £20.64

Calculate the cost of the **first class ticket**.

24% of economy price = £20.64

1% = 20.64 ÷ 24 = £0.86

Economy = 100% = 0.86 × 100 = £86

First class = 86 + 20.64 = £106.64

Answer £ 106.64 [4]

23 Ben is making lemonade.

He can buy bottles in packs of 12

He can buy labels in packs of 33

Ben does not want to have any bottles or labels left over.

What is the **minimum** number of **packs of labels** he needs to buy?

$12 = 2 \times 2 \times 3$

$33 = 3 \times 11$

$LCM = 2 \times 2 \times 3 \times 11 = 132$

Packs of labels $= 132 \div 33 = 4$

(and $132 \div 12 = 11$ packs of bottles)

Answer 4 [3]

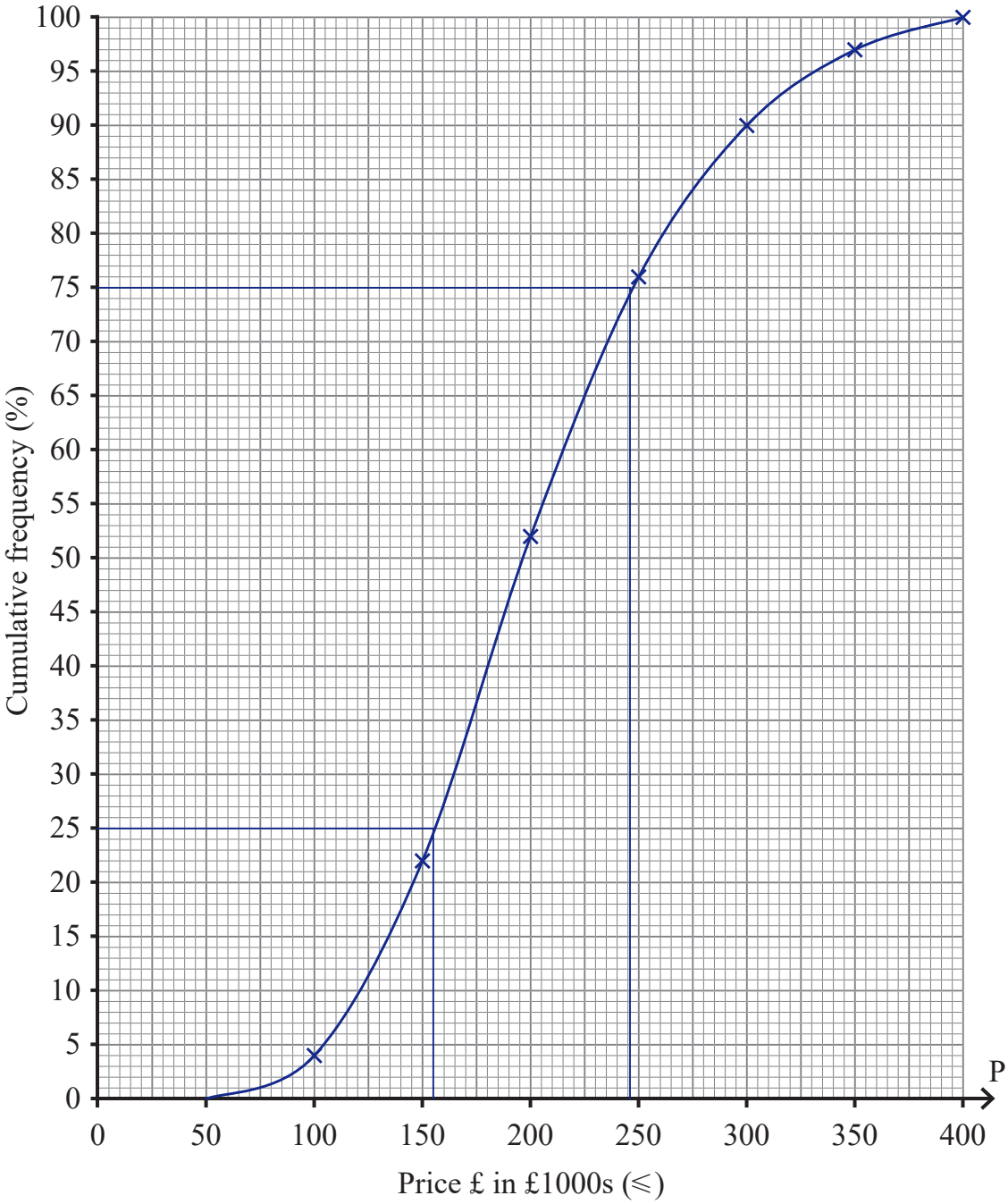
[Turn over

24 (a) The table shows the percentage distribution of house prices, P, in a town in Northern Ireland in 2020

House prices, P, in £	Percentage of houses	Cumulative frequency
$50\,000 < P \leqslant 100\,000$	4	4
$100\,000 < P \leqslant 150\,000$	18	22
$150\,000 < P \leqslant 200\,000$	30	52
$200\,000 < P \leqslant 250\,000$	24	76
$250\,000 < P \leqslant 300\,000$	14	90
$300\,000 < P \leqslant 350\,000$	7	97
$350\,000 < P \leqslant 400\,000$	3	100

Complete the cumulative frequency column in the table. [1]

(b) Plot the cumulative frequency graph on the given axes. [3]



(c) Use your graph to estimate the interquartile range.

LQ (25%) ≈ 155 000, UQ (75%) ≈ 246 000

IQR = 246 000 − 155 000

Answer £ 91 000 [2]

[Turn over

25 Factorise

(a) $8a^2b + 12a$

HCF = 4a

4a × 2ab + 4a × 3

Answer 4a(2ab + 3) [2]

(b) $a^2 - 4a - 21$

−7 × 3 = −21, −7 + 3 = −4

Answer (a − 7)(a + 3) [2]

26

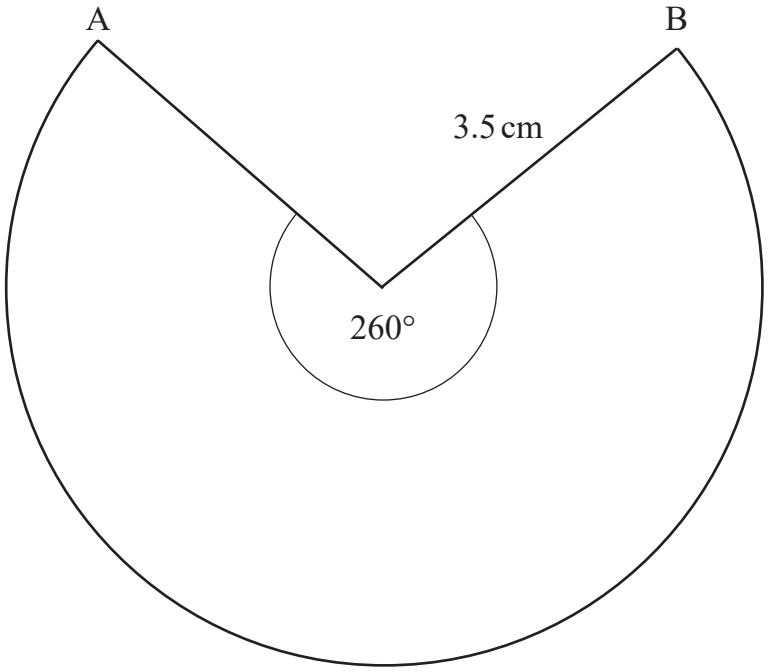


diagram not drawn accurately

Calculate the length of the arc AB, giving your answer to 1 decimal place.

Arc $= \frac{260}{360} \times \pi \times 7$

(diameter = 2 × 3.5 = 7 cm)

= 15.882...

Answer 15.9 cm [3]

THIS IS THE END OF THE QUESTION PAPER

stemup.co.uk

SOURCES:

All images © CCEA unless stated.

DO NOT WRITE ON THIS PAGE

For Examiner's use only	
Question Number	**Marks**
1	
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	
Total Marks	

Examiner Number

Permission to reproduce all copyright material has been applied for.
In some cases, efforts to contact copyright holders may have been unsuccessful and CCEA will be happy to rectify any omissions of acknowledgement in future if notified.