Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
November 2024

Mathematics

StemUp Model Solution

Unit M3
(With calculator)
Higher Tier



[GMC31]

GMC31

TUESDAY 19 NOVEMBER, 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-seven** questions.

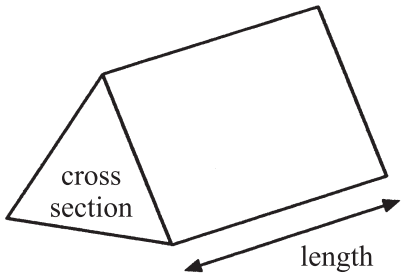
INFORMATION FOR CANDIDATES

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.

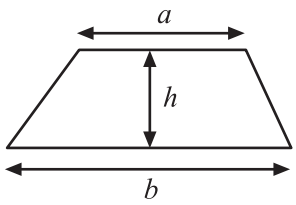
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Formula Sheet

Volume of prism = area of cross section × length

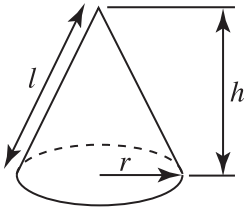


Area of trapezium = $\frac{1}{2}(a+b)h$



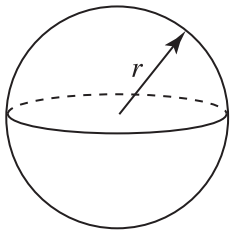
Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = πrl

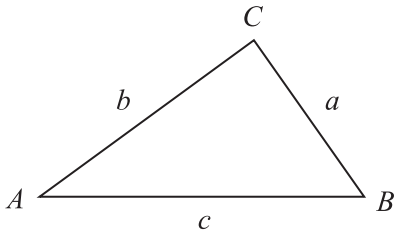


Volume of sphere = $\frac{4}{3}\pi r^3$

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 = $\frac{1}{2}ab\sin C$

1 Matthew, Karen and Jamie were trying to work out the value of 5^3

Matthew thought it was 15

Karen thought it was 125

Jamie thought it was 8

Who was correct?

Explain your answer clearly.

$5^3 = 5 \times 5 \times 5$

$= 25 \times 5$

$= 125$

Answer Karen was correct because $5^3 = 5 \times 5 \times 5 = 125$

not $5 \times 3 = 15$ and not $5 + 3 = 8$ [2]

[Turn over

2 Ciara and Len were each given £40 as a Christmas present.

Ciara spent $\frac{17}{20}$ of the money she was given.

Len spent 80% of the money he was given.

Who spent more of their money?

Explain your answer clearly.

$\frac{17}{20} \times 100 = 85\%$

Ciara: $17 \div 20 \times 40 = £34$

Len: 80% of $£40 = 0.8 \times 40 = £32$

Answer Ciara because she spent 85% but Len spent 80%

Ciara spent £34 and Len only spent £32 [2]

3 At a paint shop

Emulsion paint costs £4.25 per litre

Gloss paint costs £6 per litre

Masonry paint costs £10.50 per litre

Orla bought 12 litres of emulsion paint, 2.5 litres of gloss paint and some masonry paint.

She paid £134.25 in total.

How many litres of masonry paint did she buy?

Emulsion: 12 × 4.25 = £51

Gloss: 2.5 × 6 = £15

Masonry: 134.25 − 51 − 15 = £68.25

Litres of masonry: 68.25 ÷ 10.50 = 6.5

Answer *6.5* litres [4]

[Turn over

4

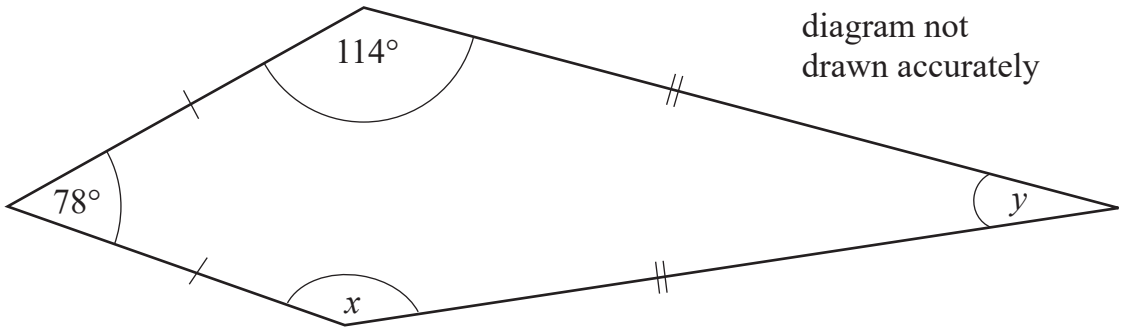


diagram not drawn accurately

The diagram shows the size of two angles in a kite.

Find the size of

(a) angle x

Kite: the angles between the unequal sides are equal

Answer 114 ° [1]

(b) angle y

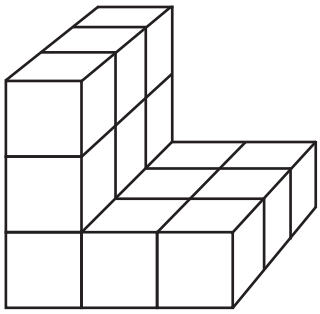
Angles in a quadrilateral add to 360°

78 + 114 + 114 = 306

y = 360 − 306 = 54

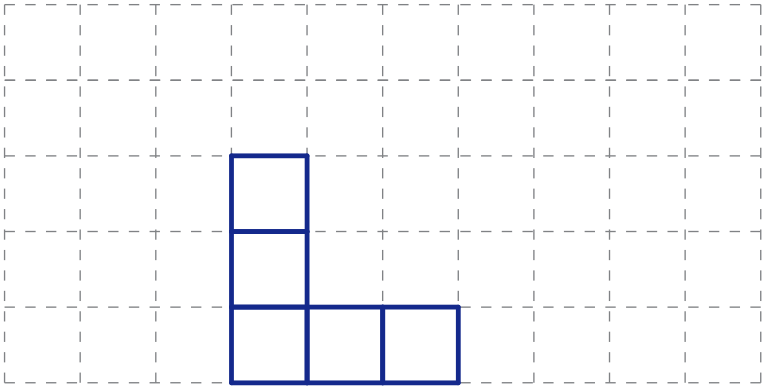
Answer 54 ° [2]

5 The diagram below shows a 3D shape made with centimetre cubes.

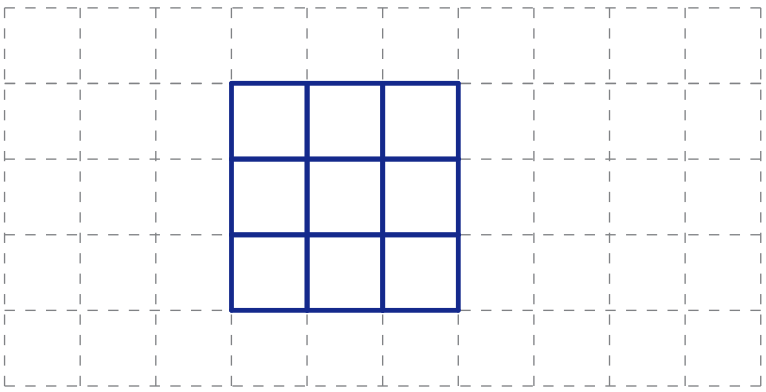


FRONT

(a) On the centimetre square grid below, draw the front elevation of the shape. [2]



(b) On the centimetre square grid below, draw the plan of the shape. [1]



[Turn over

6 The incomplete two-way table shows some information about cinema-goers one Saturday.

	Child	Adult	Senior citizen
Male	42	33	18
Female	78	27	12

(a) Use the following information to complete the two-way table.

In total there were 30 senior citizens.

There were 4 times as many children as senior citizens. [2]

Children = 4 × 30 = 120; 120 − 78 = 42, seniors: 30 − 18 = 12

(b) A child ticket is £3, an adult ticket is £7 and a senior citizen ticket is £5.50

The manager claims there was over £1000 in ticket sales.

Is he correct?

Show your working out clearly.

Children: 120 × £3 = £360

Adults: 33 + 27 = 60, 60 × £7 = £420

Senior citizens: 30 × £5.50 = £165

Total = 360 + 420 + 165 = £945

Answer No because ticket sales were only £945, which is less than £1000 [2]

7 A group of people were surveyed about the number of driving lessons they had before passing their driving test.

The results are shown in the stem and leaf diagram.

1	2	3	5	5	8	KEY: 3 | 6 = 36 lessons
2	0	3	5	9		
3	1	6				
4	4					
5	0	1				

(a) What is the range?

51 − 12 = 39

Answer 39 [1]

(b) Find the median.

14 values: (23 + 25) ÷ 2 = 24

Answer 24 [1]

(c) Alice passes her test.
When her number of driving lessons is included in the stem and leaf diagram, the range increases by 2 and the median decreases by 1

Work out the number of driving lessons Alice had.

Range 39 + 2 = 41, so Alice had 12 − 2 = 10 or 51 + 2 = 53

New median = 24 − 1 = 23

With 10: 15 values, 8th value = 23 (median decreases by 1)

With 53: 15 values, 8th value = 25 (median increases)

So Alice had 10 lessons

Answer 10 [2]

[Turn over

8 **(a)** Simplify $7g - 5h - 2g + 8h$

$7g - 2g = 5g, \quad -5h + 8h = 3h$

Answer $5g + 3h$ [2]

(b) Solve $\frac{t}{7} = 3.5$

$t = 3.5 \times 7$

Answer $t =$ 24.5 [1]

(c) Solve $4f + 9 = 37$

$4f = 37 - 9 = 28$

$f = 28 \div 4$

Answer $f =$ 7 [2]

(d) Expand $3(4e + 5)$

$3 \times 4e + 3 \times 5$

Answer $12e + 15$ [1]

(e) Factorise $18c - 30$

HCF of 18 and 30 is 6

Answer $6(3c - 5)$ [1]

9 A club has 160 members.

104 members attended an event.

(a) What **percentage** of club members attended the event?

$\frac{104}{160} \times 100 = 65$

Answer 65 % [2]

(b) The cost per ticket to attend the event last year was £7.50

This year it increased by 18%

How much did it cost per ticket to attend the event this year?

18% of £7.50 = 7.50 ÷ 100 × 18 = £1.35

7.50 + 1.35 = £8.85

Answer £ 8.85 [3]

[Turn over

10 Astrid says $\sqrt{16}+3$ can equal 7 or -1

Explain why she is correct.

√16 = 4 or −4, because 4 × 4 = 16 and (−4) × (−4) = 16

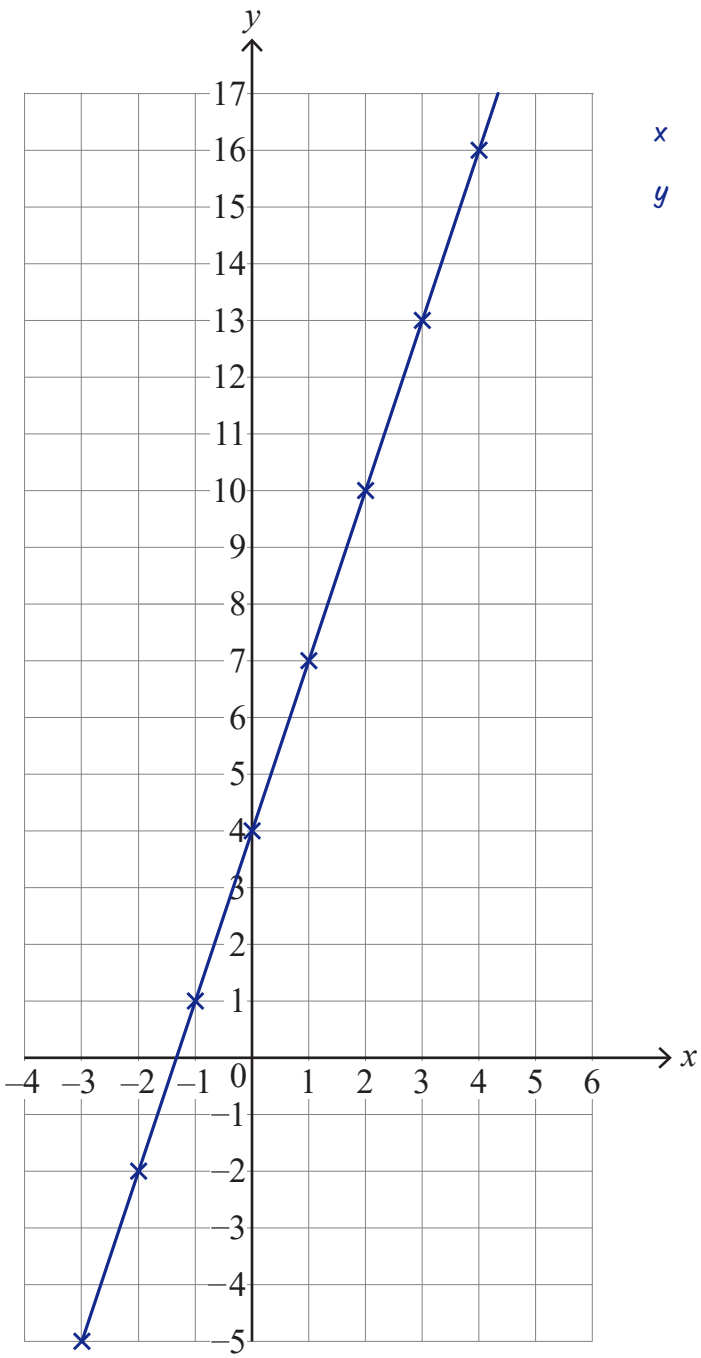
Using 4: 4 + 3 = 7

Using −4: −4 + 3 = −1

So √16 + 3 can equal 7 or −1

[2]

11 Draw the graph of $y = 3x + 4$ on the grid below.

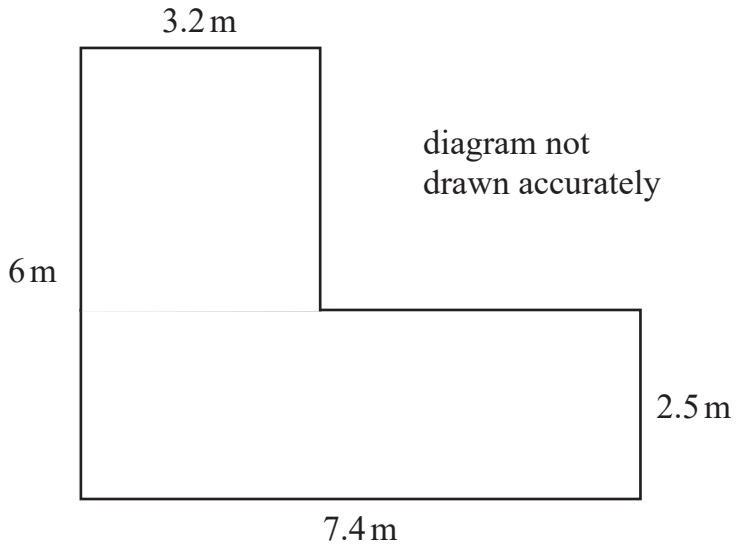


x	−2	0	2	4
y	−2	4	10	16

[3]

[Turn over

12 The diagram shows a sketch of a garden.



Rolls of grass are to be bought to cover the garden.

Each roll covers 1 square metre.

Each roll costs £4.50

Only **complete** rolls can be bought.

How much will it cost to buy enough rolls to cover the garden?

Show your working out clearly.

A: $6 \times 3.2 = 19.2\ m^2$

B: $(7.4 - 3.2) \times 2.5 = 4.2 \times 2.5 = 10.5\ m^2$

Area $= 19.2 + 10.5 = 29.7\ m^2$, so 30 rolls

Cost $= 30 \times £4.50 = £135$

Answer £ 135 [4]

13

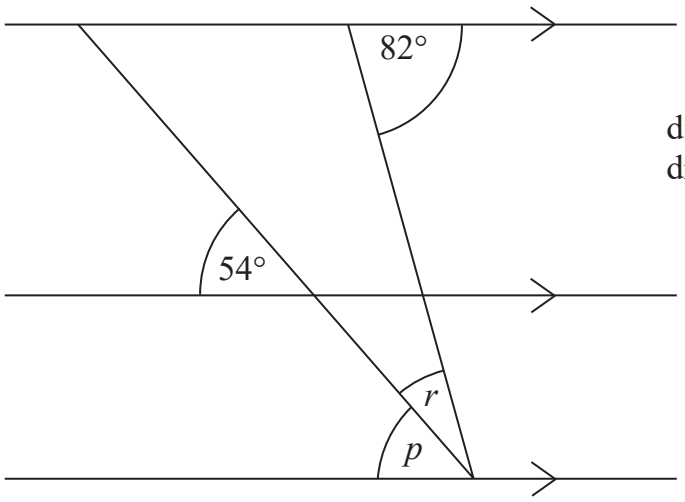


diagram not drawn accurately

Find

(a) angle p

$p = 54$ (corresponding angles)

Answer 54 ° [1]

(b) angle r

$p + r = 82$ (alternate angles)

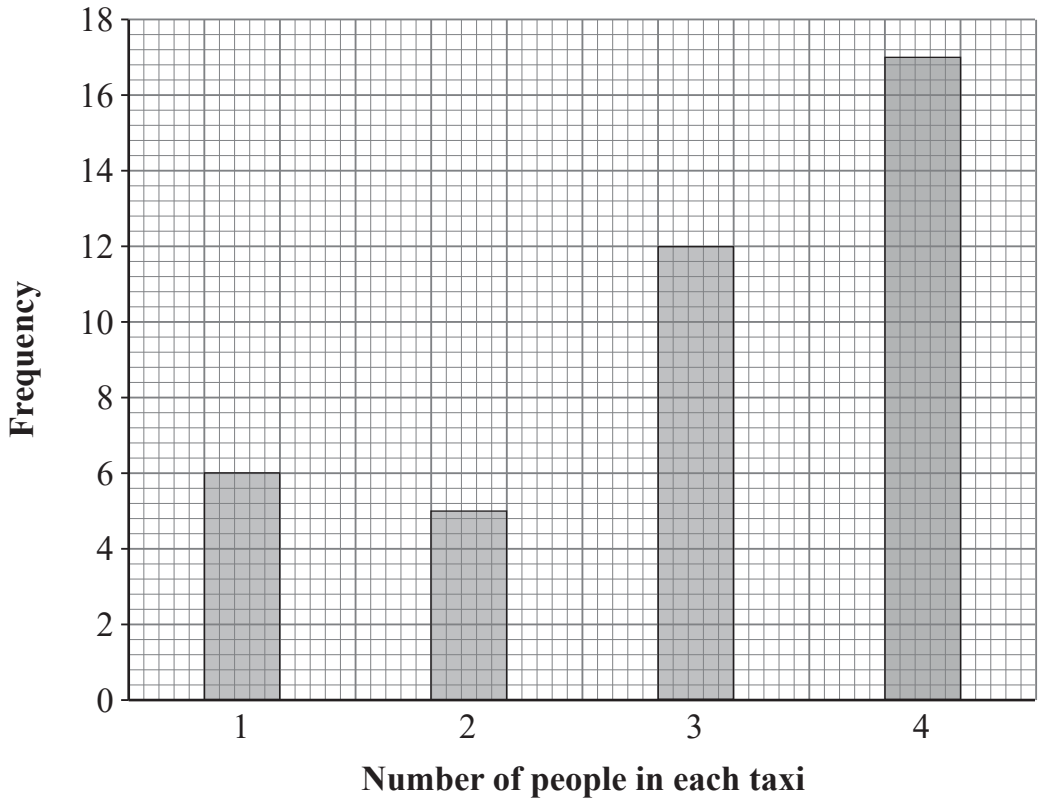
$r = 82 - 54$

$r = 28$

Answer 28 ° [2]

[Turn over

14 The bar chart shows the number of people in each taxi booked from a taxi company one Saturday night.



Calculate the mean number of people in each taxi.

Show your working out clearly.

Number of taxis = 6 + 5 + 12 + 17 = 40

People = 1 × 6 + 2 × 5 + 3 × 12 + 4 × 17

= 6 + 10 + 36 + 68 = 120

Mean = 120 ÷ 40 = 3

Answer 3 [4]

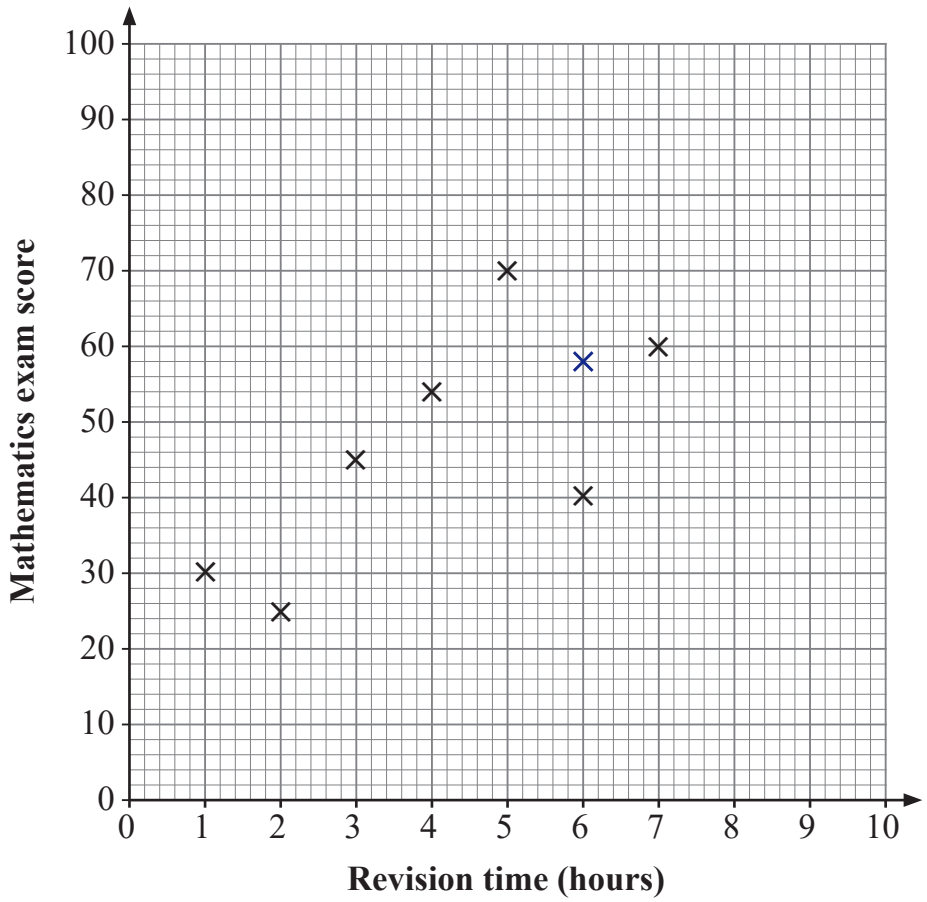
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(Questions continue overleaf)

[Turn over

15 The scatter graph shows the number of hours of revision completed by seven students and their Mathematics exam scores.



(a) Jake sat the exam late and his data was not recorded on the graph.

He spent 6 hours revising and scored 58

Plot Jake's point on the scatter graph. [1]

(b) Describe the relationship between the revision time in hours and the score in the Mathematics exam.

Answer *Positive correlation: the more hours spent revising,*

the higher the Mathematics score [1]

(c) Jake claims that if he had revised for 10 hours he would have scored above 90

Comment on the reliability of his claim.

Answer *Not reliable: 10 hours is outside the range of the data (extrapolation), so the trend may not continue* [1]

16 Anne invested £18 000 in an account paying 4% per annum compound interest.

After how many years will the value of her investment exceed £20 200?

Show your working out clearly.

After 1 year: 18000 × 1.04 = £18720

After 2 years: 18720 × 1.04 = £19468.80

After 3 years: 19468.80 × 1.04 = £20247.552

£19468.80 < £20200 but £20247.55 > £20200

Answer *3 years* [3]

[Turn over

17 x is a **two-digit** number.

The LCM (lowest common multiple) of x and 55 is 110

Find a possible value of x

$55 = 5 \times 11$

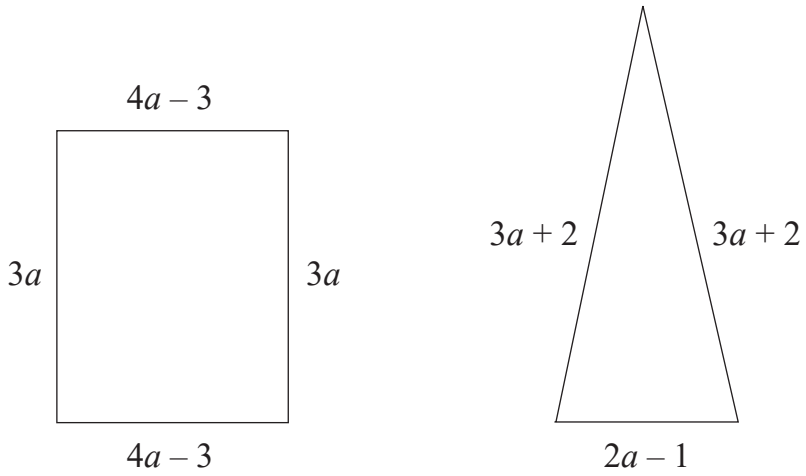
$110 = 2 \times 5 \times 11$

x must be a factor of 110 with a factor of 2

$x = 2 \times 5 = 10$ (or $2 \times 11 = 22$)

Answer 10 [2]

18 The rectangle and triangle drawn below have the **same perimeter**.



Work out the value of a, showing your method clearly.

Rectangle: $4a - 3 + 4a - 3 + 3a + 3a = 14a - 6$

Triangle: $3a + 2 + 3a + 2 + 2a - 1 = 8a + 3$

$14a - 6 = 8a + 3$

$14a - 8a = 3 + 6$

$6a = 9$

$a = 9 \div 6 = 1.5$

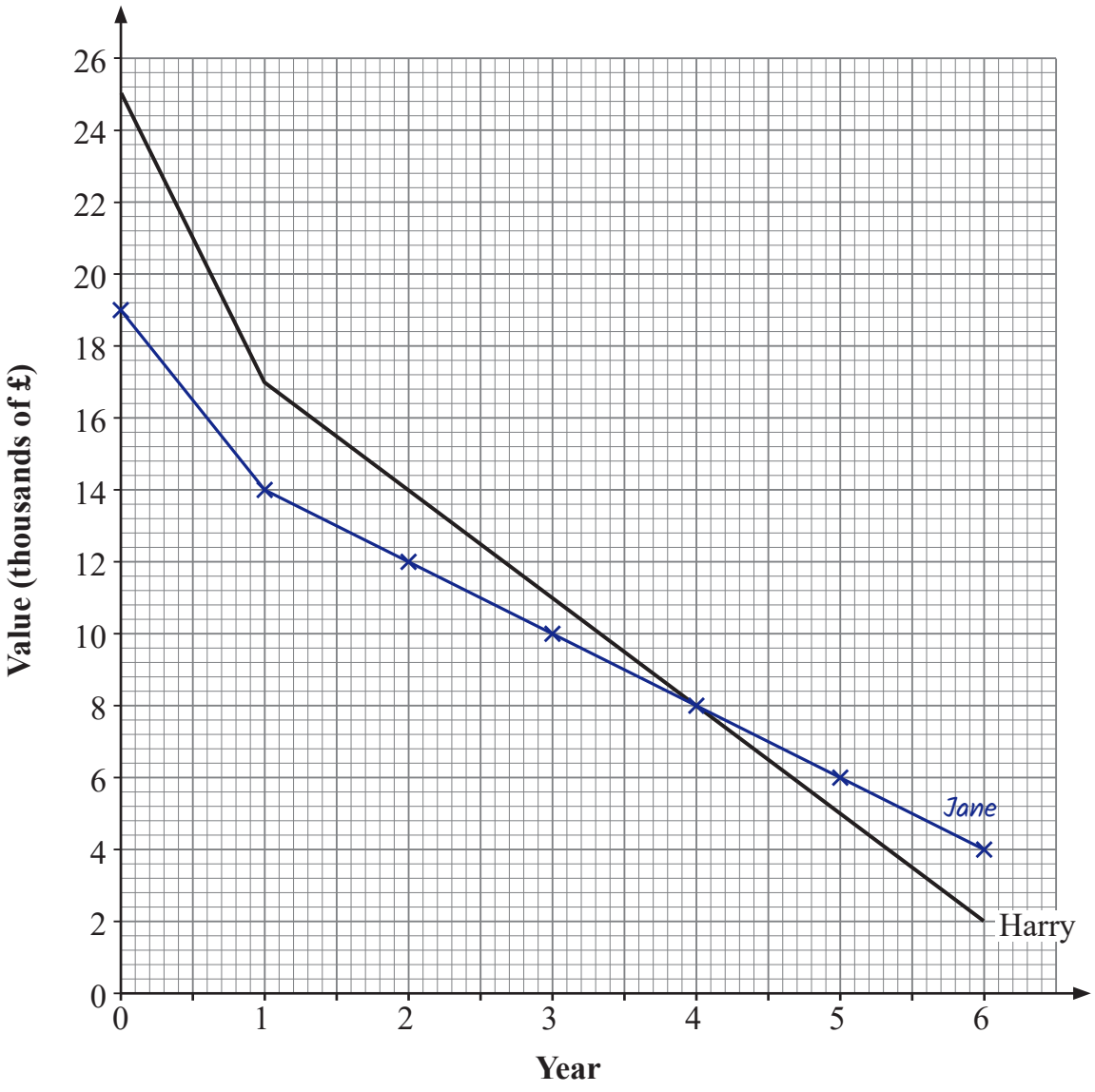
Answer $a =$ 1.5 [4]

[Turn over

19 Six years ago, Harry and Jane each bought a new car.

Harry bought his car for £25 000
In the first year, it decreased in value by £8 000
After that, it decreased in value by £3 000 each year.

A graph showing the value of Harry's car each year is shown below.



Jane bought her car for £19 000
In the first year, it decreased in value by £5 000
After that, it decreased in value by £2 000 each year.

14863

(a) On the grid opposite, draw a graph showing the value of Jane's car each year. [2]

(b) Use the graph you have drawn to write down the year when Harry's car and Jane's car had the same value.

Answer Year 4 [1]

20 A doormat is in the shape of a semicircle with diameter 82 cm.

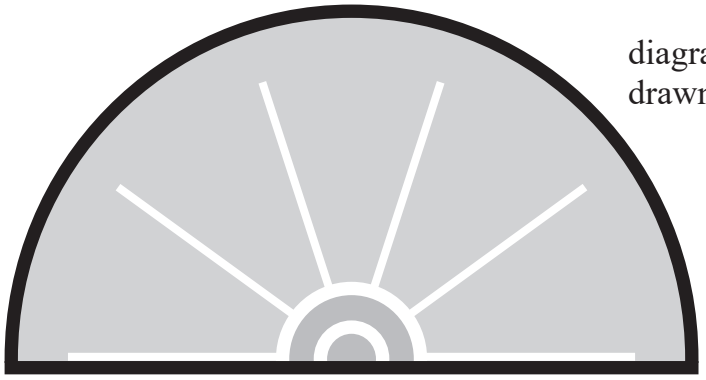


diagram not drawn accurately

Calculate the perimeter of the doormat.

Curved edge = π × 82 ÷ 2

= 257.6105976 ÷ 2 = 128.8052988 cm

Perimeter = 128.8052988 + 82

= 210.8052988 cm

Answer 210.8 cm [3]

[Turn over

21

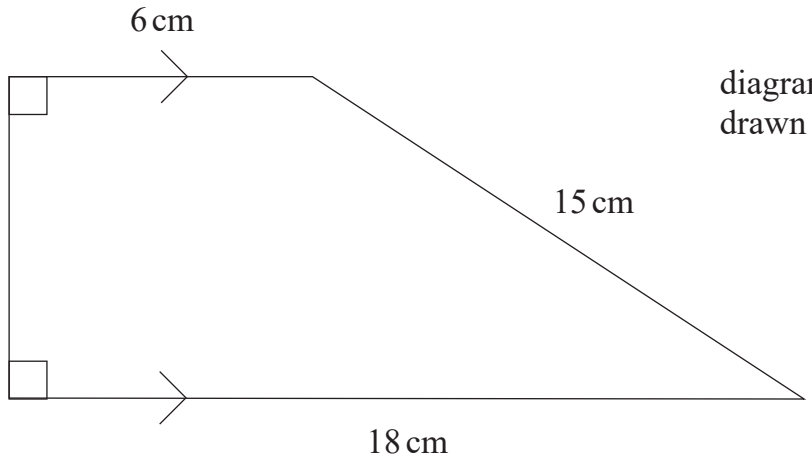


diagram not drawn accurately

Calculate the area of the trapezium.

Horizontal gap = 18 − 6 = 12 cm

$h^2 + 12^2 = 15^2$

$h^2 = 225 - 144 = 81$

$h = \sqrt{81} = 9$ cm

$\text{Area} = \frac{1}{2} \times (6 + 18) \times 9$

$= 12 \times 9 = 108$

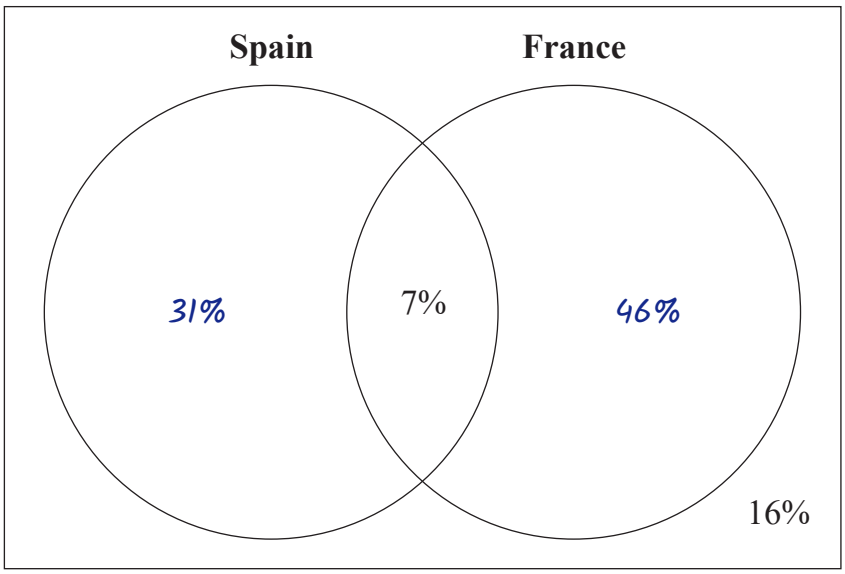
Answer 108 cm^2 [5]

22 Pupils in a year group were asked whether they had travelled to Spain or France.

Some information is shown in the Venn diagram.

53% had travelled to France.

Complete the Venn diagram below.



[2]

France only = 53 − 7 = 46%

Spain only = 100 − 46 − 7 − 16 = 31%

[Turn over

23 **(a)** Expand and simplify $(2x - 1)(3x + 4)$

$6x^2 + 8x - 3x - 4$

Answer $6x^2 + 5x - 4$ [2]

(b) **(i)** Factorise $x^2 + 6x - 16$

$8 \times (-2) = -16, \quad 8 + (-2) = 6$

Answer $(x + 8)(x - 2)$ [2]

(ii) Hence solve $x^2 + 6x - 16 = 0$

$x + 8 = 0$ or $x - 2 = 0$

Answer $x =$ -8 or 2 [1]

(c) Solve the equation

$$\frac{18 - x}{3} = 4 - 2x$$

$18 - x = 3(4 - 2x)$

$18 - x = 12 - 6x$

$6x - x = 12 - 18$

$5x = -6$

$x = -6 \div 5$

Answer $x =$ -1.2 [3]



24 In 2022 Rob sold his house for £227 700

This was a loss of 10%

He had bought the house from Lisa in 2019

She had made a profit of 15% in selling to Rob.

Work out how much Lisa originally paid for the house.

Rob bought it for: 90% = £227700

1% = 227700 ÷ 90 = £2530

100% = 2530 × 100 = £253000

Lisa: 115% = £253000

1% = 253000 ÷ 115 = £2200

100% = 2200 × 100 = £220000

Answer £ 220000 [4]

[Turn over

25 A ladder is placed against a vertical wall.

To be safe, it must be inclined at an angle between 70° and 80° to the ground.

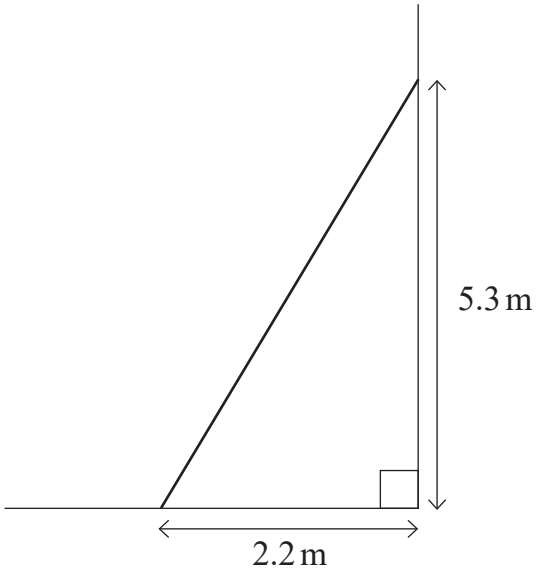


diagram not drawn accurately

Is the ladder positioned safely?

Show your working out clearly.

$\tan \alpha = \frac{5.3}{2.2}$

$\alpha = \tan^{-1}(5.3 \div 2.2) = 67.45693...°$

67.5° is less than 70°, so it is not between 70° and 80°

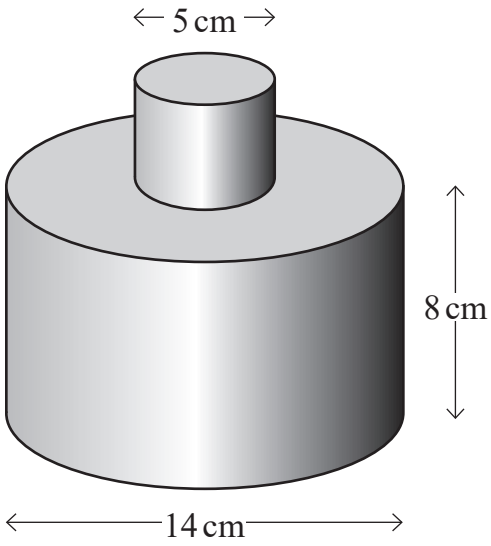
The ladder is not positioned safely

Answer No [3]

26 A solid is made from a cylinder of diameter 14 cm and height 8 cm, with a smaller cylinder of diameter 5 cm on top.

The total height of the solid is 12 cm.

Calculate the total surface area of the solid.



Base = $\pi \times 7^2 = 49\pi = 153.93804$ cm^2

Top of small cylinder = $\pi \times 2.5^2 = 6.25\pi = 19.63495408$

Curved large = $2 \times \pi \times 7 \times 8 = 112\pi = 351.8583772$

Small height = $12 - 8 = 4$: curved small = $2 \times \pi \times 2.5 \times 4 = 62.83185307$

Ring on large top = $49\pi - 6.25\pi = 134.3030859$

Total = $153.93804 + 19.63495408 + 351.8583772$

$+ 62.83185307 + 134.3030859 = 722.5663103$ cm^2

Answer 722.6 cm^2 [5]

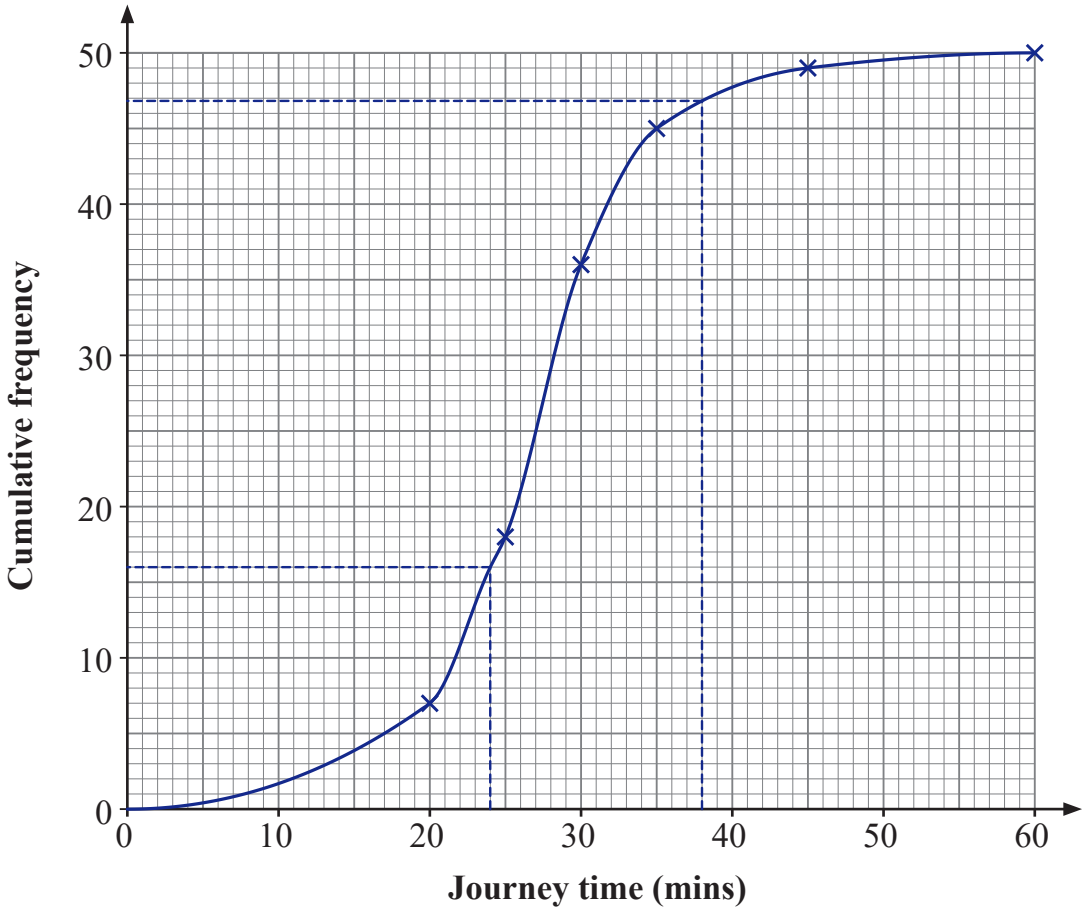
[Turn over

27 The grouped frequency table shows the time taken by 50 workers to travel to work.

Journey time (t mins)	Frequency	Journey time $\leq t$ mins	Cumulative frequency
$0 < t \leqslant 20$	7	20	7
$20 < t \leqslant 25$	11	25	18
$25 < t \leqslant 30$	18	30	36
$30 < t \leqslant 35$	9	35	45
$35 < t \leqslant 45$	4	45	49
$45 < t \leqslant 60$	1	60	50

(a) Complete the table above. [1]

(b) Draw the cumulative frequency graph on the grid below. [2]



(c) Use your graph to estimate the number of journeys that took between 24 and 38 minutes.

At 24 minutes: cumulative frequency ≈ 16

At 38 minutes: cumulative frequency ≈ 47

47 − 16 = 31

Answer 31 [2]

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