Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
November 2025

Mathematics

StemUp Model Solution

Unit M3
(With calculator)
Higher Tier



[GMC31]

GMC31

TUESDAY 18 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 thirty-one** questions.

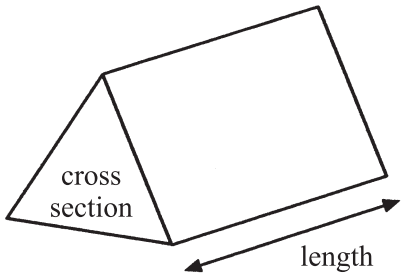
INFORMATION FOR CANDIDATES

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.

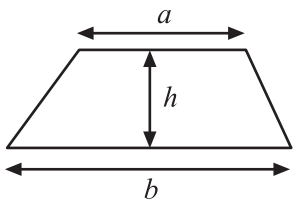
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Formula Sheet

Volume of prism = area of cross section × length

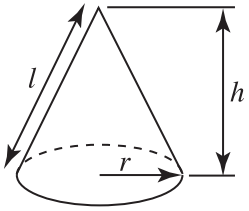


Area of trapezium = $\frac{1}{2}(a+b)h$



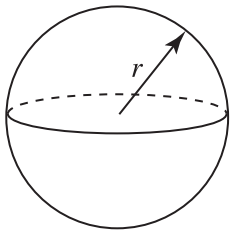
Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

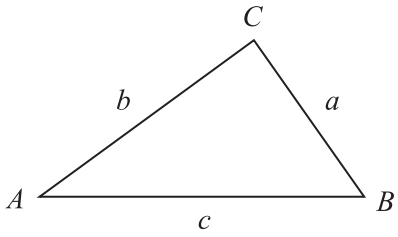


Volume of sphere = $\frac{4}{3}\pi r^3$

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: $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

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

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

stemup.co.uk

1 Work out the value of $2^3 + 3^2$

$2^3 = 2 \times 2 \times 2 = 8$

$3^2 = 3 \times 3 = 9$

$8 + 9 = 17$

Answer 17 [2]

2 Kasper wants to set a new 4-digit passcode for his phone.

He wants the first 2 digits to be a prime number between 20 and 30

He wants the last 2 digits to be a square number between 20 and 30

Write down both passcodes that he could use.

Primes between 20 and 30: 23, 29

Square numbers between 20 and 30: 25 ($5^2 = 25$)

Passcodes: 23 then 25 = 2325, 29 then 25 = 2925

Answer 2325 and 2925 [2]

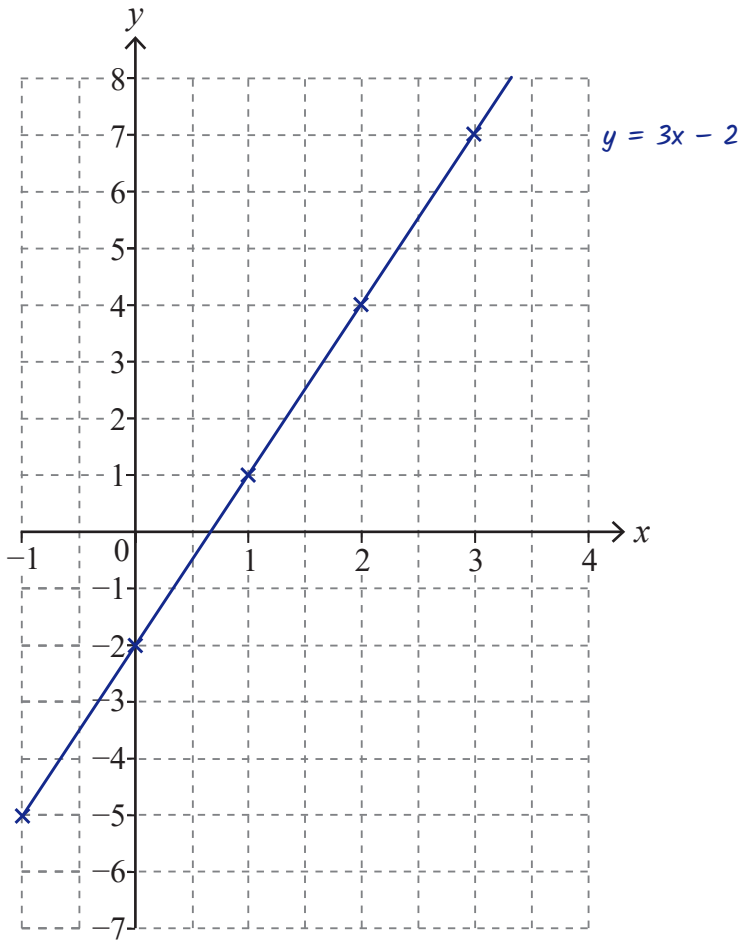
[Turn over

3 **(a)** **(i)** Complete the table for $y = 3x - 2$

x	−1	0	1	2	3
y	−5	−2	1	4	7

[1]

(ii) On the grid below, draw the graph of $y = 3x - 2$



[2]

(b) Solve the equation $3x - 2 = 5.5$

$3x - 2 = 5.5$

$3x = 5.5 + 2 = 7.5$

$x = 7.5 \div 3 = 2.5$

Answer $x =$ 2.5 [2]

4 **(a)** Claire bought 350 bonds at a cost of £4.20 per bond.

Later she bought another 200 bonds, but cannot remember how much she paid per bond.

The total amount she paid for all the bonds was £2500

Calculate how much Claire paid per bond when she bought the 200 bonds.

Show your working out clearly.

Cost of first 350 bonds: $350 \times 4.20 = £1470$

Cost of the 200 bonds: $2500 - 1470 = £1030$

Price per bond: $1030 \div 200 = £5.15$

Answer £ 5.15 [4]

(b) The "return on investment" value is the percentage profit Claire made.

Claire sold the bonds a year later for a total of £2850

What was her "return on investment" value?

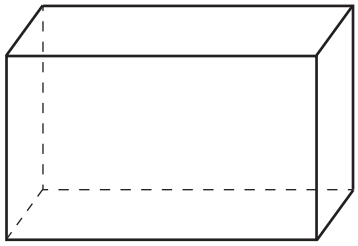
Profit $= 2850 - 2500 = £350$

Return $= \frac{350}{2500} \times 100 = 14\%$

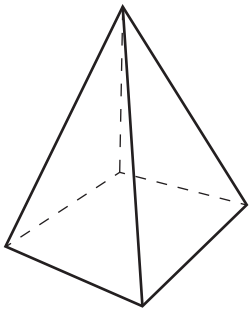
Answer 14 % [2]

[Turn over

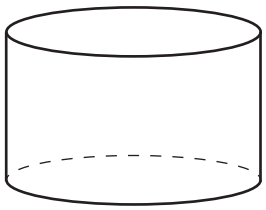
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Shape A



Shape B



Shape C

(a) What is the mathematical name of Shape A?

Answer Cuboid [1]

(b) Complete the sentences.

(i) Shape B has 8 edges. [1]

(ii) Shape B has 5 vertices. [1]

(c) Complete the sentence with the correct shape.

A net of Shape C would consist of 2 circles and a

rectangle. [1]

6 The six angles in two different triangles are listed in descending order.

The first four angles are 120° 80° 72° 40°

Find the size of the **smallest** angle that would complete the list.

Angles in a triangle add up to 180°

120° cannot go with 80° or 72° (total over 180°), so it goes with 40°:

120 + 40 = 160, 180 − 160 = 20°

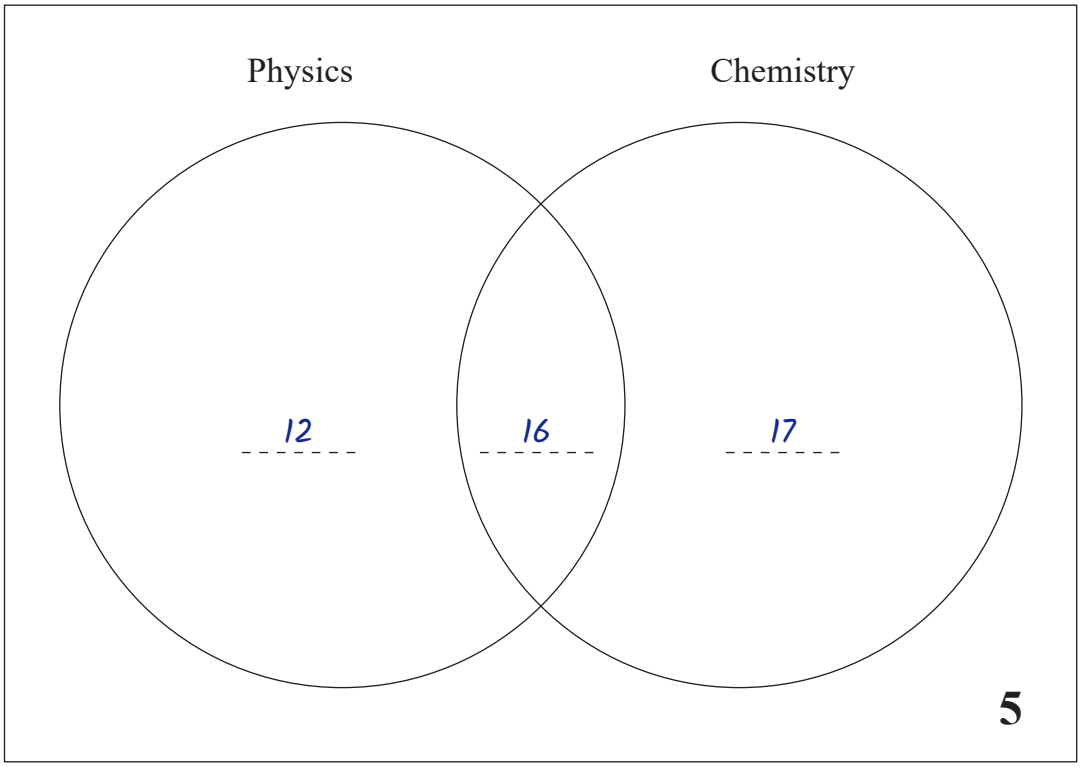
Other triangle: 80 + 72 = 152, 180 − 152 = 28°

List: 120°, 80°, 72°, 40°, 28°, 20° so the smallest is 20°

Answer _____*20*_____ ° [3]

[Turn over

7



The Venn diagram represents 50 students.

12 students study Physics but not Chemistry.

28 students study Physics.

Complete the Venn diagram to find the number of students who study Chemistry but not Physics.

Physics and Chemistry: 28 − 12 = 16

Chemistry only: 50 − 12 − 16 − 5 = 17

Answer *17* [3]

8 Pupils were asked to vote for how much homework they should get each week.

85 voted to have homework every night

105 voted not to have homework at all

110 voted to have homework on three nights per week

What percentage of pupils voted not to have homework at all?

Total = 85 + 105 + 110 = 300

$\frac{105}{300} \times 100 = 35\%$

Answer 35 % [2]

9 Use your calculator to find the value of

$$\frac{47.8 - 4.5^2}{15.6 + 4.85}$$

Round your answer to 2 decimal places.

Top: $47.8 - 4.5^2 = 47.8 - 20.25 = 27.55$

Bottom: $15.6 + 4.85 = 20.45$

$27.55 \div 20.45 = 1.347188264...$

$= 1.35$ (2 d.p.)

Answer 1.35 [2]

[Turn over

10 At a sports match

$\frac{5}{8}$ of the crowd supported the home team

$\frac{1}{3}$ of the crowd supported the away team

The rest of the crowd did not support either team.

What fraction of the crowd did not support either team?

$\frac{5}{8} + \frac{1}{3} = \frac{15}{24} + \frac{8}{24} = \frac{23}{24}$

$1 - \frac{23}{24} = \frac{1}{24}$

Answer $\frac{1}{24}$ [2]

11 A property developer bought a house for £84 000

He sold the house, making a profit of 12%

How much did he sell the house for?

12% of 84000 = 0.12 × 84000 = 10080

Selling price = 84000 + 10080 = 94080

Answer £ 94080 [3]

[Turn over

12 A quadrilateral has angles as shown in the diagram below.

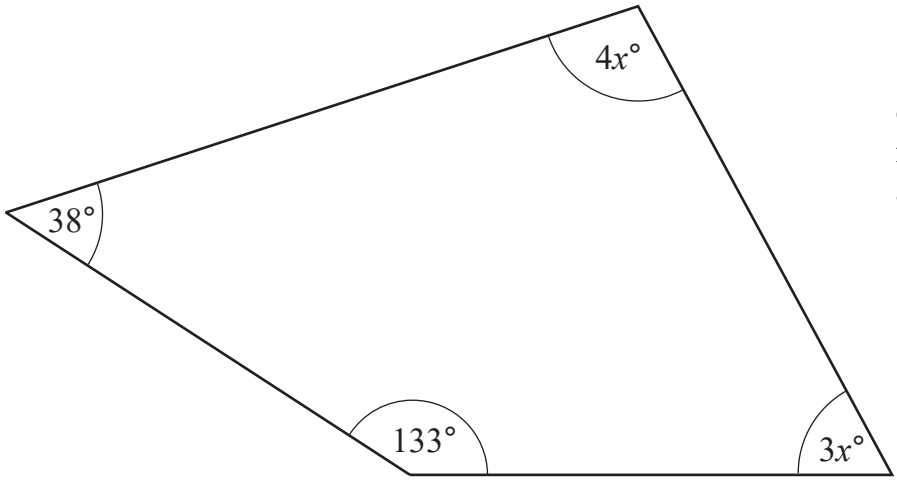


diagram not drawn accurately

Find the value of x

Show your working out clearly.

Angles in a quadrilateral add up to 360°

38 + 133 = 171

360 − 171 = 189

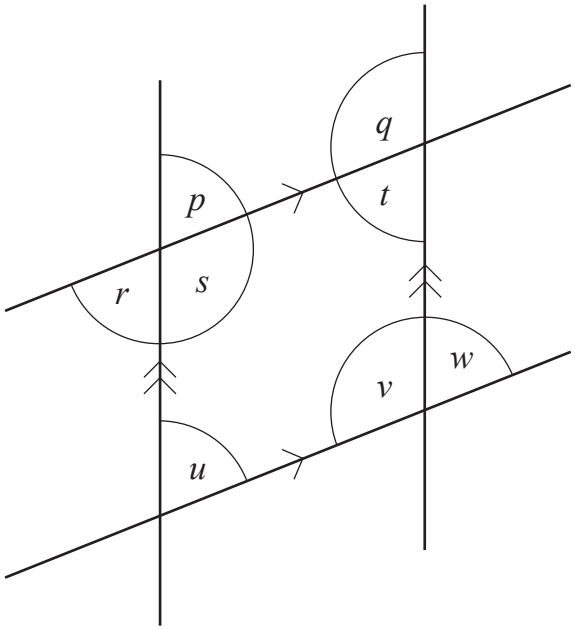
4x + 3x = 189

7x = 189

x = 189 ÷ 7 = 27

Answer $x =$ 27 [4]

13



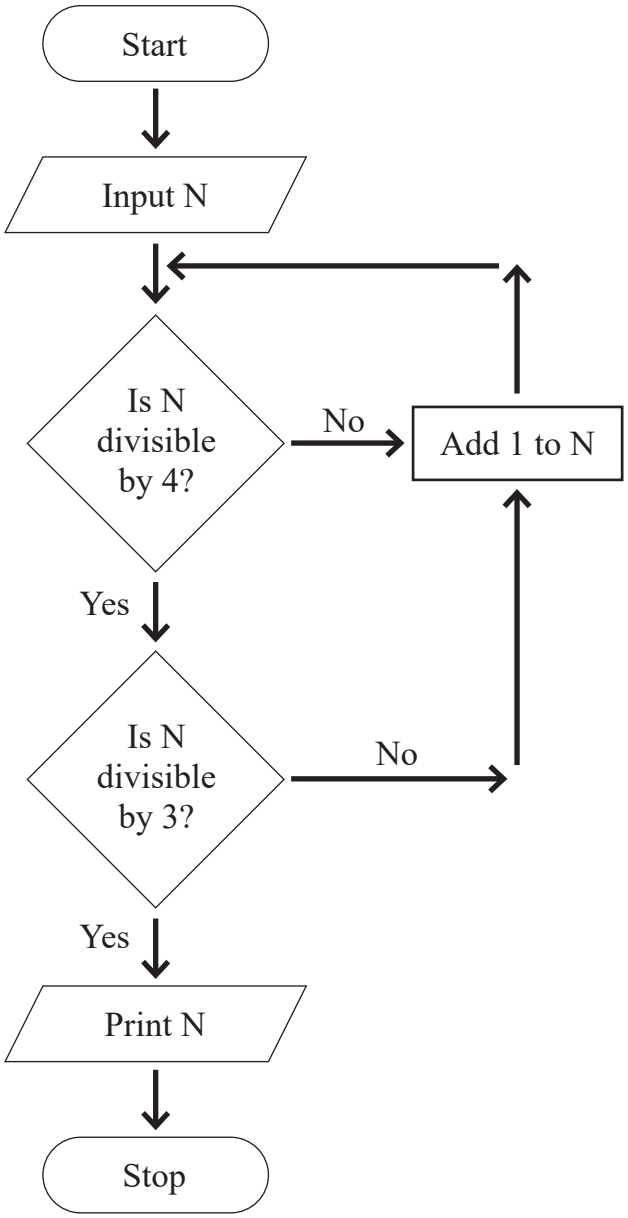
(a) Name an angle alternate to angle r Answer u [1]

(b) Name an angle corresponding to angle u Answer p [1]

(c) What is the sum of angle t and angle v? Answer 180 ° [1]

[Turn over

14 (a) Starting with N = 31, use the flow chart to find the number printed.



N = 31: not ÷ by 4, add 1

N = 32: ÷ by 4, but 32 is not ÷ by 3, add 1

N = 33: not ÷ by 4, add 1

N = 34: not ÷ by 4, add 1

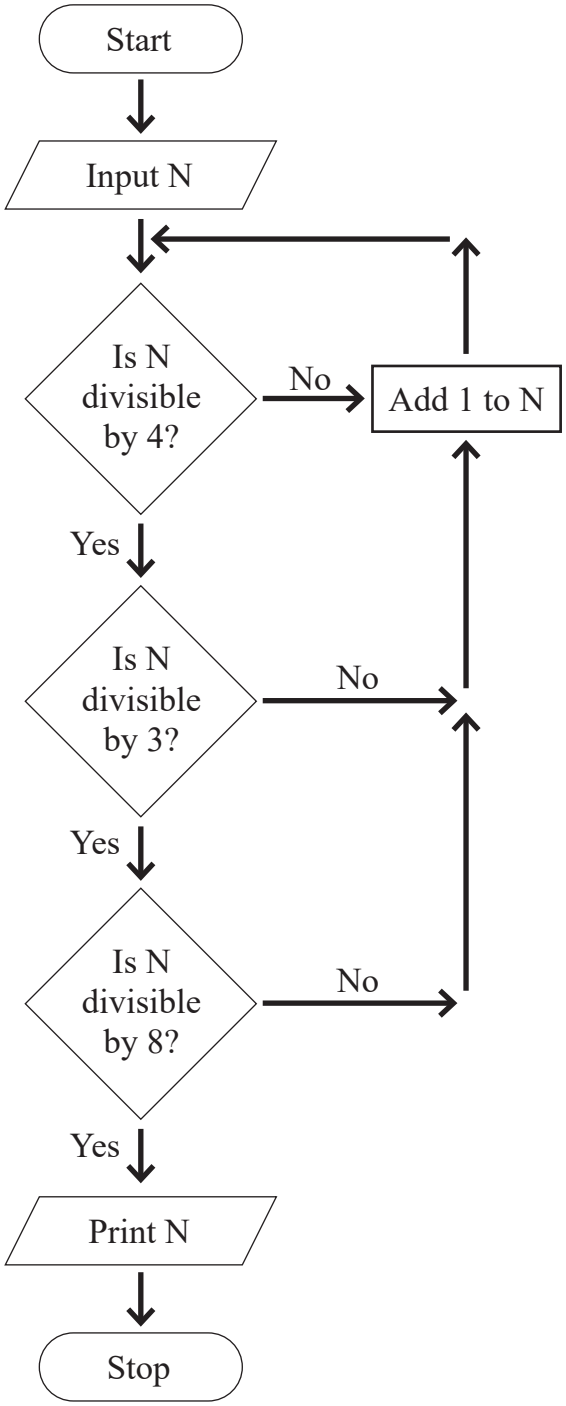
N = 35: not ÷ by 4, add 1

N = 36: 36 ÷ 4 = 9 and 36 ÷ 3 = 12, print 36

Answer 36 [2]

(b) A third decision box is added.

Starting with N = 31, find the number printed now.



36 ÷ 8 = 4.5, not ÷ by 8

40: ÷ 4 but not ÷ 3

44: ÷ 4 but not ÷ 3

48: 48 ÷ 4 = 12, 48 ÷ 3 = 16,
48 ÷ 8 = 6, print 48

Answer 48 [1]

[Turn over

15 Barbara wants to investigate the number of hours adults spend on social media.

She gives a questionnaire to a random sample of 60 members of a pensioners' club.

One of the questions is shown below.

How many hours do you spend on social media?

1 – 5 ☐

5 – 10 ☐

10 – 20 ☐

(a) Give **one** criticism of the **sample** she has selected.

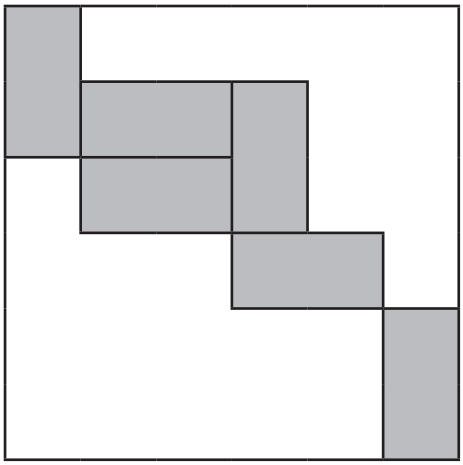
Answer *Not all adults are pensioners, so the sample is biased (it only includes one age group).* [1]

(b) Give **two** criticisms of the **questionnaire**.

1 *No time frame is given, e.g. per day or per week.*

2 *The options overlap, e.g. 5 hours fits in both 1 – 5 and 5 – 10, and there is no box for 0 or over 20 hours.* [2]

16 Six equal rectangles are placed inside a square of side 60 cm as shown in the diagram.



Calculate the area of the **unshaded** part of the square.

Show your working out clearly.

Across the square: 6 widths = 60 cm, so width = 60 ÷ 6 = 10 cm

Length = 2 widths = 20 cm

Area of one rectangle = 20 × 10 = 200 cm^2

Area of square = 60 × 60 = 3600 cm^2

Unshaded area = 3600 − 6 × 200 = 3600 − 1200 = 2400 cm^2

Answer 2400 cm^2 [4]

[Turn over

17 In March, a household electricity bill was £340

In June, the electricity bill was 15% less than in March.

In September, the electricity bill was 15% more than in June.

How much **less** was the bill in September than the bill in March?

June: $340 \times 0.85 = £289$

September: $289 \times 1.15 = £332.35$

Difference: $340 - 332.35 = £7.65$

Answer £ 7.65 [4]

18 150 expressed as a product of prime factors is $2 \times 3 \times 5^2$

What is the smallest number that 150 can be multiplied by to give a **square** number?

$150 = 2 \times 3 \times 5^2$: the 2 and the 3 need to be paired

$2 \times 3 = 6$ $(150 \times 6 = 900 = 30^2)$

Answer 6 [2]

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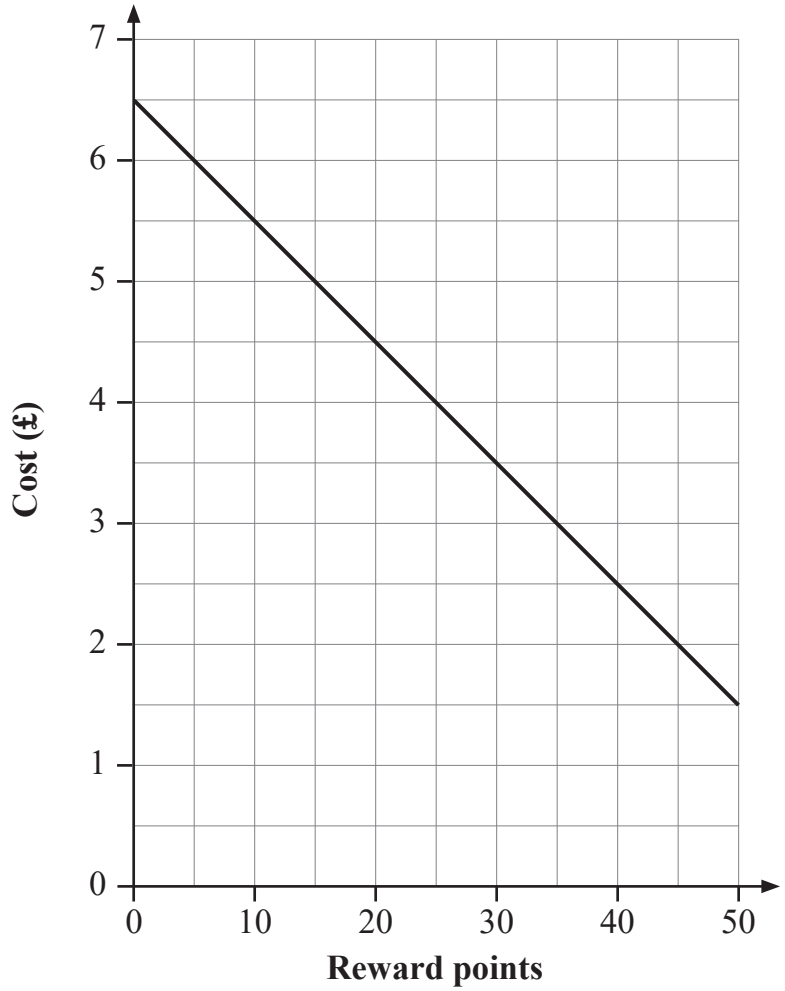
(Questions continue overleaf)

[Turn over

19 A supermarket offers discounts for customers who have collected reward points.

The graph shows the price of a tin of biscuits with reward points.

Customers can use a maximum of 50 reward points for each tin of biscuits.



(a) How much does a tin of biscuits cost with no reward points?

Answer £ 6.50 [1]

(b) How much is each reward point worth in pence?

With 0 points: £6.50, with 50 points: £1.50

50 points are worth 6.50 − 1.50 = £5.00 = 500p

1 point = 500 ÷ 50 = 10p (10 points = £1)

Answer 10 p [2]

(c) A customer wants to buy two tins of biscuits.

They have 85 reward points.

How much will they have to pay in total?

Max 50 points on one tin: 50 × 10p = £5, 6.50 − 5 = £1.50

Remaining 35 points on the other tin: 35 × 10p = £3.50

6.50 − 3.50 = £3.00

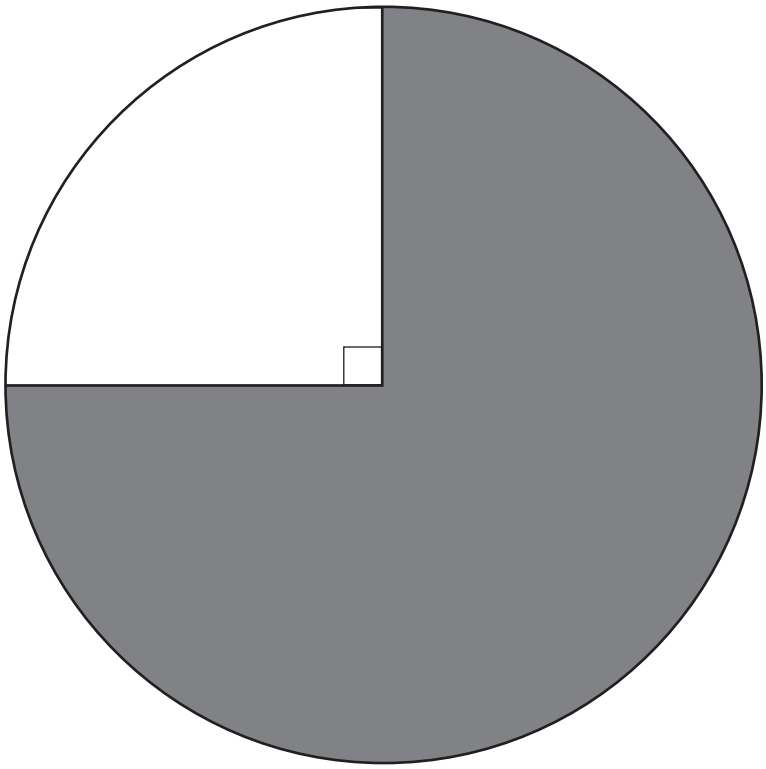
Total = 1.50 + 3.00 = £4.50

Answer £ 4.50 [2]

[Turn over

20 The circle below has a diameter of 8 cm.

Calculate the shaded area.



Radius = 8 ÷ 2 = 4 cm

Area of circle = π × 4^2 = 50.26548246 cm^2

Shaded = ¾ × 50.26548246 = 37.69911184...

= 37.7 cm^2 (3 s.f.)

Answer 37.7 cm^2 [3]

21 Calculate the perimeter of the shape shown.

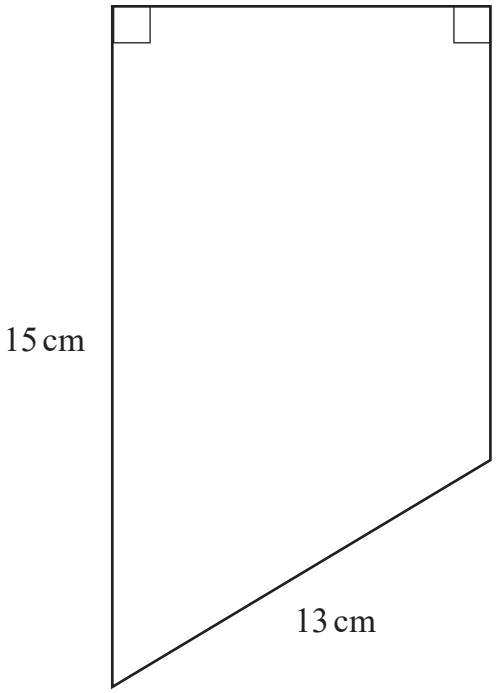


diagram not drawn accurately

Show your working out clearly.

Vertical difference = 15 − 10 = 5 cm

Top side x: $13^2 = 5^2 + x^2$

$x^2 = 169 - 25 = 144$

$x = \sqrt{144} = 12$ cm

Perimeter = 15 + 12 + 10 + 13 = 50 cm

Answer 50 cm [4]

[Turn over

22 The grouped frequency table shows the journey times to school for pupils.

Time t (minutes)	**Frequency**	Midpoint x	$f \times x$
$10 \leqslant t < 20$	13	15	195
$20 \leqslant t < 30$	23	25	575
$30 \leqslant t < 40$	9	35	315
$40 \leqslant t < 50$	5	45	225

Calculate an estimate for the journey time to school for pupils.

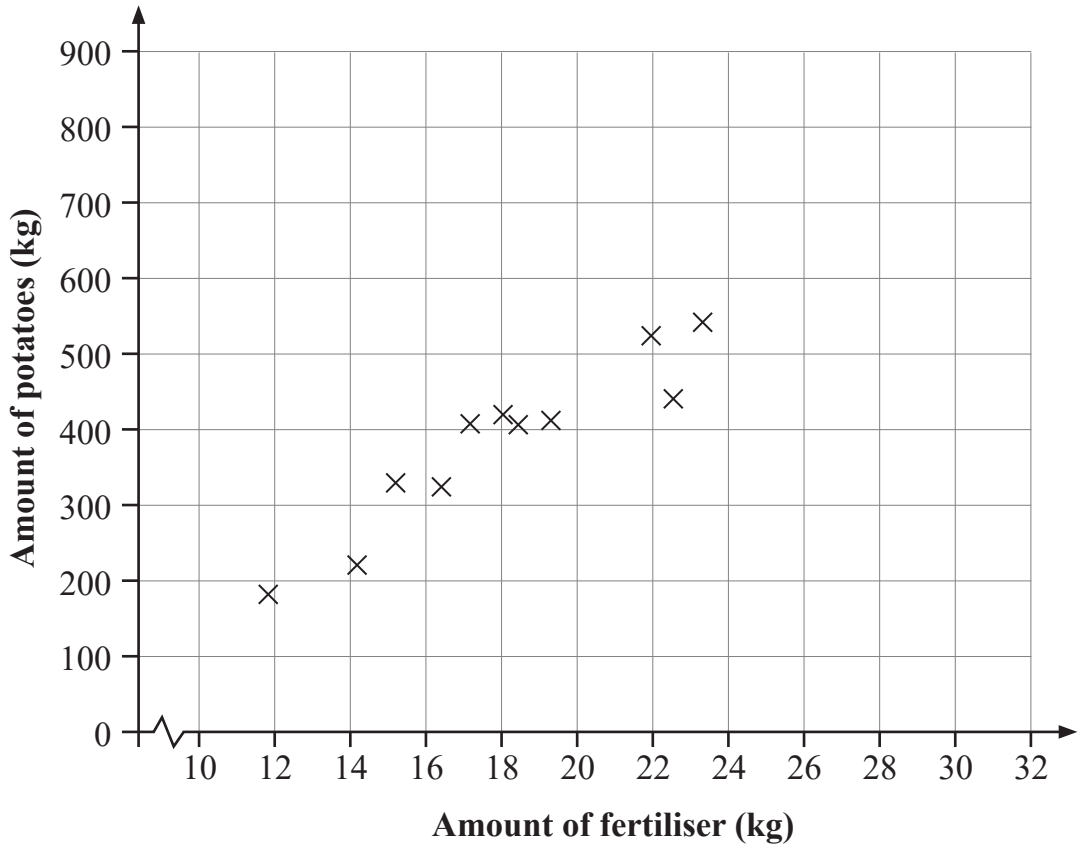
$\Sigma fx = 195 + 575 + 315 + 225 = 1310$

$\Sigma f = 13 + 23 + 9 + 5 = 50$

$\text{Mean} = \frac{1310}{50} = 26.2 \text{ minutes}$

Answer 26.2 minutes [4]

23 The scatter graph shows positive correlation between the amount of potatoes produced (kg) and the amount of fertiliser used (kg).



Zara suggests drawing a line of best fit to estimate the amount of potatoes produced when the amount of fertiliser used is 32 kg.

(a) Give a statistical reason why this would not be recommended.

32 kg is outside the range of the data, so it is extrapolation [1]

(b) Suggest an amount of fertiliser for which a line of best fit could be used.

Answer *18* kg [1]

[Turn over

24

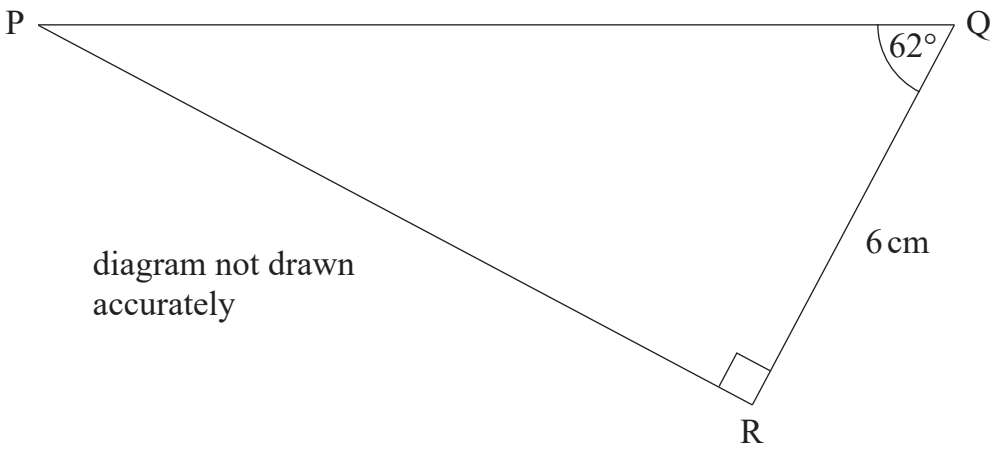


diagram not drawn accurately

Calculate the length of PQ.

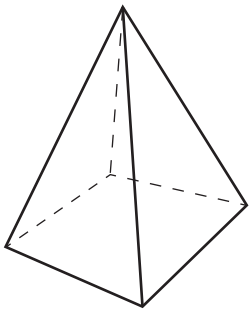
QR is adjacent to 62°, PQ is the hypotenuse

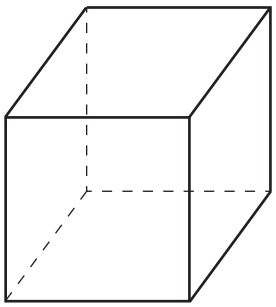
$\cos 62° = \frac{6}{PQ}$

$PQ = \frac{6}{\cos 62°} = 12.78032681...$

Answer 12.78 cm [3]

25 A square-based pyramid and a cube both exert the same **pressure** on the ground.





The cube exerts a force of 560 N.

The pyramid exerts a force of 140 N.

The length of the sides of the cube is 5 cm.

Calculate the length of the sides of the square base of the pyramid.

Area of cube face = $5 \times 5 = 25$ cm^2

Pressure = $\frac{560}{25} = 22.4$ N/cm^2

Area of pyramid base = $\frac{140}{22.4} = 6.25$ cm^2

Length = $\sqrt{6.25} = 2.5$ cm

Answer 2.5 cm [3]

[Turn over

26 The percentage scores in a Maths test were analysed.

The maximum score was 98%

Min = 98 − 82 = 16

The median score was 36%

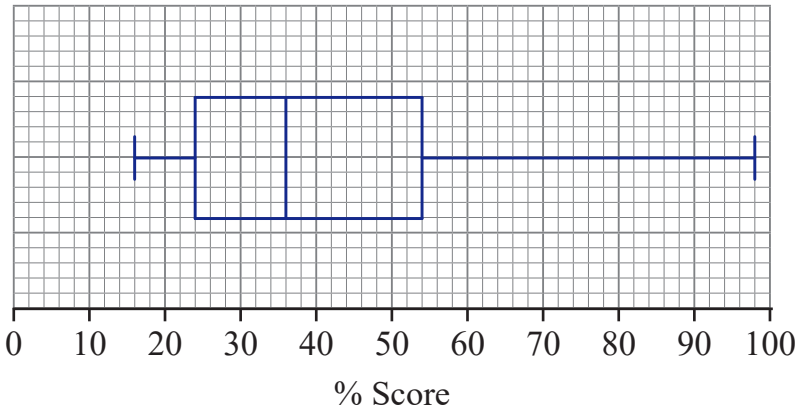
LQ = 54 − 30 = 24

The upper quartile was 54%

The range was 82%

The interquartile range was 30%

(a) Draw a box plot to represent this data set.



[4]

(b) Explain why the interquartile range is more representative of the data set than the range.

Answer The range is affected by the extreme maximum value (98%); the IQR uses only the middle 50% of the data. [1]

27 A rectangular pitch has length $(4x - 1)$ and width $(2x + 5)$.

Find an expression for the area of the pitch.

Expand and simplify your answer.

Area = $(4x - 1)(2x + 5)$

$= 8x^2 + 20x - 2x - 5$

$= 8x^2 + 18x - 5$

Answer $8x^2 + 18x - 5$ [2]

28 Factorise

$$c^2 - 12c + 27$$

Two numbers that multiply to 27 and add to −12:

$-9 \times -3 = 27, \quad -9 + -3 = -12$

Answer $(c - 9)(c - 3)$ [2]

[Turn over

29 Solve the equation

$$\frac{3x-1}{2} - \frac{1}{3} = \frac{4x-3}{3}$$

Multiply every term by 6:

$3(3x - 1) - 2 = 2(4x - 3)$

$9x - 3 - 2 = 8x - 6$

$9x - 8x = -6 + 3 + 2$

$x = -1$

Answer $x =$ _____ −1 _____ [4]

30 A car depreciated in value by 6.2%

The value is now £22 512

What was the value before the depreciation?

100% − 6.2% = 93.8%, so 93.8% = £22512

1% = 22512 ÷ 93.8 = 240

100% = 240 × 100 = £24000

Answer £ _____ 24000 _____ [3]

31 Find the equation of the straight line passing through the points (0, 8) and (6, –4).

Give your answer in the form $y = mx + c$

$m = \frac{-4 - 8}{6 - 0} = \frac{-12}{6} = -2$

Line passes through (0, 8), so $c = 8$

$y = -2x + 8$

Answer $y = -2x + 8$ [3]

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Question Number	**Marks**
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