Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
November 2025

Mathematics

StemUp Model Solution

Unit M4
(With calculator)
Higher Tier



[GMC41]

GMC41

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 twenty-four** questions.

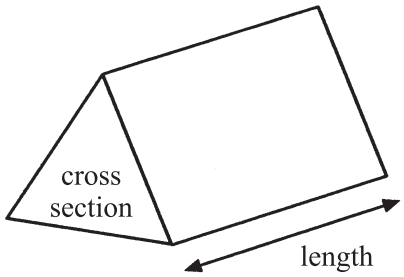
INFORMATION FOR CANDIDATES

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.

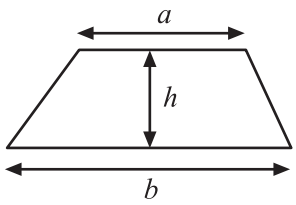
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Formula Sheet

Volume of prism = area of cross section × length

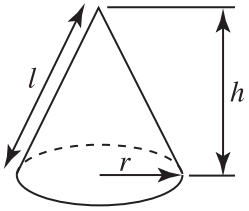


Area of trapezium = $\frac{1}{2}(a+b)h$



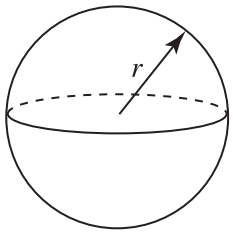
Volume of cone = $\frac{1}{3}\pi r^2 h$

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

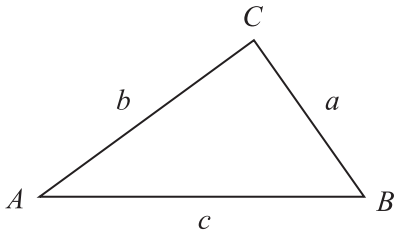


Volume of sphere = $\frac{4}{3}\pi r^3$

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

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

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

15155

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(Questions begin overleaf)

1 Claire bought bonds at a cost of £2500

The "return on investment" value is the percentage profit she made.

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

What was her "return on investment" value?

Show your working out clearly.

Profit = 2850 − 2500 = £350

$$\text{Return} = \frac{350}{2500} \times 100$$

= 14%

Answer 14 % [2]

2 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 × 0.85 = £289

September: 289 × 1.15 = £332.35

Difference = 340 − 332.35 = £7.65

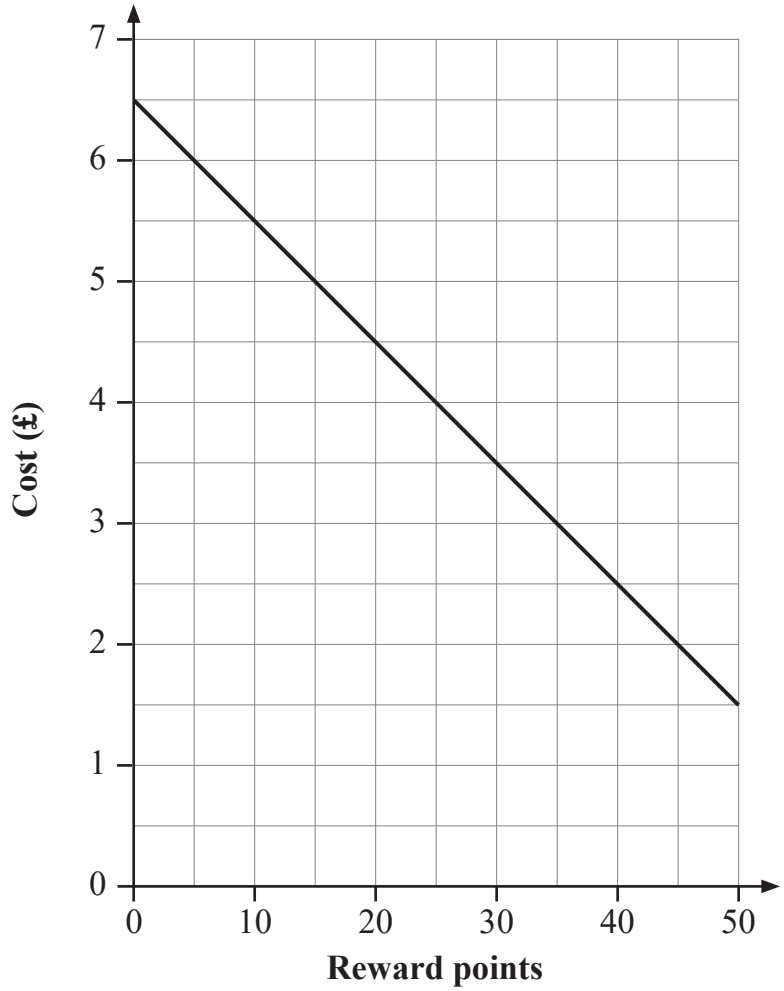
Answer £ 7.65 [4]

[Turn over

3 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?

Line meets cost axis at 0 points: £6.50

Answer £ 6.50 [1]

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

50 points reduce cost from £6.50 to £1.50

50 points = £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?

85 points × 10p = £8.50 discount

Cost of two tins = 2 × 6.50 = £13.00

13.00 − 8.50 = £4.50

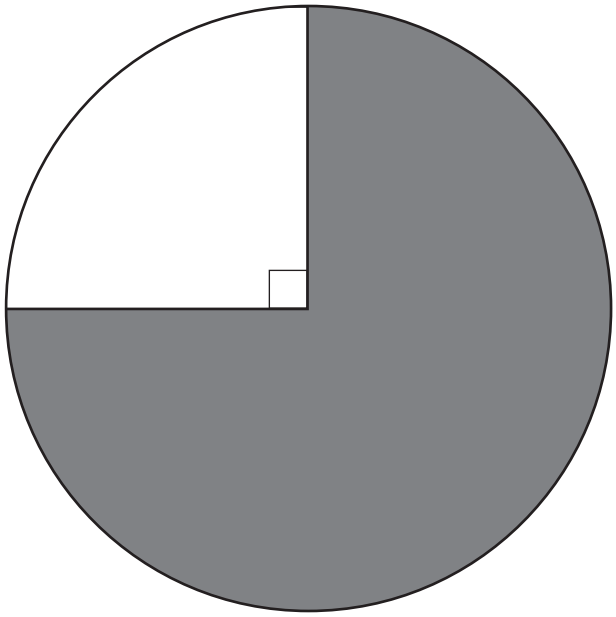
(e.g. 50 points on one tin: £1.50, 35 on the other: £3.00)

Answer £ 4.50 [2]

[Turn over

4 The circle below has a diameter of 8 cm.

Calculate the shaded area.



radius = 8 ÷ 2 = 4 cm

Area of circle = $\pi \times 4^2$ = 50.26548246 cm^2

Shaded = $\frac{3}{4} \times 50.26548246$

= 37.69911184...

= 37.7 cm^2

Answer 37.7 cm^2 [3]

5 150 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?

$150 = 2 \times 3 \times 5^2$

2 and 3 have odd powers, so multiply by 2×3

Answer 6 [2]

[Turn over

6 Calculate the perimeter of the shape shown.

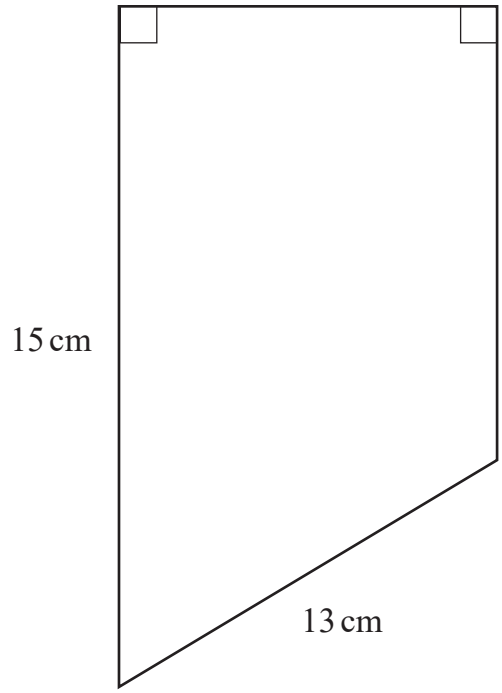


diagram not drawn accurately

Show your working out clearly.

Draw a horizontal line from the bottom of the 10 cm side:

vertical difference = 15 − 10 = 5 cm

$13^2 = 5^2 + x^2$

$x^2 = 169 - 25 = 144$

$x = \sqrt{144} = 12$ cm (top side)

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

Answer 50 cm [4]

7 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 mean journey time to school for pupils.

$\Sigma fx = 15 \times 13 + 25 \times 23 + 35 \times 9 + 45 \times 5$

$= 195 + 575 + 315 + 225 = 1310$

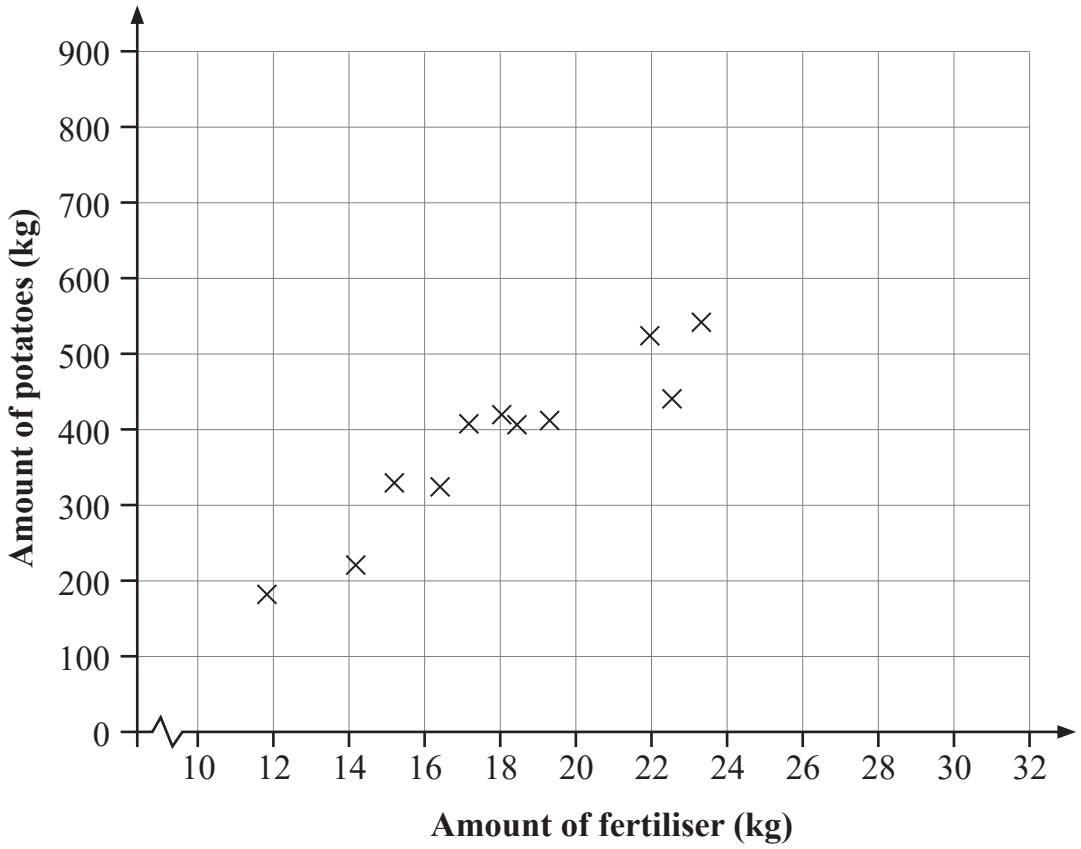
$\Sigma f = 13 + 23 + 9 + 5 = 50$

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

Answer 26.2 minutes [4]

[Turn over

8 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 (extrapolation) [1]

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

Answer 18 kg [1]

9

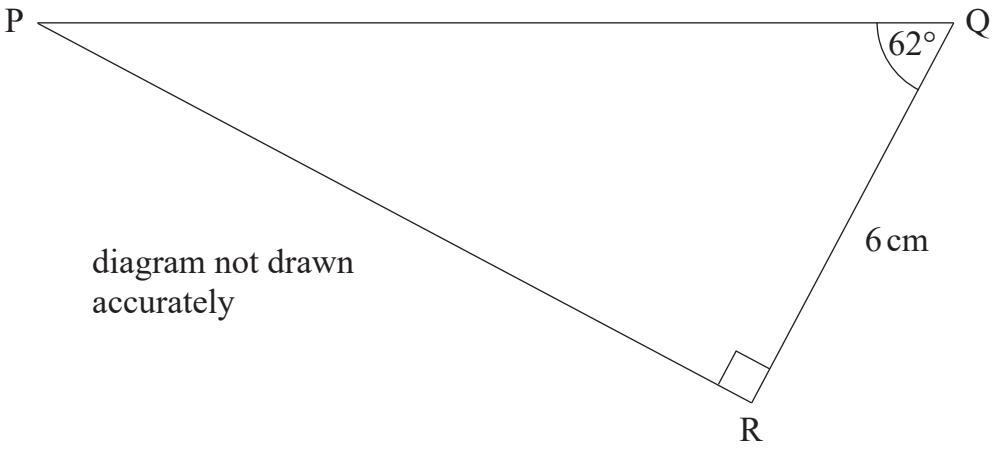


diagram not drawn accurately

Calculate the length of PQ.

QR is adjacent to 62°, PQ is the hypotenuse

$\cos 62° = \frac{6}{PQ}$

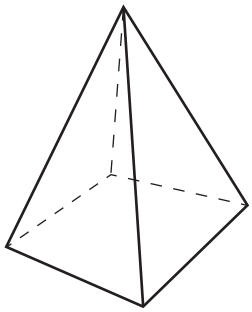
$PQ = \frac{6}{\cos 62°}$

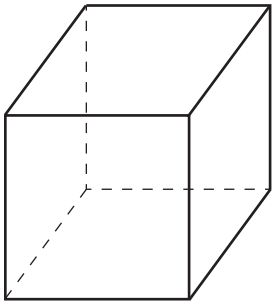
$= 12.78032681... = 12.78$ cm

Answer 12.78 cm [3]

[Turn over

10 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.

Pressure of cube = $\frac{560}{5 \times 5} = \frac{560}{25} = 22.4$ N/cm^2

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

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

Answer 2.5 cm [3]

11 The percentage scores in a Maths test were analysed.

The maximum score was 98%

The median score was 36%

The upper quartile was 54%

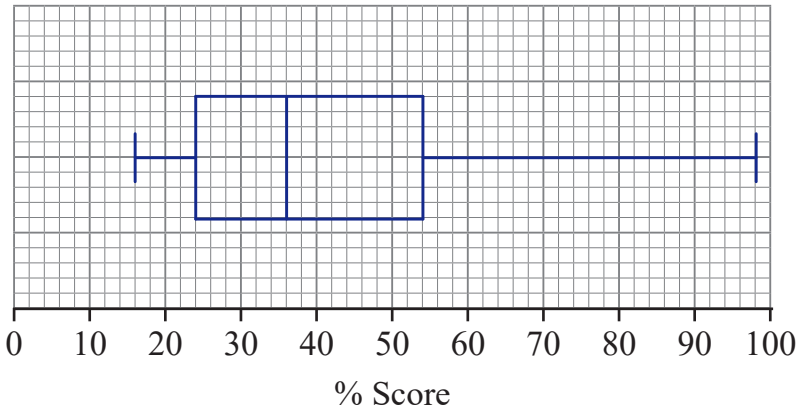
The range was 82%

The interquartile range was 30%

Min = 98 − 82 = 16

LQ = 54 − 30 = 24

(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% so ignores extreme values [1]

[Turn over

12 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]

13 Factorise

(a) $c^2 - 12c + 27$

Two numbers: product 27, sum −12

−9 and −3

(c − 9)(c − 3)

Answer *(c − 9)(c − 3)* [2]

(b) $t^2 - 64$

Difference of two squares: $t^2 - 8^2$

(t + 8)(t − 8)

Answer *(t + 8)(t − 8)* [1]

[Turn over

14 Solve the equation

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

Multiply every term by 6:

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

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

$9x - 5 = 8x - 6$

$9x - 8x = -6 + 5$

$x = -1$

Answer $x =$ -1 [4]

15 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%

Original × 0.938 = 22 512

Original = 22 512 ÷ 0.938

= £24 000

Answer £ 24 000 [3]

15155

16 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]

[Turn over

17

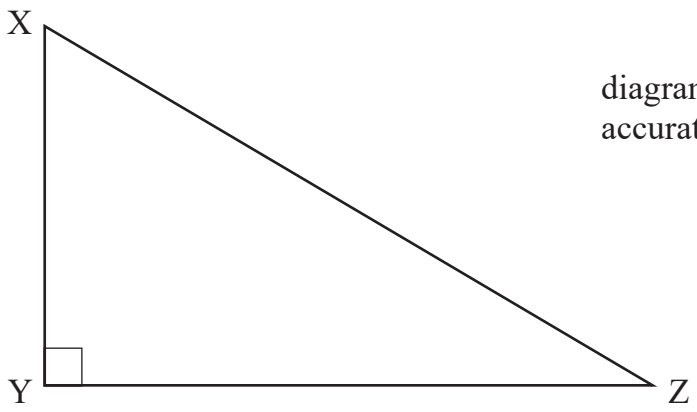


diagram not drawn accurately

For the triangle XYZ the following measurements are given.

XZ = 4.68 cm correct to 3 significant figures.

XY = 2.7 cm correct to 1 decimal place.

Calculate the upper bound for the length of YZ.

Upper bound XZ = 4.685 cm

Lower bound XY = 2.65 cm

$YZ^2 = XZ^2 - XY^2$

Upper bound YZ = $\sqrt{(4.685^2 - 2.65^2)}$

$= \sqrt{(21.949225 - 7.0225)}$

$= \sqrt{14.926725}$

= 3.863512003 cm

Answer 3.863512003 cm [4]

18 Line L passes through the points (3, –2) and (9, –1).

Line K passes through the points (d, 23) and (–1, 5).

Lines L and K are perpendicular.

Find the value of d.

Gradient of L = $\frac{-1-(-2)}{9-3} = \frac{1}{6}$

Perpendicular, so gradient of K = −6

$\frac{5-23}{-1-d} = -6$

$-18 = -6(-1-d)$

$-18 = 6 + 6d$

$6d = -24$

$d = -4$

Answer d = −4 [4]

[Turn over

19 The diagram shows a shape made from two rectangles.

All lengths are given in cm.

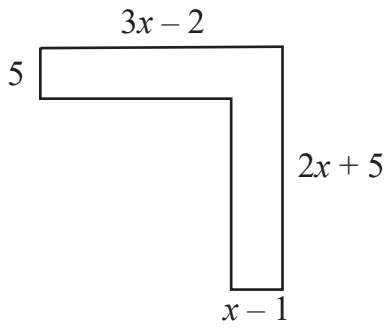


diagram not drawn accurately

The area of the shape is 122 cm^2

By setting up and solving a quadratic equation find the value of x

Area = $5(3x - 2) + 2x(x - 1) = 122$

[top rectangle 5 by $(3x - 2)$; lower part $(x - 1)$ by $(2x + 5 - 5) = 2x$]

$15x - 10 + 2x^2 - 2x = 122$

$2x^2 + 13x - 132 = 0$

$(2x - 11)(x + 12) = 0$

$x = 5.5$ or $x = -12$ (length cannot be negative)

Answer $x =$ 5.5 [5]

20

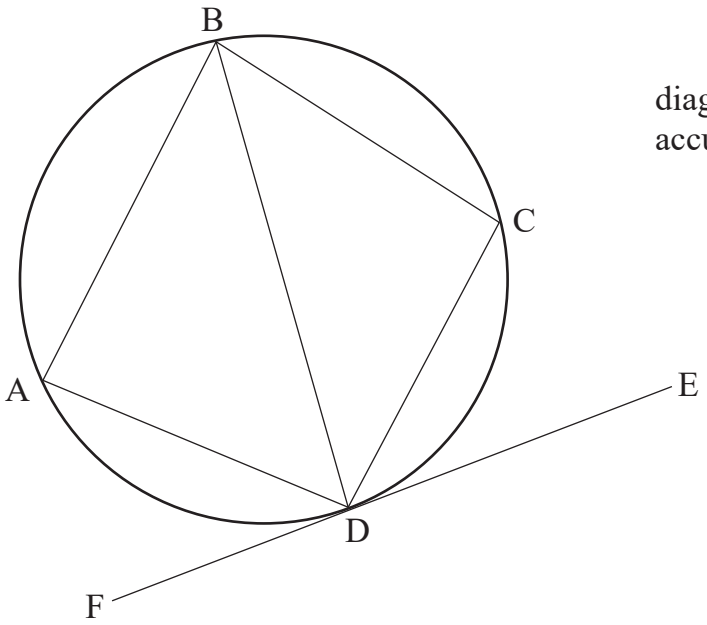


diagram not drawn accurately

A, B, C and D are points on the circumference of a circle.

EF is a tangent to the circle.

Angle BAD = 88°

Angle CBD = 27°

(a) Angle BCD = 92 ° because opposite angles in a cyclic quadrilateral add up to 180° (180 – 88 = 92) [2]

(b) Angle CDE = 27 ° because of the alternate segment theorem (angle between tangent and chord CD = angle CBD = 27°) [2]

(c) Explain why BD cannot be a diameter of the circle.

Angle BAD = 88°, not 90°. If BD were a diameter, angle BAD would be an angle in a semicircle, which must be 90° [2]

[Turn over

21

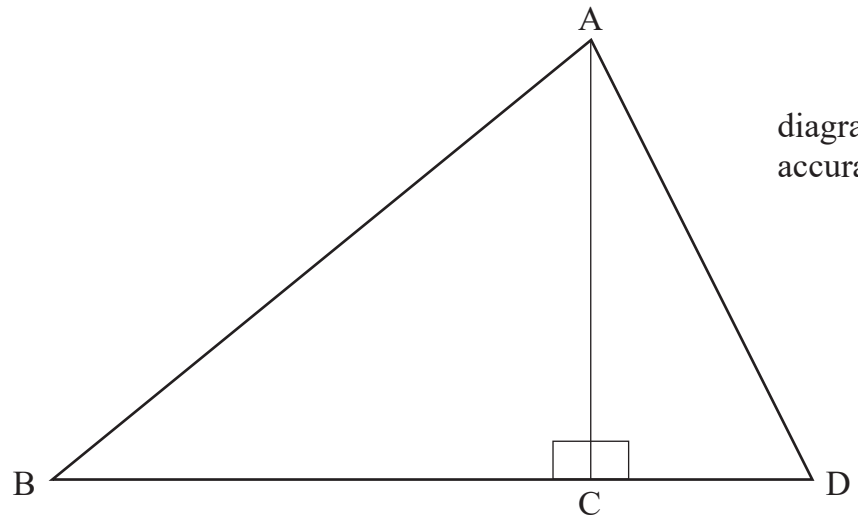


diagram not drawn accurately

Angle CAD = 36°

AD = 9.5 cm

AC is 5 cm shorter than AB

Work out the size of angle ABC. Give your answer to 1 decimal place.

$\cos 36° = \frac{AC}{9.5}$

$AC = 9.5 \times \cos 36° = 7.685661447 \text{ cm}$

$AB = 7.685661447 + 5 = 12.685661447 \text{ cm}$

$\sin B = \frac{AC}{AB} = \frac{7.685661447}{12.685661447} = 0.6058...$

$B = \sin^{-1}(0.6058...) = 37.29... = 37.3°$

Answer 37.3 ° [5]

22 **(a)** Factorise fully

$$3ax^2 - 108ay^2$$

$3ax^2 - 108ay^2 = 3a(x^2 - 36y^2)$

$= 3a(x + 6y)(x - 6y)$

Answer $3a(x + 6y)(x - 6y)$ [3]

(b) Hence, simplify

$$\frac{3ax^2 - 108ay^2}{5x^2 + 30xy} \div \frac{6a^2}{3x^2 - 2x}$$

$\frac{3a(x + 6y)(x - 6y)}{5x(x + 6y)} \div \frac{6a^2}{x(3x - 2)}$

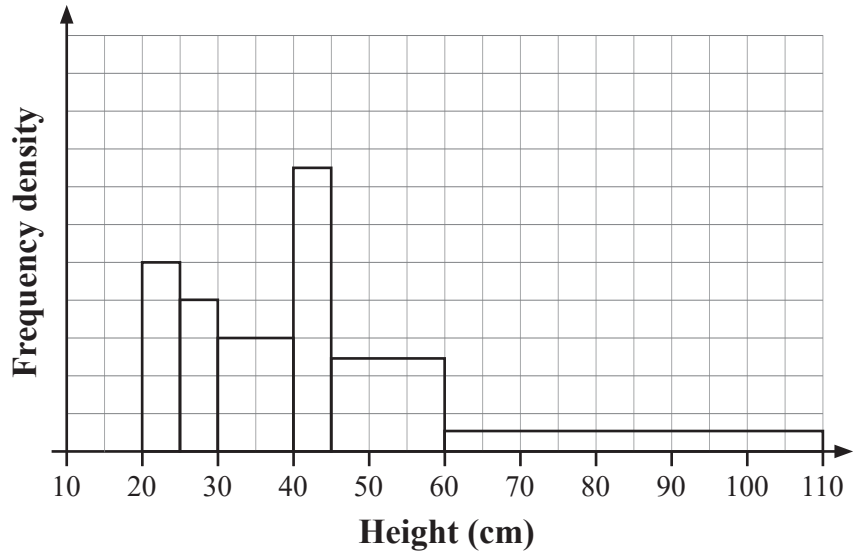
$= \frac{3a(x + 6y)(x - 6y)}{5x(x + 6y)} \times \frac{x(3x - 2)}{6a^2}$

$= \frac{(x - 6y)(3x - 2)}{10a}$

Answer $\frac{(x - 6y)(3x - 2)}{10a}$ [3]

[Turn over

23 The histogram gives information about the heights of some plants.



The number of plants with a height between 45 cm and 60 cm is 25 more than the number of plants with a height between 20 cm and 25 cm.

(a) Calculate the total number of plants represented by the histogram.

Let one small square = x (frequency density)

45 to 60: 15 × 2.5x = 37.5x; 20 to 25: 5 × 5x = 25x

37.5x − 25x = 25 → 12.5x = 25 → x = 2

Frequencies (width × fd):

20-25: 5 × 10 = 50 25-30: 5 × 8 = 40

30-40: 10 × 6 = 60 40-45: 5 × 15 = 75

45-60: 15 × 5 = 75 60-110: 50 × 1 = 50

Total = 50 + 40 + 60 + 75 + 75 + 50 = 350

Answer *350* [4]

(b) (i) Calculate an estimate for the median height.

350 ÷ 2 = 175th plant

Cumulative: 50, 90, 150, 225 so median is in 40-45

$40 + \frac{25}{75} \times 5 = 41.66... = 41.7$ cm

Answer 41.7 cm [3]

(ii) Give a reason why your answer for the median height is only an estimate.

We do not know the exact height of each plant [1]

(c) A stratified sample of 80 plants is taken from this data.

Calculate an estimate for how many plants in the stratified sample have height more than 55 cm.

Height more than 55 cm:

55-60: 5 × 10 = 25, 60-110: 50

25 + 50 = 75 plants

$\frac{75}{350} \times 80 = 17.14... \approx 17$

Answer 17 [3]

[Turn over

24 Solve the equation

$$\frac{4}{p-1} - \frac{5}{2p+1} = \frac{2}{3}$$

~~Give your answers to 2 decimal places.~~

$\frac{4(2p+1) - 5(p-1)}{(p-1)(2p+1)} = \frac{2}{3}$

$\frac{8p + 4 - 5p + 5}{2p^2 + p - 2p - 1} = \frac{2}{3}$

$\frac{3p + 9}{2p^2 - p - 1} = \frac{2}{3}$

$3(3p + 9) = 2(2p^2 - p - 1)$

$9p + 27 = 4p^2 - 2p - 2$

$4p^2 - 11p - 29 = 0$

$p = \frac{11 \pm \sqrt{((-11)^2 - 4 \times 4 \times (-29))}}{2 \times 4} = \frac{11 \pm \sqrt{585}}{8}$

$p = 4.40086...$ or $p = -1.64836...$

$p = 4.40$ or $p = -1.65$

Answer p = 4.40 or −1.65 [7]

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