Elite Mathematics
Pearson Edexcel International GCSE

IGCSE LINEAR · 4MA1

4MA1/2H June 2026 Worked Solutions

June 2026 paper rebuilt with the worked solution after each question.

26	2020–2026	Single-paper solutions
paper questions	55 past papers	checked by Dr Eslam



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PAST PAPER

4MA1/2H June 2026

June 2026

26	100	2 h
questions	marks	exam time

Each question is followed by its worked solution and final answer.

4MA1/2H JUNE 2026

Question 1

3 marks | Number Toolkit

1 Write 4500 as a product of powers of its prime factors.
Show your working clearly.

.....

(Total for Question 1 is 3 marks)

WORKED SOLUTION

Question 1 · 4MA1/2H June 2026

1 Solution | Step 1

$$4500 = 45 \times 100 = (9 \times 5)(4 \times 25).$$

Split into factors that are easy to prime-factorise.

2 Solution | Step 2

$$4500 = (3^2 \times 5)(2^2 \times 5^2) = 2^2 \times 3^2 \times 5^3.$$

Express each factor as prime powers and combine powers of 5.

FINAL ANSWER

$2^2 \times 3^2 \times 5^3$

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Question 2

5 marks | Sequences

2 The nth term of an arithmetic sequence is given by $8n - 5$

(a) Work out the ratio of the 40th term of the sequence to the 60th term of the sequence.
Give your ratio in its simplest form.

.....

(3)

Here are the first five terms of a different arithmetic sequence.

3 8 13 18 23

(b) Find an expression for the nth term of this sequence.

.....

(2)

(Total for Question 2 is 5 marks)

WORKED SOLUTION

Question 2 · 4MA1/2H June 2026

1 **Part (a) | Step 1**

$$u_{40} = 8(40) - 5 = 315, \qquad u_{60} = 8(60) - 5 = 475.$$

Substitute the two term numbers into the given rule.

2 **Part (a) | Step 2**

$$315 : 475 = (315 \div 5) : (475 \div 5) = 63 : 95.$$

Divide both entries by their highest common factor, 5.

3 **Part (b) | Step 1**

The common difference is $8 - 3 = 5$, so the rule has the form $5n + c$.

A constant difference gives a linear nth term.

4 **Part (b) | Step 2**

At $n = 1$, $5 + c = 3$, giving $c = -2$. Thus $u_n = 5n - 2$.

Use the first term to find the constant.

✓ **FINAL ANSWER**

(a) $63 : 95$ (b) $5n - 2$

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Question 3

5 marks | Averages from Frequency Tables

3 The table shows information about the number of hours each of 40 candles burned.

Number of hours (h)	Frequency
$15 < h \leqslant 19$	2
$19 < h \leqslant 23$	5
$23 < h \leqslant 27$	12
$27 < h \leqslant 31$	15
$31 < h \leqslant 35$	6

(a) Write down the modal class.

.....

(1)

(b) Work out an estimate for the mean number of hours.

..... hours

(4)

(Total for Question 3 is 5 marks)

WORKED SOLUTION

Question 3 · 4MA1/2H June 2026

1 **Part (a) | Step 1**

The greatest frequency is 15, in the interval $27 < h \leq 31$.

The modal class is the class with the highest frequency.

2 **Part (b) | Step 1**

The class midpoints are $17, 21, 25, 29, 33$ hours.

Use the midpoint of each class as a representative value.

3 **Part (b) | Step 2**

$$\sum fm = 2(17) + 5(21) + 12(25) + 15(29) + 6(33)$$

$$= 34 + 105 + 300 + 435 + 198 = 1072.$$

Multiply each midpoint by its frequency and add.

4 **Part (b) | Step 3**

$$\text{Estimated mean} = \frac{1072}{2+5+12+15+6} = \frac{1072}{40} = 26.8 \text{ hours}.$$

Divide the estimated total by the number of candles.

✓ **FINAL ANSWER**

(a) $27 < h \leq 31$ (b) 26.8 hours

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Question 4

3 marks | Reverse Percentages

4 Sara sells water bottles.

In July, she sold 450 water bottles.
In August, she sold 612 water bottles.

Work out the percentage increase in the number of water bottles she sold from July to August.

..... %

(Total for Question 4 is 3 marks)

WORKED SOLUTION

Question 4 · 4MA1/2H June 2026

1 Solution | Step 1

$$\text{Increase} = 612 - 450 = 162.$$

Find the change from the original number.

2 Solution | Step 2

$$\text{Percentage increase} = \frac{162}{450} \times 100 = 36\%.$$

Express the increase as a percentage of the July value, not the August value.

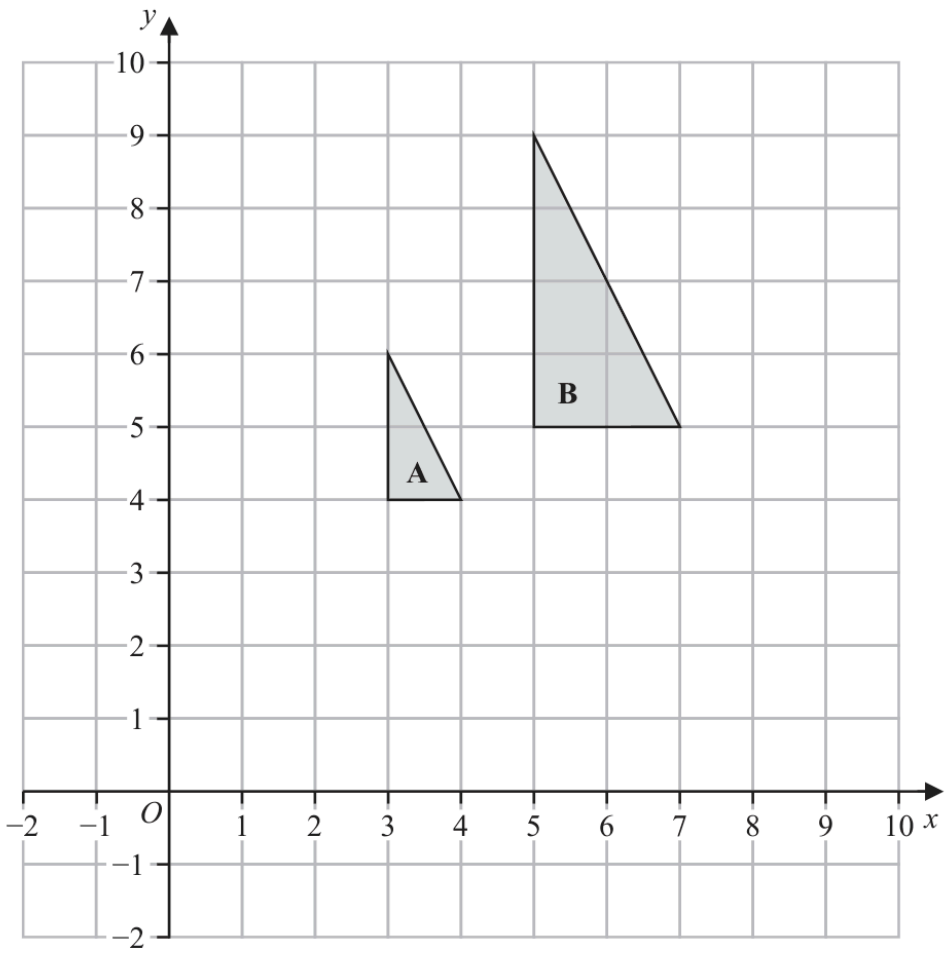
FINAL ANSWER

36%

Question 5

4 marks | Transformations

5



(a) Describe fully the single transformation that maps triangle **A** onto triangle **B**

.....

.....

(3)

(b) On the grid, translate triangle **A** by the vector $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$

Label your triangle **C**

(1)

(Total for Question 5 is 4 marks)

1 **Part (a) | Step 1**

Triangle A has vertices $(3,4),(4,4),(3,6)$; the corresponding vertices of B are $(5,5),(7,5),(5,9)$.

The lengths have doubled.

Read corresponding vertices and compare side lengths.

2 **Part (a) | Step 2**

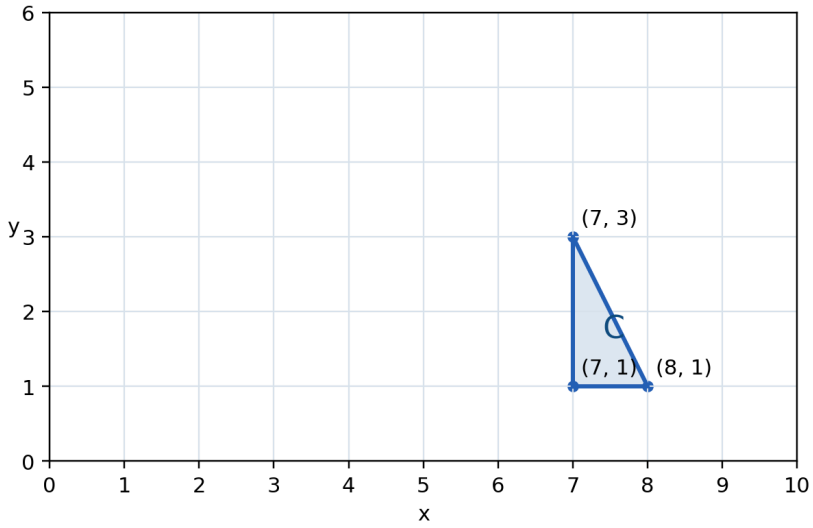
For enlargement factor 2, the centre O satisfies $B = O + 2(A - O)$, so $O = 2A - B$. Using $(3,4) \mapsto (5,5)$ gives $O = (6,8) - (5,5) = (1,3)$.

Find the fixed centre from a corresponding pair; the other pairs give the same centre.

3 **Part (b) | Step 1**

Add $(4,-3)$ to every vertex: $(3,4) \mapsto (7,1)$, $(4,4) \mapsto (8,1)$, and $(3,6) \mapsto (7,3)$. Plot these three points, join them with straight sides and label the triangle C.

A translation moves every point by the same vector.



✓ **FINAL ANSWER**

(a) Enlargement with scale factor 2 and centre $(1,3)$. (b) $C : (7,1),(8,1),(7,3)$.

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Question 6

3 marks | Angles in Polygons & Parallel Lines

6 $ABCDE$ is a pentagon.

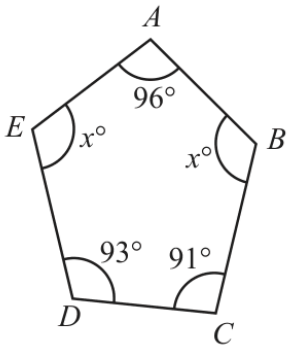


Diagram **NOT** accurately drawn

angle $EAB = 96°$ angle $BCD = 91°$ angle $CDE = 93°$ angle DEA = angle $ABC = x°$

Work out the value of x

$x =$ .....

(Total for Question 6 is 3 marks)

WORKED SOLUTION

Question 6 · 4MA1/2H June 2026

1 **Solution | Step 1**

The sum of the interior angles of a pentagon is $(5-2)180° = 540°$.

Use the interior-angle sum formula.

2 **Solution | Step 2**

$$96 + 91 + 93 + x + x = 540 \quad \Rightarrow \quad 2x = 260 \quad \Rightarrow \quad x = 130.$$

Subtract the three known angles and divide the remainder equally.

✓ **FINAL ANSWER**

$x = 130$

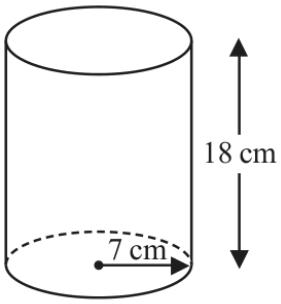
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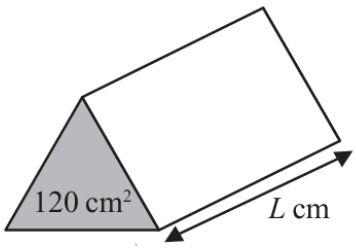
Question 7

3 marks | Volume & Surface Area

7 The diagram shows a cylinder and a prism.

Diagram **NOT** accurately drawn





The radius of the cylinder is 7 cm
The height of the cylinder is 18 cm

The area of the cross section of the prism, shown shaded in the diagram, is 120 cm^2
The length of the prism is L cm

The volume of the cylinder is equal to the volume of the prism.

Work out the value of L
Give your answer correct to 3 significant figures.

$L =$ .....

(Total for Question 7 is 3 marks)

WORKED SOLUTION

Question 7 · 4MA1/2H June 2026

1 Solution | Step 1

$$V_{\text{cylinder}} = \pi r^2 h = \pi(7)^2(18) = 882\pi\ \text{cm}^3.$$

Use the stated radius, not a diameter.

2 Solution | Step 2

$$V_{\text{prism}} = 120L, \qquad 120L = 882\pi \quad \Rightarrow \quad L = \frac{882\pi}{120} = 23.090706\ldots.$$

Prism volume equals cross-sectional area times length; equate the two volumes.

FINAL ANSWER

$L = 23.1\text{ cm}$ (3 significant figures).

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Question 8

3 marks | Reverse Percentages

8 A golf club increases the cost of membership by 17%
After the increase, the cost of membership is 3276 zloty.

Work out the cost of membership before the increase.

..... zloty

(Total for Question 8 is 3 marks)

WORKED SOLUTION

Question 8 · 4MA1/2H June 2026

1 Solution | Step 1

Let the original membership cost be C zloty. After a 17% increase, $1.17C = 3276$.

The new value is 117% of the original.

2 Solution | Step 2

$$C = \frac{3276}{1.17} = 2800 \text{ zloty}.$$

Divide by the increase multiplier.

FINAL ANSWER

2800 zloty

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Question 9

7 marks | Factorising

9 (a) Find the value of $7n^0$ where $n > 0$

.....

(1)

(b) Simplify fully $\left(2m^5p^4\right)^3$

.....

(2)

(c) Factorise fully $18c^5w^2 + 30cw^3$

.....

(2)

(d) Factorise $x^2 + 6x - 27$

.....

(2)

(Total for Question 9 is 7 marks)

WORKED SOLUTION

Question 9 · 4MA1/2H June 2026

1 **Part (a) | Step 1**

Since $n > 0$, $n^0 = 1$. Hence $7n^0 = 7(1) = 7$.

A nonzero number raised to power zero equals 1; only n is raised to zero.

2 **Part (b) | Step 1**

$$(2m^5p^4)^3 = 2^3m^{5\times3}p^{4\times3} = 8m^{15}p^{12}.$$

Cube the coefficient and multiply each exponent by 3.

3 **Part (c) | Step 1**

The highest common factor of $18c^5w^2$ and $30cw^3$ is $6cw^2$.

Take the numerical HCF and the smallest power of each shared variable.

4 **Part (c) | Step 2**

$$18c^5w^2 + 30cw^3 = 6cw^2(3c^4 + 5w).$$

Divide each original term by the common factor.

5

Part (d) | Step 1

Two numbers with product -27 and sum 6 are 9 and -3.

For a monic quadratic, find a factor pair with the required sum.

6

Part (d) | Step 2

$$x^2 + 6x - 27 = (x + 9)(x - 3).$$

The cross terms are -3x+9x=6x.

✓ **FINAL ANSWER**

(a) 7 (b) $8m^{15}p^{12}$ (c) $6cw^2(3c^4 + 5w)$ (d) $(x + 9)(x - 3)$

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Question 10

4 marks | Compound Interest & Depreciation

10 Johan owns a car.

The current value of the car is 32 000 euros.
The value of the car will now depreciate by 15% per year.

Lena is going to save up and buy Johan's car in 3 years' time.
She has already saved 2516 euros.

She will save an equal amount of money each month for the next 3 years.

Work out how much money Lena needs to save each month.

..... euros

(Total for Question 10 is 4 marks)

WORKED SOLUTION

Question 10 · 4MA1/2H June 2026

1 Solution | Step 1

The annual multiplier is $1 - 0.15 = 0.85$. After 3 years the value is

$$32000(0.85)^3 = 19652 \text{ euros.}$$

Apply the decrease to each successive year, giving a power of 3.

2 Solution | Step 2

Lena still needs $19652 - 2516 = 17136$ euros. There are $3 \times 12 = 36$ months.

Subtract her existing savings and convert years to months.

3 Solution | Step 3

$$\text{Monthly saving} = \frac{17136}{36} = 476 \text{ euros.}$$

Divide the remaining target equally over the months.

✓ **FINAL ANSWER**

476 euros per month

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Question 11

2 marks | Prime Factors, HCF & LCM

11 Find the highest prime number that is a factor of 3.6×10^{24}

.....

(Total for Question 11 is 2 marks)

WORKED SOLUTION

Question 11 · 4MA1/2H June 2026

1 Solution | Step 1

$$3.6 \times 10^{24} = 36 \times 10^{23} = (2^2 \times 3^2)(2 \times 5)^{23} = 2^{25}3^2 5^{23}.$$

Rewrite with an integer coefficient, then decompose 36 and 10 into primes.

2 Solution | Step 2

The only prime factors are $2, 3, 5$, so the highest is 5.

A larger composite factor is not a prime factor.

✓ **FINAL ANSWER**

5

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Question 12

2 marks | Set Notation & Venn Diagrams

12 $\mathscr{E} = \{\text{integers } x \text{ such that } 20 \leqslant x \leqslant 32\}$

$A = \{x \text{ such that } x < 27\}$

$B = \{x \text{ such that } 25 \leqslant x \leqslant 30\}$

(a) List the members of the set $A \cap B$

.....

(1)

(b) List the members of the set $(A \cup B)'$

.....

(1)

(Total for Question 12 is 2 marks)

WORKED SOLUTION

Question 12 · 4MA1/2H June 2026

1 **Part (a) | Step 1**

Within the universal set, $A = \{20, 21, 22, 23, 24, 25, 26\}$ and $B = \{25, 26, 27, 28, 29, 30\}$. Their common members are 25 and 26.

Intersection consists of elements in both sets.

2 **Part (b) | Step 1**

$A \cup B = \{20, 21, \ldots, 30\}$. The members of $\mathcal{E} = \{20, 21, \ldots, 32\}$ outside this union are 31 and 32.

Take the complement relative to the stated universal set, not all integers.

FINAL ANSWER

(a) $A \cap B = \{25, 26\}$ (b) $(A \cup B)' = \{31, 32\}$

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Question 13

4 marks | Statistics Toolkit

13 Leo collects apples from three trees.
The incomplete table gives some information about the apples he collects from these trees.

Tree	Number of apples	Mean weight of apples (grams)	Total weight of apples (grams)
A	12	150	
B	20		2700
C		145	2610

Work out the mean weight of all the apples Leo collects from these three trees.

..... grams

(Total for Question 13 is 4 marks)

WORKED SOLUTION

Question 13 · 4MA1/2H June 2026

1 Solution | Step 1

Tree A contributes $12 \times 150 = 1800$ grams.

Total weight equals count times mean weight.

2 Solution | Step 2

Tree C has $2610 \div 145 = 18$ apples.

Number of items equals total divided by mean.

3 Solution | Step 3

The total weight is $1800 + 2700 + 2610 = 7110$ grams and the total number of apples is $12 + 20 + 18 = 50$.

Add weights and counts separately; do not average the three group means.

4 Solution | Step 4

$$\text{Combined mean} = \frac{7110}{50} = 142.2 \text{ grams.}$$

Divide the total weight by the total count.

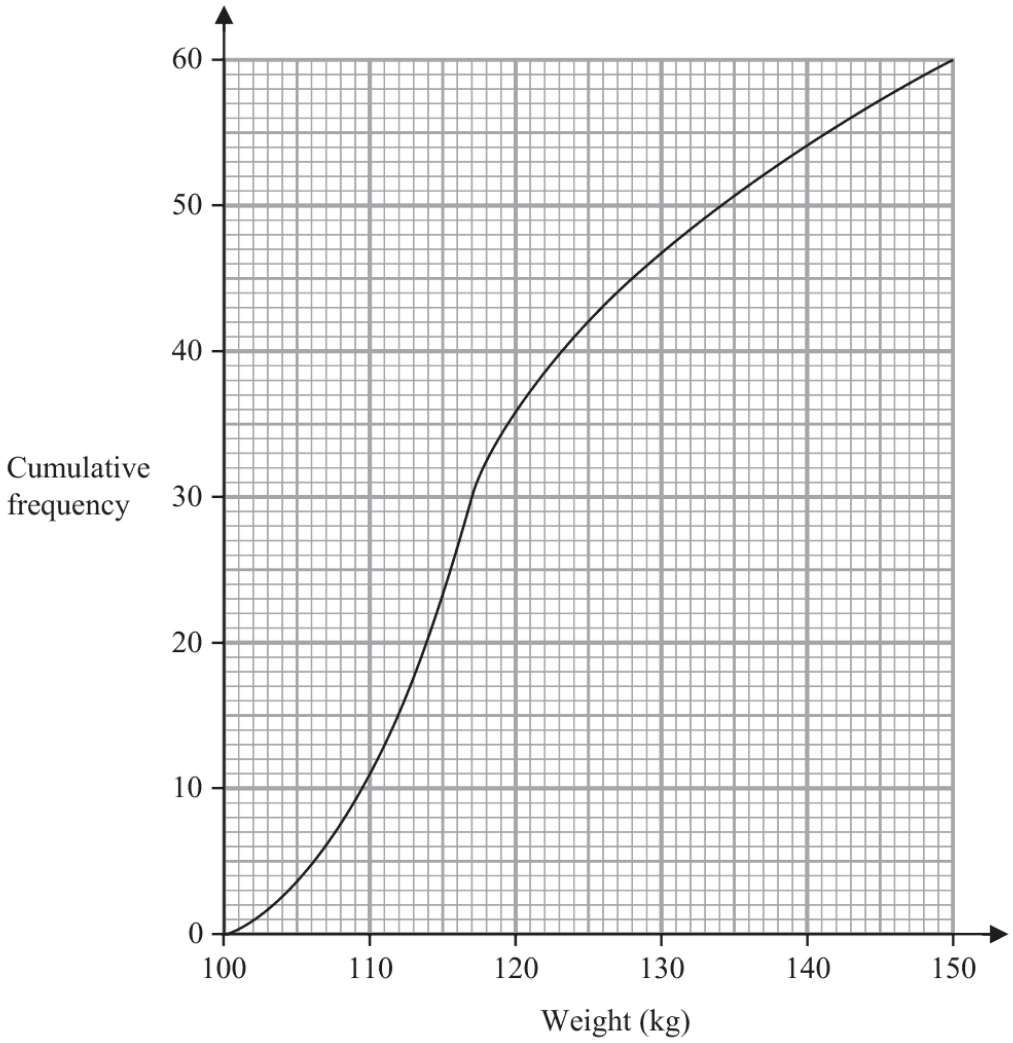
FINAL ANSWER

142.2 grams

Question 14

3 marks | Cumulative Frequency Diagrams

14 The cumulative frequency graph gives information about the weights, in kg, of 60 crates.



(a) Use the graph to find an estimate for the median weight.

..... kg

(1)

(b) Use the graph to find an estimate for the interquartile range.

..... kg

(2)

(Total for Question 14 is 3 marks)

1 **Part (a) | Step 1**

The median is the $60/2 = 30$th value. Draw horizontally from cumulative frequency 30 to the curve, then vertically to the weight axis: about $117\ \text{kg}$.

The median splits the 60 observations in half.

2 **Part (b) | Step 1**

Read the lower quartile at cumulative frequency $60/4 = 15$, giving $Q_1 \approx 112\ \text{kg}$. Read the upper quartile at cumulative frequency $3(60)/4 = 45$, giving $Q_3 \approx 128\ \text{kg}$.

Quartiles occur at one-quarter and three-quarters of the total frequency.

3 **Part (b) | Step 2**

$$\text{IQR} = Q_3 - Q_1 \approx 128 - 112 = 16\ \text{kg}.$$

Interquartile range is upper quartile minus lower quartile.

✓ **FINAL ANSWER**

(a) $117\ \text{kg}$ approximately. (b) $16\ \text{kg}$ approximately.

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Question 15

4 marks | Circles, Arcs & Sectors

15 The diagram shows a sector $OABC$ of a circle, centre O

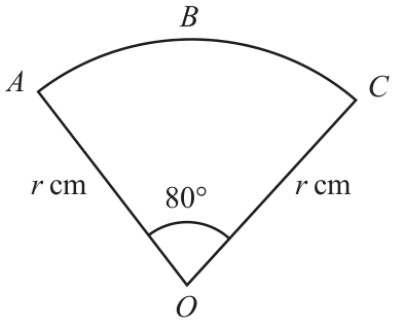


Diagram **NOT** accurately drawn

$OA = OC = r$ cm angle $AOC = 80°$

The area of the sector $OABC$ is 32π cm^2

Work out the perimeter of the sector $OABC$
Give your answer correct to one decimal place.

..... cm

(Total for Question 15 is 4 marks)

WORKED SOLUTION

Question 15 · 4MA1/2H June 2026

1 **Solution | Step 1**

$$\frac{80}{360}\pi r^2 = 32\pi \quad \Rightarrow \quad r^2 = 32\frac{360}{80} = 144 \quad \Rightarrow \quad r = 12 \text{ cm}.$$

Use the fraction of the full circle and choose the positive radius.

2 **Solution | Step 2**

$$\text{Arc length} = \frac{80}{360}(2\pi \times 12) = \frac{16\pi}{3} \text{ cm}.$$

The same central-angle fraction applies to the circumference.

3 **Solution | Step 3**

$$P = 12 + 12 + \frac{16\pi}{3} = 40.7551608\ldots \text{ cm}.$$

The sector perimeter contains both radii as well as the arc.

FINAL ANSWER

$40.8\ \text{cm}$ (1 decimal place).

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Question 16

5 marks | Functions

16 The functions f and g are such that

$$f(x) = 4 + x \qquad g(x) = 3x^2 + 2$$

(a) Find $g(4)$

.....

(1)

(b) Find $f^{-1}(7)$

.....

(2)

(c) Express $gf(x)$ in the form $ax^2 + bx + c$ where a, b and c are integers.

$gf(x) =$ .....

(2)

(Total for Question 16 is 5 marks)

WORKED SOLUTION

Question 16 · 4MA1/2H June 2026

1 **Part (a) | Step 1**

$$g(4) = 3(4)^2 + 2 = 48 + 2 = 50.$$

Substitute 4 for the function input.

2 **Part (b) | Step 1**

If $y = 4 + x$, then $x = y - 4$, so $f^{-1}(x) = x - 4$.

Reverse the input-output relationship.

3 **Part (b) | Step 2**

$$f^{-1}(7) = 7 - 4 = 3.$$

Apply the inverse function to 7.

4 **Part (c) | Step 1**

$$gf(x) = g(f(x)) = g(x + 4) = 3(x + 4)^2 + 2.$$

Apply f first and use its whole output as the input of g.

5 **Part (c) | Step 2**

$$3(x^2 + 8x + 16) + 2 = 3x^2 + 24x + 50.$$

Expand and collect the constant terms.

✓ **FINAL ANSWER**

(a) 50 (b) 3 (c) $gf(x) = 3x^2 + 24x + 50$

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Question 17

2 marks | Algebraic Proof

17 Use algebra to show that $0.5\dot{3}\dot{9} = \frac{89}{165}$

(Total for Question 17 is 2 marks)

WORKED SOLUTION

Question 17 · 4MA1/2H June 2026

1 Solution | Step 1

Let $x = 0.5\overline{39} = 0.5393939\ldots$. Then $10x = 5.393939\ldots$ and $1000x = 539.393939\ldots$.

Shift past the non-recurring digit and then one complete two-digit recurring block.

2 Solution | Step 2

Subtract:

$$1000x - 10x = 539.393939\ldots - 5.393939\ldots = 534.$$

$$990x = 534 \quad \Rightarrow \quad x = \frac{534}{990} = \frac{89}{165}.$$

Identical infinite decimal tails cancel exactly; reduce the resulting fraction by 6.

FINAL ANSWER

$0.5\overline{39} = \frac{89}{165}$.

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Question 18

4 marks | Rearranging Formulae

18 Make x the subject of the formula $a = \dfrac{3w - x^2}{x^2 + 6}$

.....

(Total for Question 18 is 4 marks)

WORKED SOLUTION

Question 18 · 4MA1/2H June 2026

1 Solution | Step 1

$$a = \frac{3w - x^2}{x^2 + 6} \quad \Rightarrow \quad a(x^2 + 6) = 3w - x^2.$$

Multiply by x^2+6, which is positive for real x.

2 Solution | Step 2

$$ax^2 + 6a = 3w - x^2 \quad \Rightarrow \quad ax^2 + x^2 = 3w - 6a.$$

Collect both terms involving x^2 on one side.

3 Solution | Step 3

$$(a + 1)x^2 = 3w - 6a \quad \Rightarrow \quad x^2 = \frac{3w - 6a}{a + 1}.$$

Factor out x^2 and divide by a+1, assuming a is not -1.

4 Solution | Step 4

$$x = \pm\sqrt{\frac{3w - 6a}{a + 1}} \quad (a \neq -1).$$

For real solutions the radicand must be nonnegative. If $a = -1$, the original equation instead requires $w = -2$; then every real x satisfies it.

Taking square roots gives both signs; handle separately the value excluded by division.

FINAL ANSWER

$x = \pm\sqrt{\dfrac{3w - 6a}{a + 1}}$, for $a \neq -1$ and nonnegative radicand.

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Question 19

2 marks | Circle Theorems

19 B, D and E are points on a circle.

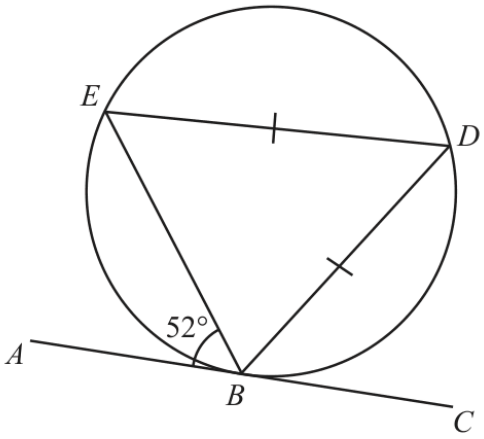


Diagram **NOT** accurately drawn

ABC is the tangent to the circle at B

angle $ABE = 52°$ $ED = BD$

Work out the size of angle BED

.....°

(Total for Question 19 is 2 marks)

WORKED SOLUTION

Question 19 · 4MA1/2H June 2026

1 **Solution | Step 1**

$\angle BDE = \angle ABE = 52°$, by the alternate segment theorem for tangent AB and chord BE.
The angle between a tangent and chord equals the angle in the opposite segment.

2 **Solution | Step 2**

Since $ED = BD$, the base angles $\angle BED$ and $\angle EBD$ are equal. Thus

$$\angle BED = \frac{180° - 52°}{2} = 64°.$$

Equal sides in triangle EBD subtend equal opposite angles, and its angles sum to 180 degrees.

✓ **FINAL ANSWER**

$64°$

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Question 20

3 marks | Probability Toolkit

20 A box only contains green counters and red counters.

Nuno chooses at random a counter from the box.
He puts the counter back into the box.

Nuno then chooses at random a second counter from the box.

The probability that Nuno chooses at least one red counter is $\frac{39}{64}$

Work out the probability that Nuno chooses exactly one red counter.

.....

(Total for Question 20 is 3 marks)

WORKED SOLUTION

Question 20 · 4MA1/2H June 2026

1 Solution | Step 1

Let $g = P(G)$. With replacement, the draws are independent.

$$P(GG) = 1 - P(\text{at least one red}) = 1 - \frac{39}{64} = \frac{25}{64}.$$

The complementary event to at least one red is two greens.

2 Solution | Step 2

$$g^2 = \frac{25}{64} \quad \Rightarrow \quad g = \frac{5}{8}, \qquad P(R) = 1 - \frac{5}{8} = \frac{3}{8}.$$

Multiply identical independent green probabilities and take the nonnegative root.

3 Solution | Step 3

$$P(\text{exactly one red}) = P(RG) + P(GR) = \frac{3}{8}\frac{5}{8} + \frac{5}{8}\frac{3}{8} = \frac{30}{64} = \frac{15}{32}.$$

The two possible orders are mutually exclusive and must both be included.

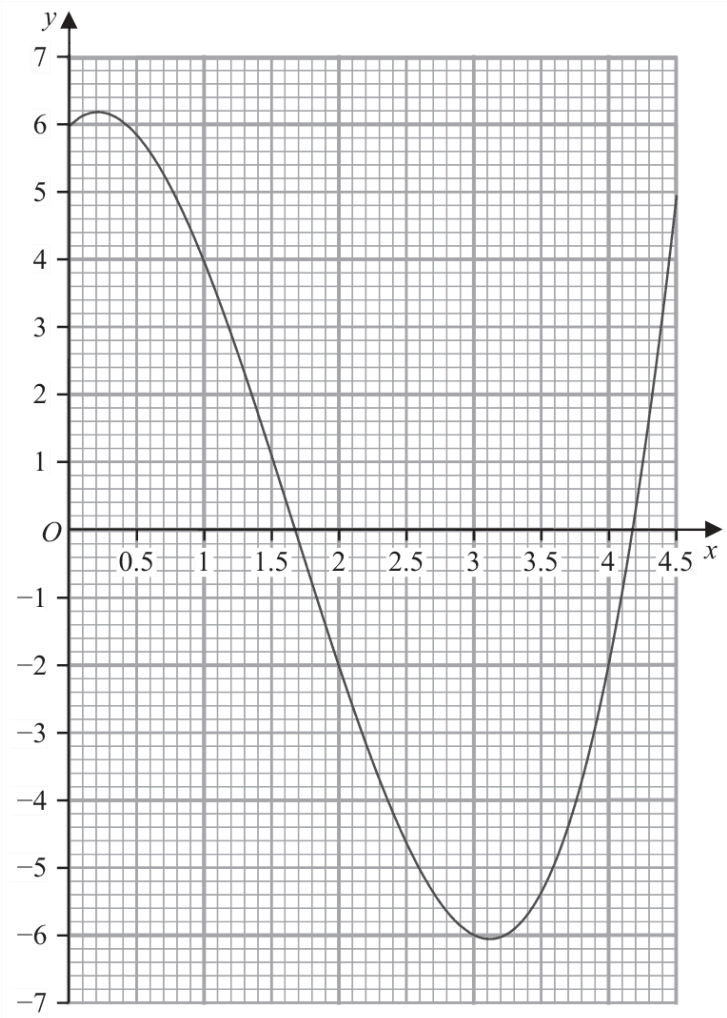
✓ **FINAL ANSWER**

$$\frac{15}{32}$$

Question 21

5 marks | Graphs of Functions

21 The curve with equation $y = f(x)$ is drawn on a grid.



(a) By drawing a suitable straight line (at least 3 cm long) on the grid, work out an estimate for the gradient of the curve at the point where $x = 1$
Show your working clearly.

.....

(2)

(b) By drawing a suitable straight line on the grid, find the solutions of the equation $x = 3 + \frac{1}{2}f(x)$
Show your working clearly.

.....

(3)

(Total for Question 21 is 5 marks)

1 **Part (a) | Step 1**

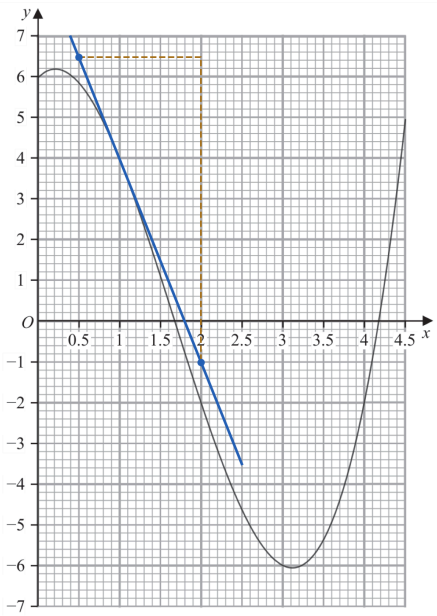
At $x = 1$, the point is approximately $(1, 4)$. Draw a tangent there, extending at least $3\ \text{cm}$. A suitable approximate tangent is $y = -5x + 9$, through $(0.5, 6.5)$ and $(2, -1)$.

The gradient at a point is estimated by the gradient of its tangent; use two well-separated points on the line.

2 **Part (a) | Step 2**

$$\text{Gradient} \approx \frac{-1 - 6.5}{2 - 0.5} = \frac{-7.5}{1.5} = -5.$$

Calculate change in y divided by change in x using the axis values.



3 **Part (b) | Step 1**

$$x = 3 + \tfrac{1}{2} f(x) \quad \Rightarrow \quad f(x) = 2x - 6.$$

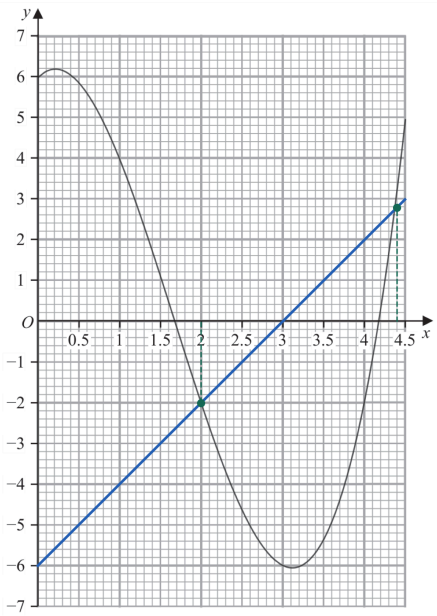
Rearrange so the given curve y=f(x) can be intersected by a straight line.

4

Part (b) | Step 2

Draw $y = 2x - 6$ through $(0, -6), (3, 0), (4.5, 3)$ on the same grid. Read the x-coordinates of its two intersections with the curve: approximately 2.0 and 4.4.

Each intersection has equal y-values on the line and curve and therefore solves the original equation.



FINAL ANSWER

(a) Gradient ≈ -5. (b) $x \approx 2.0$ or $x \approx 4.4$.

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Question 22

4 marks | Vectors

22 The diagram shows a quadrilateral $OABC$ where O, A, B and C represent the positions of four houses.

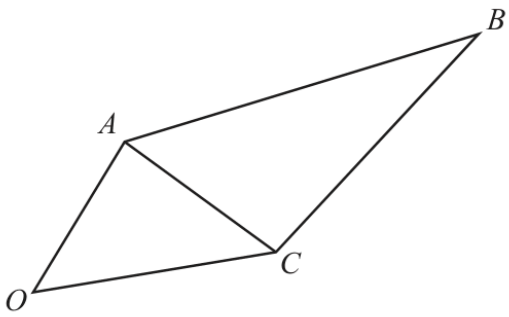


Diagram **NOT** accurately drawn

$\overrightarrow{OA} = \begin{pmatrix} 2 \\ 8 \end{pmatrix}$ $\overrightarrow{OB} = \begin{pmatrix} 21 \\ 14 \end{pmatrix}$ $\overrightarrow{OC} = \begin{pmatrix} 12 \\ 3 \end{pmatrix}$

Ria walks directly from A to B
Anna walks directly from A to C and then walks directly from C to B

$\overrightarrow{OA}$, $\overrightarrow{OB}$ and $\overrightarrow{OC}$ are given in metres.

Work out how much further Anna walks than Ria walks.
Give your answer correct to one decimal place.

..... metres

(Total for Question 22 is 4 marks)

WORKED SOLUTION

Question 22 · 4MA1/2H June 2026

1 **Solution | Step 1**

$$\overrightarrow{AB} = \begin{pmatrix} 21 \\ 14 \end{pmatrix} - \begin{pmatrix} 2 \\ 8 \end{pmatrix} = \begin{pmatrix} 19 \\ 6 \end{pmatrix}, \quad \overrightarrow{AC} = \begin{pmatrix} 12 \\ 3 \end{pmatrix} - \begin{pmatrix} 2 \\ 8 \end{pmatrix} = \begin{pmatrix} 10 \\ -5 \end{pmatrix},$$

$$\overrightarrow{CB} = \begin{pmatrix} 21 \\ 14 \end{pmatrix} - \begin{pmatrix} 12 \\ 3 \end{pmatrix} = \begin{pmatrix} 9 \\ 11 \end{pmatrix}.$$

Subtract the starting position vector from the finishing position vector.

2 **Solution | Step 2**

$$AB = \sqrt{19^2 + 6^2} = \sqrt{397}, \quad AC = \sqrt{10^2 + (-5)^2} = \sqrt{125}, \quad CB = \sqrt{9^2 + 11^2} = \sqrt{202}.$$

The modulus of a two-dimensional vector is the square root of the sum of squares of its components.

3 Solution | Step 3

$$\text{Extra distance} = AC + CB - AB = \sqrt{125} + \sqrt{202} - \sqrt{397} = 5.468151\ldots \text{ m}.$$

Compare Anna's two-stage route with Ria's direct route; do not round the intermediate lengths.

FINAL ANSWER

Anna walks 5.5 m further (1 decimal place).

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Question 23

5 marks | Simultaneous Equations

23 The straight line **L** has equation $y = 3x - 2$

The curve **C** has equation $x^2 + y^2 - 2y = 12$

Find the coordinates of the points where **L** and **C** intersect.
Show clear algebraic working.

(..... , ...) and (..... , ...)

(Total for Question 23 is 5 marks)

WORKED SOLUTION

Question 23 · 4MA1/2H June 2026

1 Solution | Step 1

Substitute $y = 3x - 2$ into $x^2 + y^2 - 2y = 12$:

$$x^2 + (3x - 2)^2 - 2(3x - 2) = 12.$$

Both equations must hold at an intersection.

2 Solution | Step 2

$$x^2 + 9x^2 - 12x + 4 - 6x + 4 = 12$$

$$10x^2 - 18x - 4 = 0 \quad \Rightarrow \quad 5x^2 - 9x - 2 = 0.$$

Expand carefully, collect like terms, and divide by 2.

3 Solution | Step 3

$$(5x + 1)(x - 2) = 0 \quad \Rightarrow \quad x = -\frac{1}{5} \text{ or } x = 2.$$

Use factorisation and the zero-product property.

4 Solution | Step 4

When $x = -\frac{1}{5}$, $y = 3(-\frac{1}{5}) - 2 = -\frac{13}{5}$. When $x = 2$, $y = 3(2) - 2 = 4$.
Substitute each root into the line, preserving the coordinate pairings.

FINAL ANSWER

$\left(-\frac{1}{5}, -\frac{13}{5}\right)$ and $(2, 4)$.

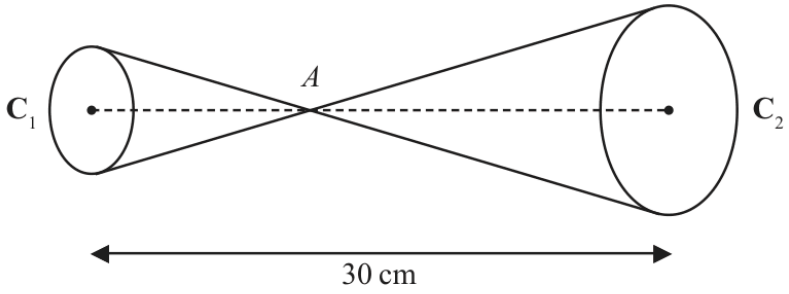
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Question 24

5 marks | Area & Volume of Similar Shapes

24 The diagram shows two cones $\mathbf{C}_1$ and $\mathbf{C}_2$

Diagram **NOT** accurately drawn



The vertex of $\mathbf{C}_1$ coincides with the vertex of $\mathbf{C}_2$ at the point A
$\mathbf{C}_1$ and $\mathbf{C}_2$ have the same axis of symmetry.

$$\text{height of } \mathbf{C}_1 + \text{height of } \mathbf{C}_2 = 30 \text{ cm}$$

$$\text{total surface area of } \mathbf{C}_1 : \text{total surface area of } \mathbf{C}_2 = 4 : 9$$

$$\text{volume of } \mathbf{C}_1 = 23.04\pi \text{ cm}^3$$

Work out the radius of the base of $\mathbf{C}_2$
Show your working clearly.

..... cm

(Total for Question 24 is 5 marks)

WORKED SOLUTION

Question 24 · 4MA1/2H June 2026

1 **Solution | Step 1**

The straight generators shown through A give equal vertex angles, so the cones are similar. The area ratio $4 : 9$ gives length ratio $\sqrt{4} : \sqrt{9} = 2 : 3$.
For similar solids, surface areas scale as the square of corresponding lengths.

2 **Solution | Step 2**

The heights total 30 cm, so

$$h_1 = \frac{2}{5}(30) = 12 \text{ cm}, \qquad h_2 = \frac{3}{5}(30) = 18 \text{ cm}.$$

Split the total in the common length ratio 2:3.

3 **Solution | Step 3**

$$\frac{1}{3}\pi r_1^2(12) = 23.04\pi \quad \Rightarrow \quad 4r_1^2 = 23.04 \quad \Rightarrow \quad r_1 = \sqrt{5.76} = 2.4 \text{ cm}.$$

Use the volume of the first cone and choose a positive radius.

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4 **Solution | Step 4**

$$r_2 = \frac{3}{2}r_1 = \frac{3}{2}(2.4) = 3.6 \text{ cm}.$$

Radii scale by the same factor as the heights.

✓ **FINAL ANSWER**

3.6 cm

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Question 25

5 marks | Sequences

25 An arithmetic series has first term 3 and common difference 8

The nth term of the series is U_n
The sum of the first n terms of the series is S_n

Given that $S_{5k} - S_{3k} = 25\,560$

find the value of U_{4k}
Show clear algebraic working.

.....

(Total for Question 25 is 5 marks)

WORKED SOLUTION

Question 25 · 4MA1/2H June 2026

1 Solution | Step 1

With first term 3 and difference 8,

$$S_n = \frac{n}{2}[2(3) + (n-1)8] = \frac{n}{2}(8n - 2) = 4n^2 - n.$$

Use the arithmetic-series sum formula with the given first term and common difference.

2 Solution | Step 2

$$S_{5k} = 100k^2 - 5k, \qquad S_{3k} = 36k^2 - 3k.$$

$$(100k^2 - 5k) - (36k^2 - 3k) = 25560 \quad \Rightarrow \quad 64k^2 - 2k - 25560 = 0.$$

Substitute 5k and 3k as the term counts, then subtract the complete expressions.

3 Solution | Step 3

$$32k^2 - k - 12780 = 0 \quad \Rightarrow \quad (k - 20)(32k + 639) = 0.$$

The roots are $k = 20$ and $k = -639/32$. Reject the negative root because the numbers of terms must be positive.
Factor the quadratic and apply the contextual restriction.

4 Solution | Step 4

$$U_n = 3 + (n-1)8 = 8n - 5, \qquad U_{4k} = U_{80} = 8(80) - 5 = 635.$$

Use the nth-term formula with 4k=80, not with k=20.

FINAL ANSWER

$U_{4k} = 635$

Question 26

5 marks | Transformations of Graphs

26 The curve **P** has equation $y = f(x)$
The coordinates of the minimum point on **P** are $(-5, 4)$

(a) Write down the coordinates of the minimum point on the curve with equation $y = 3f(x)$

(..... , ...)

(1)

The curve ***Q*** has equation $y = 2 - (x + 3)^2$

The curve ***R*** has equation $y = 2 - (3 - x)^2$

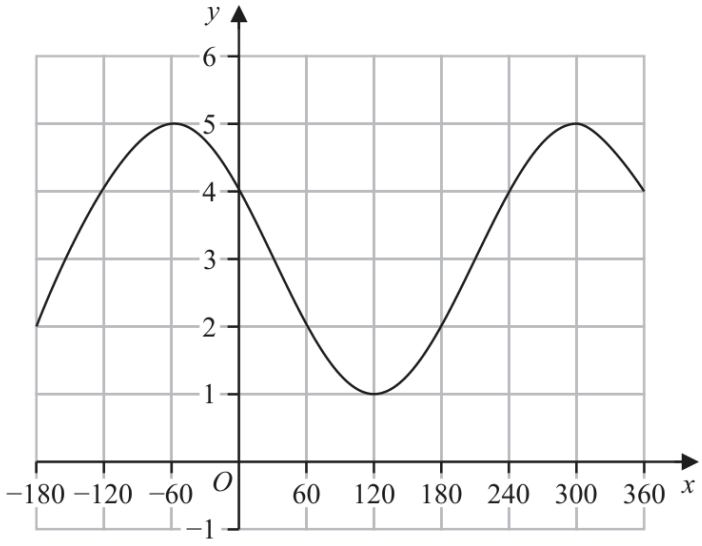
(b) Describe fully the single transformation that maps ***Q*** to ***R***

.....

.....

(1)

The graph of $y = a\cos(x + b)° + c$ for $-180 \leqslant x \leqslant 360$ is drawn on the grid.



Given that $a > 0$ and $0 < b < 360$

(c) find the value of a, the value of b and the value of c

a = ...

b = ...

c = ...

(3)

(Total for Question 26 is 5 marks)

1 **Part (a) | Step 1**

For $y = 3f(x)$, x-coordinates are unchanged and y-coordinates are multiplied by 3. Thus $(-5, 4) \mapsto (-5, 12)$.

The vertical scale factor is positive, so a minimum remains a minimum.

2 **Part (b) | Step 1**

For $Q(x) = 2 - (x + 3)^2$,

$$Q(-x) = 2 - (-x + 3)^2 = 2 - (3 - x)^2 = R(x).$$

Replacing x by $-x$ reflects the graph in the y-axis.

The point mapping is (x,y) to (-x,y).

3 **Part (c) | Step 1**

The maximum is 5 and the minimum is 1, so

$$a = \frac{5 - 1}{2} = 2, \qquad c = \frac{5 + 1}{2} = 3.$$

The positive amplitude is half the range; the vertical shift is the midline.

4 **Part (c) | Step 2**

A maximum occurs at $x = -60°$. For positive a, cosine is maximal when $x + b = 0°$ modulo $360°$, giving $b = 60$ in the stated interval. Hence $y = 2\cos(x + 60)° + 3$.

Read the phase from a maximum and apply 0<b<360.

✓ **FINAL ANSWER**

(a) $(-5, 12)$ (b) Reflection in the y-axis. (c) $a = 2, \quad b = 60, \quad c = 3$.