ELITE MATHEMATICS

Modular Unit 2

Linear to Modular | Regional papers

Worked solutions

31 question entries | 120 marks

Linear questions reorganised for Modular practice. Not an original Pearson Modular examination.

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Student edition | June 2026 | Elite Mathematics

Question 2

3 marks

June 2026 | 4MA1/1HR | Prime factorisation

2 Write 504 as a product of powers of its prime factors.
Show your working clearly.

.....

(Total for Question 2 is 3 marks)

Question 2 | Worked solution

3 marks

June 2026 | 4MA1/1HR | Prime factorisation

Solution

3 marks

STEP 1

$$504 = 2 \times 252 = 2^2 \times 126 = 2^3 \times 63.$$

Divide repeatedly by the prime 2.

STEP 2

$$63 = 3 \times 21 = 3^2 \times 7, \qquad 504 = 2^3 \times 3^2 \times 7.$$

All remaining factors are prime; group repeated factors as powers.

Final answer
$504 = 2^3 \times 3^2 \times 7$

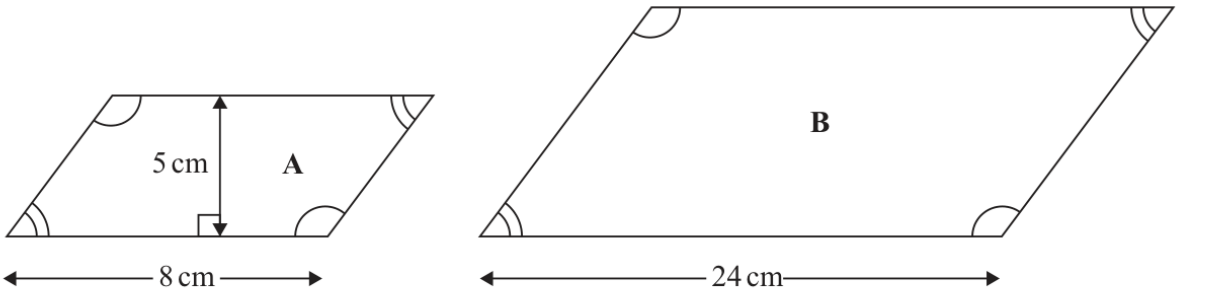
Question 6

3 marks

June 2026 | 4MA1/1HR | Area of similar figures

6

Diagram **NOT** accurately drawn



A and **B** are similar parallelograms.

Work out the area of **B**

..... cm^2

(Total for Question 6 is 3 marks)

Question 6 | Worked solution

3 marks

June 2026 | 4MA1/1HR | Area of similar figures

Solution

3 marks

STEP 1

$$k = \frac{24}{8} = 3.$$

The marked corresponding bases give the linear scale factor from A to B.

STEP 2

$$\text{area}(A) = 8 \times 5 = 40 \text{ cm}^2.$$

The 5 cm measurement is the perpendicular height.

STEP 3

$$\text{area}(B) = k^2 \,\text{area}(A) = 3^2 \times 40 = 360 \text{ cm}^2.$$

Areas scale by the square of the linear scale factor.

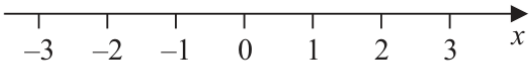
Final answer
360 cm^2

Question 7

5 marks

June 2026 | 4MA1/1HR | Linear inequalities

7



(a) Represent the inequality $x < 1$ on the number line above.

(1)

$2 \leqslant y + 3 < 7$
y is an integer.

(b) Write down all the possible values of y

.....

(2)

(c) Solve the inequality $8 - 5w > -10$

.....

(2)

(Total for Question 7 is 5 marks)

Question 7 | Worked solution

5 marks

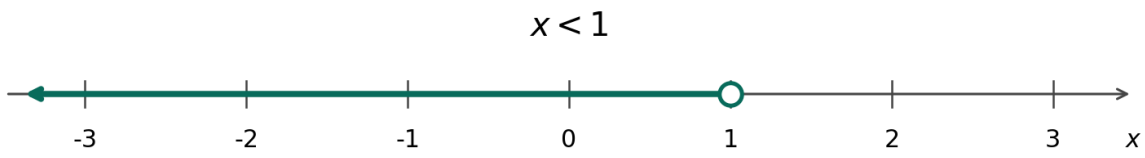
June 2026 | 4MA1/1HR | Linear inequalities

Part (a)

1 marks

STEP 1

Place an open circle at 1 and draw a horizontal ray from it to the left, with a left-pointing arrow. Do not fill the circle. The strict inequality excludes 1 and includes every real number less than 1.



Final answer

Open circle at 1, ray to the left: $(-\infty, 1)$.

Part (b)

2 marks

STEP 1

$$2 \leq y + 3 < 7 \quad \Longrightarrow \quad -1 \leq y < 4.$$

Subtract 3 from all three expressions.

STEP 2

The integer values in this interval are $-1, 0, 1, 2, 3$. Include the lower endpoint but exclude 4.

Final answer

$y = -1, 0, 1, 2, 3$

Part (c)

2 marks

STEP 1

$$8 - 5w > -10 \quad \Longrightarrow \quad -5w > -18.$$

Subtract 8 from both sides.

STEP 2

$$w < \frac{18}{5} = 3.6.$$

Division by a negative number reverses the inequality sign.

Final answer

$w < 3.6$

Question 9

3 marks

June 2026 | 4MA1/1HR | Combined means

9 Caleb owns 11 sheep.

The mean weight of all 11 sheep is 77 kg
The mean weight of 8 of the sheep is 75.2 kg

Work out the mean weight of the other 3 sheep.

..... kg

(Total for Question 9 is 3 marks)

Question 9 | Worked solution

3 marks

June 2026 | 4MA1/1HR | Combined means

Solution

3 marks

STEP 1

$$W_{11} = 11(77) = 847 \text{ kg}, \qquad W_8 = 8(75.2) = 601.6 \text{ kg}.$$

Total weight equals number of sheep multiplied by their mean weight.

STEP 2

$$W_3 = 847 - 601.6 = 245.4 \text{ kg}, \qquad \overline{w}_3 = \frac{245.4}{3} = 81.8 \text{ kg}.$$

Subtract the known subgroup total and divide the remaining total by 3.

Final answer
81.8 kg

Question 10

3 marks

June 2026 | 4MA1/1HR | Compound interest

10 Arwa invests 200 000 yen in a savings account for 3 years.
She gets 1.4% per year compound interest.

Work out how much money Arwa will have in her savings account at the end of 3 years.
Give your answer correct to the nearest yen.

..... yen

(Total for Question 10 is 3 marks)

Question 10 | Worked solution

3 marks

June 2026 | 4MA1/1HR | Compound interest

Solution

3 marks

STEP 1

$$\text{annual multiplier} = 1 + \frac{1.4}{100} = 1.014.$$

An increase of 1.4% retains the original amount and adds 1.4%.

STEP 2

$$A = 200000(1.014)^3 = 208518.1488 \text{ yen}.$$

Apply the multiplier once for each of the 3 years.

STEP 3

$$A \approx 208518 \text{ yen}.$$

Round to the nearest whole yen.

Final answer
208518 yen

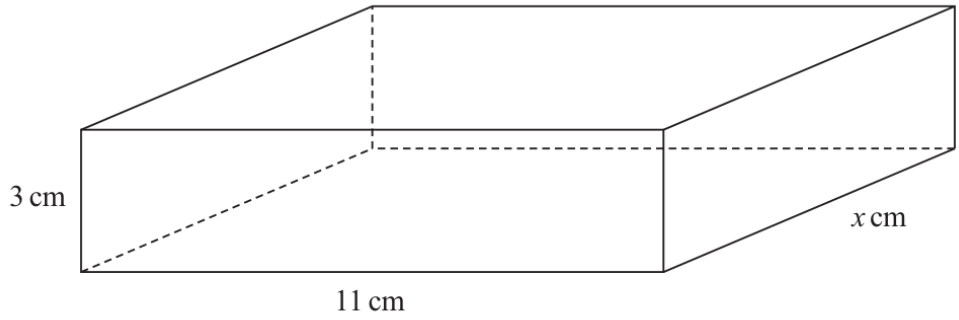
Question 11

4 marks

June 2026 | 4MA1/1HR | Cuboid volume and surface area

11 The diagram shows a solid cuboid.

Diagram **NOT** accurately drawn



The cuboid measures 3 cm by 11 cm by x cm

The volume of the cuboid is 264 cm^3

Work out the total surface area of the cuboid.

..... cm^2

(Total for Question 11 is 4 marks)

Question 11 | Worked solution

4 marks

June 2026 | 4MA1/1HR | Cuboid volume and surface area

Solution

4 marks

STEP 1

$$3 \times 11 \times x = 264, \qquad x = \frac{264}{33} = 8 \text{ cm}.$$

The volume is the product of the three perpendicular edge lengths.

STEP 2

$$S = 2(3 \times 11) + 2(3 \times 8) + 2(11 \times 8).$$

There are two faces of each of the three rectangular sizes.

STEP 3

$$S = 66 + 48 + 176 = 290 \text{ cm}^2.$$

Add all six face areas.

Final answer
290 cm^2

Question 12

3 marks

June 2026 | 4MA1/1HR | Simultaneous linear equations

12 Solve the simultaneous equations

$$4x + 4y = 5$$
$$x + 2y = 1$$

Show clear algebraic working.

$x =$ .....

$y =$ .....

(Total for Question 12 is 3 marks)

Question 12 | Worked solution

3 marks

June 2026 | 4MA1/1HR | Simultaneous linear equations

Solution

3 marks

STEP 1

$$4x + 4y = 5, \qquad x + 2y = 1.$$

Use the two given equations.

STEP 2

$$4(x + 2y) = 4 \quad \Longrightarrow \quad 4x + 8y = 4.$$

Multiply the second equation by 4 to match the coefficients of x.

STEP 3

$$(4x + 8y) - (4x + 4y) = 4 - 5 \quad \Longrightarrow \quad 4y = -1, \quad y = -\frac{1}{4}.$$

Subtract the first equation to eliminate x.

STEP 4

$$x + 2\left(-\frac{1}{4}\right) = 1 \quad \Longrightarrow \quad x = \frac{3}{2}.$$

Substitute into the second original equation.

Final answer

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

Question 14

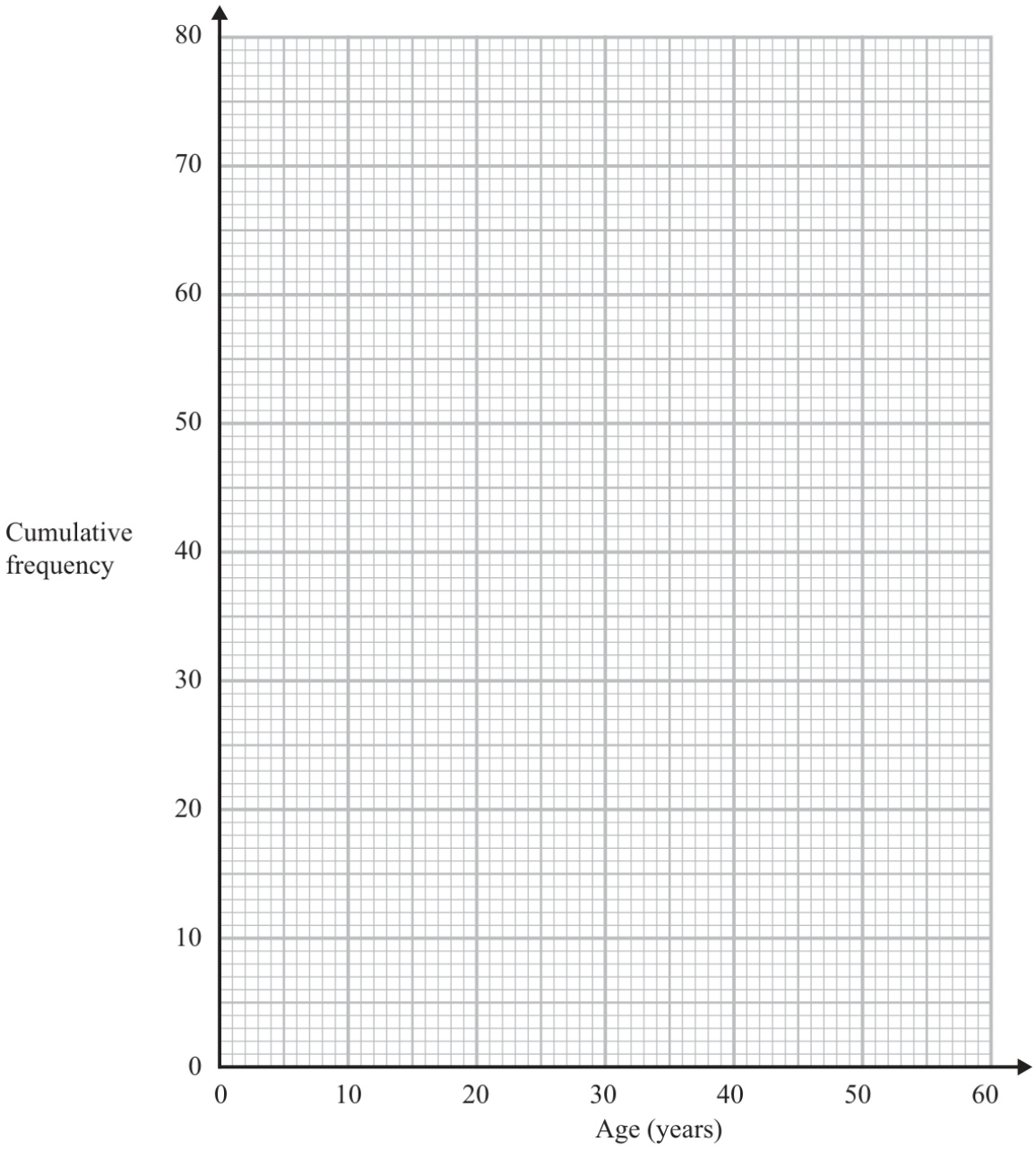
4 marks

June 2026 | 4MA1/1HR | Cumulative frequency

14 The cumulative frequency table gives information about the ages, in years, of 80 people who went to a cinema on Saturday.

Age (a years)	Cumulative frequency
$0 < a \leqslant 10$	19
$0 < a \leqslant 20$	37
$0 < a \leqslant 30$	52
$0 < a \leqslant 40$	63
$0 < a \leqslant 50$	73
$0 < a \leqslant 60$	80

(a) On the grid below, draw a cumulative frequency graph for this information.



(2)

(b) Use your graph to find an estimate for the median age of the 80 people.

..... years

(1)

(c) Use your graph to find an estimate for the number of the 80 people aged 16 and under.

.....

(1)

(Total for Question 14 is 4 marks)

Question 14 | Worked solution

4 marks

June 2026 | 4MA1/1HR | Cumulative frequency

Part (a)

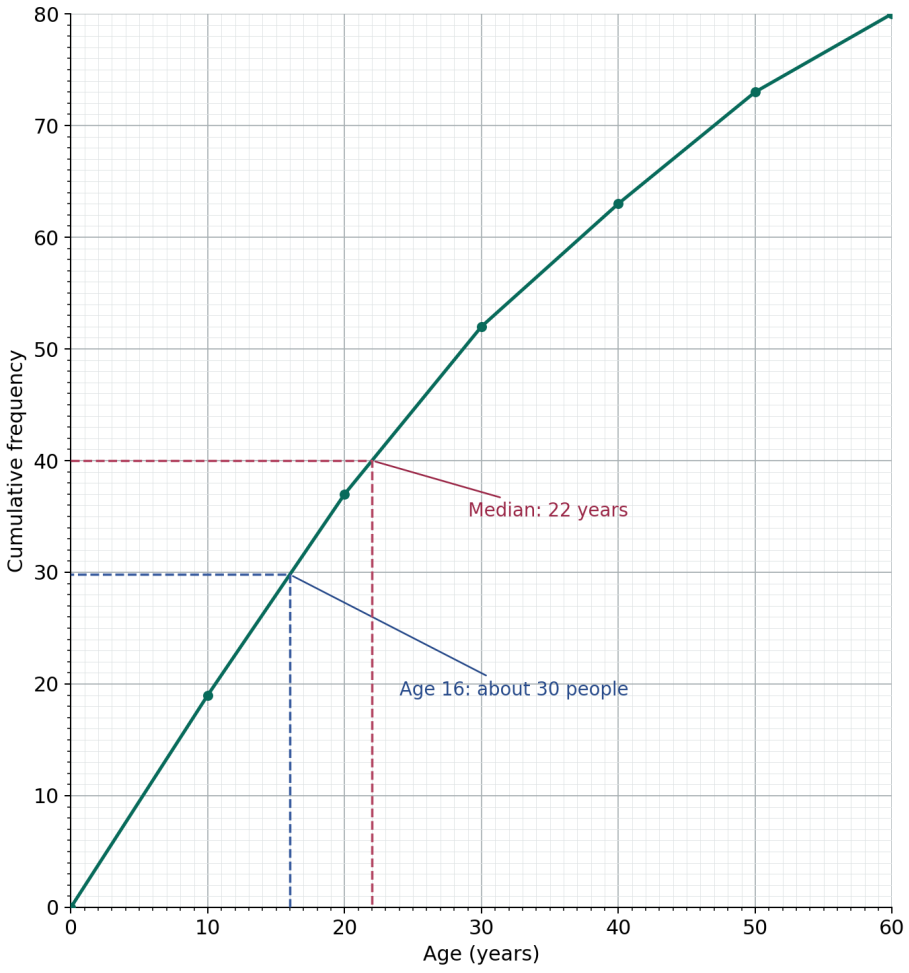
2 marks

STEP 1

Use age (years) on the horizontal axis from 0 to 60, and cumulative frequency on the vertical axis from 0 to 80. Plot $(0, 0), (10, 19), (20, 37), (30, 52), (40, 63), (50, 73), (60, 80)$. Each cumulative total is plotted at its upper age boundary.

STEP 2

Join the points in order with an increasing curve or straight line segments. Do not draw bars or a staircase. This represents the accumulated number up to each age boundary.



Final answer

Increasing cumulative-frequency graph through $(0, 0), (10, 19), (20, 37), (30, 52), (40, 63), (50, 73), (60, 80)$.

Part (b)

1 marks

STEP 1

$$\text{median position} = \frac{80}{2} = 40.$$

Read horizontally from cumulative frequency 40 to the graph, then vertically down to the age axis.

STEP 2

Using straight segments,

$$20 + \frac{40 - 37}{52 - 37} \times 10 = 22 \text{ years}.$$

The median is estimated between ages 20 and 30; a smooth graph gives a nearby estimate.

Final answer
Approximately 22 years.

Part (c)

1 marks

STEP 1

Read vertically from age 16 to the graph, then horizontally to the cumulative-frequency axis. The ordinate is the estimated number aged 16 and under.

STEP 2

Using straight segments,

$$19 + \frac{16 - 10}{20 - 10}(37 - 19) = 29.8 \approx 30.$$

Round the estimated count to a whole number of people.

Final answer
Approximately 30 people.

Question 15

3 marks

June 2026 | 4MA1/1HR | Regular polygons and a concave pentagon

15

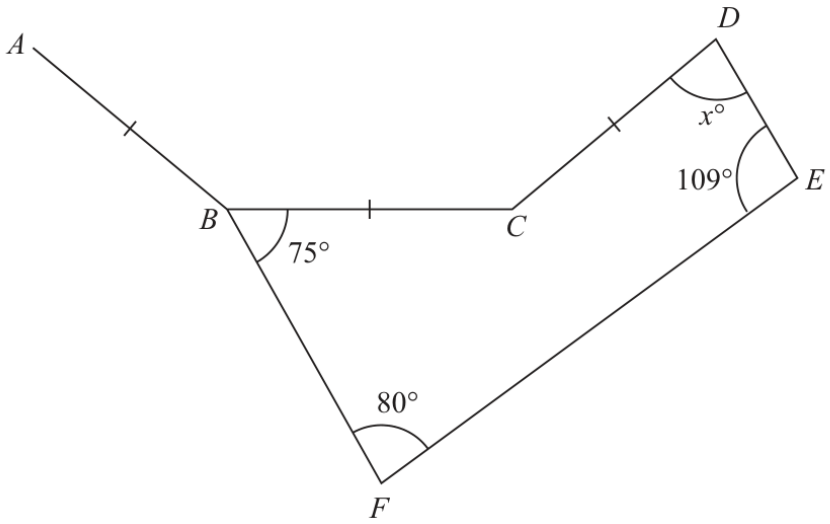


Diagram **NOT** accurately drawn

BCDEF is a pentagon.
AB, *BC* and *CD* are three sides of a regular 10-sided polygon.

Find the value of x

$x =$ .....

(Total for Question 15 is 3 marks)

Question 15 | Worked solution

3 marks

June 2026 | 4MA1/1HR | Regular polygons and a concave pentagon

Solution

3 marks

STEP 1

$$\text{interior angle of a regular decagon} = \frac{(10-2)180^\circ}{10} = 144^\circ.$$

BC and CD are consecutive sides of the regular decagon.

STEP 2

$$\text{reflex interior angle at C} = 360^\circ - 144^\circ = 216^\circ.$$

The pentagon BCDEF is concave at C, and its interior lies on the other side from the decagon interior angle.

STEP 3

$$75^\circ + 216^\circ + x + 109^\circ + 80^\circ = (5-2)180^\circ = 540^\circ,$$

The interior-angle sum formula also applies to a simple concave pentagon.

STEP 4

$$x = 540^\circ - 480^\circ = 60^\circ.$$

Subtract the four known interior angles.

Final answer

$x = 60^\circ$

Question 17

5 marks

June 2026 | 4MA1/1HR | Differentiation and stationary points

17 $y = x^3 + 5x^2 - 8x$

(a) Find $\dfrac{dy}{dx}$

$\dfrac{dy}{dx} =$ .....

(2)

The curve with equation $y = x^3 + 5x^2 - 8x$ has two stationary points, P and Q
The x-coordinate of P is less than the x-coordinate of Q

(b) Work out the coordinates of P
Show clear algebraic working.

(..... , ...)

(3)

(Total for Question 17 is 5 marks)

Question 17 | Worked solution

5 marks

June 2026 | 4MA1/1HR | Differentiation and stationary points

Part (a)

2 marks

STEP 1

$$\frac{\mathrm{d}y}{\mathrm{d}x} = 3x^2 + 10x - 8.$$

Apply the power rule to each term of $y = x^3 + 5x^2 - 8x$.

Final answer
$\frac{\mathrm{d}y}{\mathrm{d}x} = 3x^2 + 10x - 8$

Part (b)

3 marks

STEP 1

$$3x^2 + 10x - 8 = 0 \quad \Longrightarrow \quad (3x - 2)(x + 4) = 0.$$

At a stationary point the derivative is zero.

STEP 2

$$x = \frac{2}{3} \quad \text{or} \quad x = -4.$$

Set each factor equal to zero.

STEP 3

P has the smaller x-coordinate, so $x_P = -4$. Then

$$y_P = (-4)^3 + 5(-4)^2 - 8(-4) = -64 + 80 + 32 = 48.$$

Choose the left-hand stationary point and substitute into the original curve equation.

Final answer
$P = (-4, 48)$

Question 19

5 marks

June 2026 | 4MA1/1HR | Circle theorem angle reasoning

19 P, Q, R and S are points on a circle, centre O

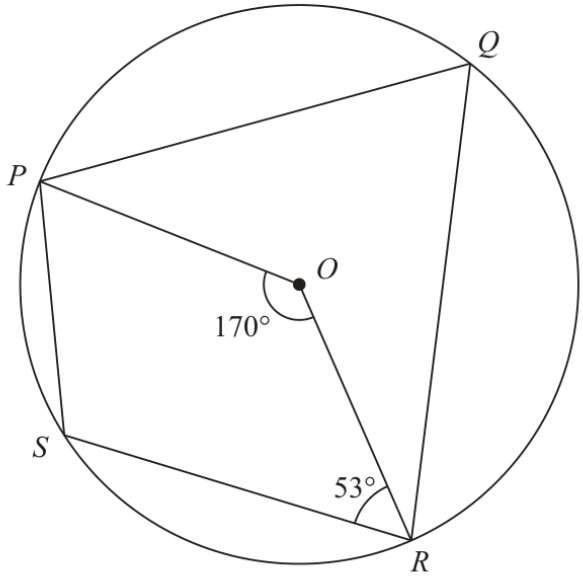


Diagram **NOT** accurately drawn

Angle $POR = 170°$ Angle $ORS = 53°$

Find the size of angle SPO
Give a reason for each stage of your working.

.....°

.....

(Total for Question 19 is 5 marks)

Question 19 | Worked solution

5 marks

June 2026 | 4MA1/1HR | Circle theorem angle reasoning

Solution

5 marks

STEP 1

$$\angle PQR = \frac{170^\circ}{2} = 85^\circ.$$

The angle at the centre is twice the angle at the circumference subtended by the same arc PR containing S.

STEP 2

$$\angle PSR = 180^\circ - 85^\circ = 95^\circ.$$

Opposite angles of cyclic quadrilateral PQRS sum to 180 degrees.

STEP 3

$$\angle SPO = 360^\circ - (170^\circ + 53^\circ + 95^\circ) = 42^\circ.$$

The interior angles of quadrilateral PSRO sum to 360 degrees; its other angles are POR, ORS and PSR.

Final answer
$\angle SPO = 42^\circ$

Question 20

5 marks

June 2026 | 4MA1/1HR | Linked direct proportions

20 y is directly proportional to t^2
$y = 40$ when $t = 4$

t is directly proportional to the cube root of x
$t = 12$ when $x = 8$

Work out the value of y when $x = 27$

$y =$ .....

(Total for Question 20 is 5 marks)

Question 20 | Worked solution

5 marks

June 2026 | 4MA1/1HR | Linked direct proportions

Solution

5 marks

STEP 1

$$y = kt^2, \qquad 40 = k(4^2) \quad \Longrightarrow \quad k = \frac{5}{2}.$$

Direct proportionality to t squared means a constant times t squared.

STEP 2

$$t = c\sqrt[3]{x}, \qquad 12 = c\sqrt[3]{8} = 2c \quad \Longrightarrow \quad c = 6.$$

Find the second proportionality constant using the given pair of values.

STEP 3

$$x = 27 \quad \Longrightarrow \quad t = 6\sqrt[3]{27} = 18.$$

Use the cube-root relationship first.

STEP 4

$$y = \frac{5}{2}(18)^2 = 810.$$

Substitute the new value of t into the square relationship.

Final answer
$y = 810$

Question 23

7 marks

June 2026 | 4MA1/1HR | Domain, composite and inverse functions

23 The function f is such that $f(x) = \frac{1}{x}$

(a) Write down the value of x that cannot be included in any domain of f

.....

(1)

The function g is such that $g(x) = 4x^2 - 8x + 15$
The domain of g is $x \geqslant 1$

(b) Work out $gf(0.5)$

.....

(2)

(c) Express the inverse function g^{-1} in the form $g^{-1}(x) = ...$

$g^{-1}(x) =$ .....

(4)

(Total for Question 23 is 7 marks)

Question 23 | Worked solution

7 marks

June 2026 | 4MA1/1HR | Domain, composite and inverse functions

Part (a)

1 marks

STEP 1

For $f(x) = \frac{1}{x}$, the denominator is zero when $x = 0$. Division by zero is undefined, so this input must be excluded.

Final answer

$x = 0$ must be excluded.

Part (b)

2 marks

STEP 1

$$f(0.5) = \frac{1}{0.5} = 2.$$

In gf, apply f first.

STEP 2

$$gf(0.5) = g(2) = 4(2)^2 - 8(2) + 15 = 16 - 16 + 15 = 15.$$

The input 2 lies in the stated domain $x \geq 1$ of g.

Final answer

$gf(0.5) = 15$

Part (c)

4 marks

STEP 1

$$y = 4x^2 - 8x + 15 = 4(x-1)^2 + 11.$$

Complete the square to isolate the expression containing x.

STEP 2

$$(x-1)^2 = \frac{y-11}{4}, \qquad x - 1 = \frac{\sqrt{y-11}}{2}.$$

Choose the nonnegative root because the domain of g is $x \geq 1$.

STEP 3

$$x = 1 + \frac{\sqrt{y - 11}}{2}.$$

Rearrange to make the original input the subject.

STEP 4

$$g^{-1}(x) = 1 + \frac{\sqrt{x - 11}}{2}, \qquad x \geq 11.$$

Exchange the input and output labels; the range of g becomes the domain of the inverse.

Final answer
$g^{-1}(x) = 1 + \frac{\sqrt{x-11}}{2}, \quad x \geq 11$

Question 24

4 marks

June 2026 | 4MA1/1HR | Equation of a tangent to a circle

24 The centre of a circle is the point with coordinates (3, 1)

The point P with coordinates (7, 6) lies on the circle.

The line **L** is the tangent to the circle at P

Find an equation for **L**
Give your answer in the form $ax + by + c = 0$ where a, b and c are integers.

.....

(Total for Question 24 is 4 marks)

Question 24 | Worked solution

4 marks

June 2026 | 4MA1/1HR | Equation of a tangent to a circle

Solution

4 marks

STEP 1

$$m_{CP} = \frac{6-1}{7-3} = \frac{5}{4}.$$

Find the gradient of the radius from the centre C=(3,1) to P=(7,6).

STEP 2

$$m_L = -\frac{4}{5}.$$

The tangent is perpendicular to the radius at P, so its gradient is the negative reciprocal.

STEP 3

$$y - 6 = -\frac{4}{5}(x - 7).$$

Use the tangent gradient and the given point of contact.

STEP 4

$$5y - 30 = -4x + 28 \quad \Longrightarrow \quad 4x + 5y - 58 = 0.$$

Multiply by 5 and collect all terms on one side to obtain integer coefficients.

Final answer

$4x + 5y - 58 = 0$

Question 25

6 marks

June 2026 | 4MA1/1HR | Vector geometry and line division

25

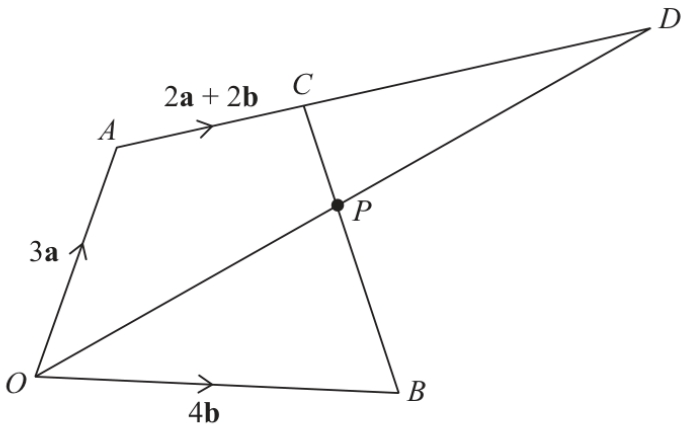


Diagram **NOT** accurately drawn

$\overrightarrow{OA} = 3\mathbf{a}$ $\overrightarrow{OB} = 4\mathbf{b}$ $\overrightarrow{AC} = 2\mathbf{a} + 2\mathbf{b}$ $\overrightarrow{CD} = \frac{3}{2} \times \overrightarrow{AC}$

P is the point on BC such that OPD is a straight line.

(a) Find $\overrightarrow{OD}$ in terms of **a** and **b**
Give your answer in its simplest form.

.....

(2)

(b) Find the ratio $OP : PD$
Show your working clearly.

.....

(4)

(Total for Question 25 is 6 marks)

Question 25 | Worked solution

6 marks

June 2026 | 4MA1/1HR | Vector geometry and line division

Part (a)

2 marks

STEP 1

$$\overrightarrow{CD} = \frac{3}{2}(2\mathbf{a} + 2\mathbf{b}) = 3\mathbf{a} + 3\mathbf{b}.$$

Use the stated relationship between CD and AC.

STEP 2

$$\overrightarrow{OD} = \overrightarrow{OA} + \overrightarrow{AC} + \overrightarrow{CD} = 3\mathbf{a} + (2\mathbf{a} + 2\mathbf{b}) + (3\mathbf{a} + 3\mathbf{b}) = 8\mathbf{a} + 5\mathbf{b}.$$

Add consecutive vectors along the route O-A-C-D.

Final answer
$\overrightarrow{OD} = 8\mathbf{a} + 5\mathbf{b}$

Part (b)

4 marks

STEP 1

$$\overrightarrow{OC} = 3\mathbf{a} + (2\mathbf{a} + 2\mathbf{b}) = 5\mathbf{a} + 2\mathbf{b}, \qquad \overrightarrow{BC} = 5\mathbf{a} - 2\mathbf{b}.$$

Use OC=OA+AC and BC=OC-OB.

STEP 2

Write $\overrightarrow{OP} = t\overrightarrow{OD} = 8t\mathbf{a} + 5t\mathbf{b}$. Also, because P lies on BC,

$$\overrightarrow{OP} = \overrightarrow{OB} + s\overrightarrow{BC} = 5s\mathbf{a} + (4 - 2s)\mathbf{b}.$$

Use one scalar parameter on each of the two intersecting lines.

STEP 3

$$8t = 5s, \qquad 5t = 4 - 2s, \qquad s = \frac{8}{5}t.$$

Equate the coefficients of the two nonparallel base vectors.

STEP 4

$$5t = 4 - \frac{16}{5}t \quad \Longrightarrow \quad 41t = 20 \quad \Longrightarrow \quad t = \frac{20}{41}.$$

Substitute the first relation into the second and solve.

STEP 5

$$OP : PD = t : (1 - t) = \frac{20}{41} : \frac{21}{41} = 20 : 21.$$

OD is divided into the fractions t and 1-t at P.

Final answer
$OP : PD = 20 : 21$

Question 2

2 marks

June 2026 | 4MA1/2HR | Arithmetic sequences

2 Here are the first five terms of an arithmetic sequence.

14 8 2 –4 –10

Find an expression, in terms of n, for the nth term of this sequence.

.....

(Total for Question 2 is 2 marks)

Question 2 | Worked solution

2 marks

June 2026 | 4MA1/2HR | Arithmetic sequences

Solution

2 marks

STEP 1

The common difference is $8 - 14 = -6$. Each successive term decreases by 6.

STEP 2

$$u_n = 14 + (n-1)(-6) = 20 - 6n.$$

Use first term plus (n-1) common differences.

Final answer
$u_n = 20 - 6n$.

Question 4 | parts b

2 marks

June 2026 | 4MA1/2HR | Linear equations, substitution and algebraic indices

$P = c^2 - 5d$

(b) Work out the value of P when $c = -7$ and $d = 3$

$P =$ .....

(2)

Question 4 | parts b | Worked solution

2 marks

June 2026 | 4MA1/2HR | Linear equations, substitution and algebraic indices

Part (b)

2 marks

STEP 1

$$P = (-7)^2 - 5(3) = 49 - 15 = 34.$$

The square applies to the whole negative number, so (-7) squared is positive.

Final answer
$P = 34$.

Question 5

5 marks

June 2026 | 4MA1/2HR | Ratio

5 Sarah and Dej each give some money to charity **A** and to charity **B**

Sarah shares \$400 between charity **A** and charity **B** in the ratio 2 : 3

Dej shares \$375 between the two charities.
He gives twice as much money to charity **B** as he gives to charity **A**

Dej gives more money to charity **B** than Sarah gives to charity **B**

How much more?

\$.....

(Total for Question 5 is 5 marks)

Question 5 | Worked solution

5 marks

June 2026 | 4MA1/2HR | Ratio

Solution

5 marks

STEP 1

$$\text{Sarah to B} = 400 \times \frac{3}{2+3} = 240 \text{ dollars.}$$

Charity B receives 3 of the 5 equal shares.

STEP 2

Dej gives to A and B in the ratio $1 : 2$, so

$$\text{Dej to B} = 375 \times \frac{2}{3} = 250 \text{ dollars.}$$

Twice as much to B means that B receives 2 of the 3 shares.

STEP 3

$$250 - 240 = 10 \text{ dollars.}$$

Subtract the two donations to charity B.

Final answer
$10 more.

Question 6

4 marks

June 2026 | 4MA1/2HR | Statistics: median, mode and range

6 Mika has six cards.
There is a number on each card.
The cards are arranged with the numbers in order of size.
Three of the numbers are hidden.



The mode of the six numbers is 8
The range of the six numbers is 7
The sum of the six numbers is 31

Work out the median of the six numbers.

.....

(Total for Question 6 is 4 marks)

Question 6 | Worked solution

4 marks

June 2026 | 4MA1/2HR | Statistics: median, mode and range

Solution

4 marks

STEP 1

The largest card is 8, so the smallest is $8 - 7 = 1$. Range is largest minus smallest.

STEP 2

The fifth card must be 8, since 8 is the mode. Only the fifth position can supply another 8 in the ordered cards.

STEP 3

If the third card is z, then

$$1 + 3 + z + 7 + 8 + 8 = 31 \quad \Rightarrow \quad z = 4.$$

Use the total of all six cards.

STEP 4

The ordered cards are $1, 3, 4, 7, 8, 8$, so

$$\text{median} = \frac{4 + 7}{2} = 5.5.$$

With six values, average the third and fourth.

Final answer
Median $= 5.5$.

Question 7

3 marks

June 2026 | 4MA1/2HR | Standard form

7 (a) Write 4×10^{-5} as an ordinary number.

.....

(1)

(b) Work out $(6 \times 10^{158}) \times (2 \times 10^{72})$
Give your answer in standard form.

.....

(2)

(Total for Question 7 is 3 marks)

Question 7 | Worked solution

3 marks

June 2026 | 4MA1/2HR | Standard form

Part (a)

1 marks

STEP 1

$$4 \times 10^{-5} = \frac{4}{100000} = 0.00004.$$

Move the decimal point five places left.

Final answer
0.00004.

Part (b)

2 marks

STEP 1

$$(6 \times 10^{158})(2 \times 10^{72}) = 12 \times 10^{230} = 1.2 \times 10^{231}.$$

Multiply the coefficients and add the exponents; normalize the coefficient into [1,10).

Final answer
1.2×10^{231}.

Question 8

3 marks

June 2026 | 4MA1/2HR | Reverse percentages

8 Lauren's salary increased by 4%
After the increase, her salary was 36 400 euros.

Work out Lauren's salary before the increase.

..... euros

(Total for Question 8 is 3 marks)

Question 8 | Worked solution

3 marks

June 2026 | 4MA1/2HR | Reverse percentages

Solution

3 marks

STEP 1

Let the old salary be s euros. Then

$$1.04s = 36400.$$

The increased salary is 104% of the original.

STEP 2

$$s = \frac{36400}{1.04} = 35000.$$

Divide by the percentage multiplier.

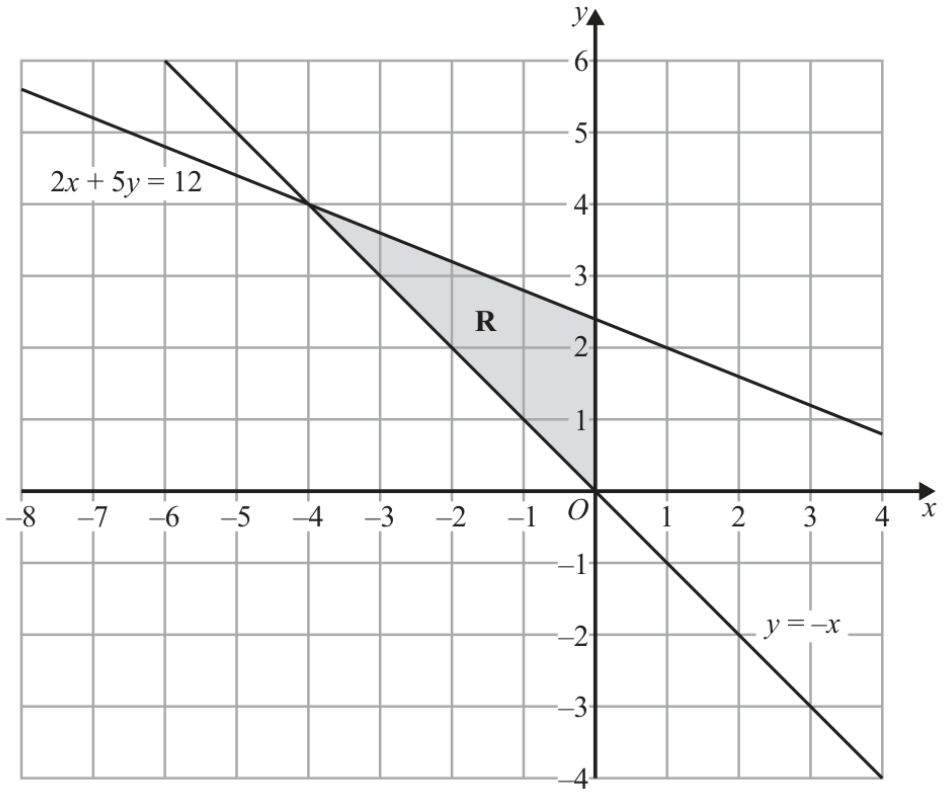
Final answer
35000 euros.

Question 12

3 marks

June 2026 | 4MA1/2HR | Graphical inequalities

12



The region **R**, shown shaded in the diagram, is bounded by the y-axis and the straight lines with equations

$$y = -x$$

$$2x + 5y = 12$$

Write down the three inequalities that define **R**

.....

.....

.....

(Total for Question 12 is 3 marks)

Question 12 | Worked solution

3 marks

June 2026 | 4MA1/2HR | Graphical inequalities

Solution

3 marks

STEP 1

$x \leq 0$. R lies to the left of the y-axis.

STEP 2

$y \geq -x$. R lies above the line y=-x.

STEP 3

$2x + 5y \leq 12$. R lies below the other line. All three boundaries are solid, so equality is included.

Final answer

$x \leq 0, \quad y \geq -x, \quad 2x + 5y \leq 12.$

Question 15

2 marks

June 2026 | 4MA1/2HR | Interquartile range

15 Mina recorded the times taken, in minutes, by 11 people to complete a puzzle.
Here are her results.

2 2 3 6 7 9 9 12 13 17 20

Find the interquartile range of these times.

..... minutes

(Total for Question 15 is 2 marks)

Question 15 | Worked solution

2 marks

June 2026 | 4MA1/2HR | Interquartile range

Solution

2 marks

STEP 1

The overall median is the sixth value, 9. The lower five values are $2, 2, 3, 6, 7$, and the upper five are $9, 12, 13, 17, 20$. Exclude the overall median when forming the two halves.

STEP 2

$$Q_1 = 3, \quad Q_3 = 13, \quad \text{IQR} = 13 - 3 = 10 \text{ minutes}.$$

Take each half-median, then subtract the lower quartile from the upper.

Final answer
10 minutes.

Question 18

2 marks

June 2026 | 4MA1/2HR | Vectors

18 Here are two vectors.

$$\overrightarrow{AB} = \begin{pmatrix} 4 \\ 5 \end{pmatrix} \qquad \overrightarrow{CB} = \begin{pmatrix} -2 \\ 8 \end{pmatrix}$$

Find $\overrightarrow{AC}$ as a column vector.

$$\overrightarrow{AC} = \begin{pmatrix} \ldots\ldots \\ \ldots\ldots \end{pmatrix}$$

(Total for Question 18 is 2 marks)

Question 18 | Worked solution

2 marks

June 2026 | 4MA1/2HR | Vectors

Solution

2 marks

STEP 1

$$\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC} = \overrightarrow{AB} - \overrightarrow{CB}.$$

Reverse CB to travel from B to C.

STEP 2

$$\overrightarrow{AC} = \begin{pmatrix} 4 \\ 5 \end{pmatrix} - \begin{pmatrix} -2 \\ 8 \end{pmatrix} = \begin{pmatrix} 6 \\ -3 \end{pmatrix}.$$

Subtract corresponding components.

Final answer

$\overrightarrow{AC} = \begin{pmatrix} 6 \\ -3 \end{pmatrix}$.

Question 20

3 marks

June 2026 | 4MA1/2HR | Rearranging formulae

20 Make x the subject of $y = \dfrac{3x+5}{4-2x}$

.....

(Total for Question 20 is 3 marks)

Question 20 | Worked solution

3 marks

June 2026 | 4MA1/2HR | Rearranging formulae

Solution

3 marks

STEP 1

$$y(4-2x) = 3x+5 \quad \Rightarrow \quad 4y - 2xy = 3x + 5.$$

Multiply by the denominator, which is nonzero in the original expression.

STEP 2

$$4y - 5 = 3x + 2xy = x(3+2y).$$

Collect both x-terms together and factor out x.

STEP 3

$$x = \frac{4y-5}{2y+3}.$$

Divide by 2y+3. The inverse formula requires y not equal to -3/2; the original requires x not equal to 2.

Final answer

$x = \frac{4y-5}{2y+3}$.

Question 22

5 marks

June 2026 | 4MA1/2HR | Nonlinear simultaneous equations

22 Solve the simultaneous equations

$$y^2 = x^2 + 7$$
$$y = 3x - 5$$

Show clear algebraic working.

.....

(Total for Question 22 is 5 marks)

Question 22 | Worked solution

5 marks

June 2026 | 4MA1/2HR | Nonlinear simultaneous equations

Solution

5 marks

STEP 1

$$(3x-5)^2 = x^2 + 7 \quad \Rightarrow \quad 9x^2 - 30x + 25 = x^2 + 7.$$

Substitute the linear expression for y into the nonlinear equation.

STEP 2

$$8x^2 - 30x + 18 = 0 \quad \Rightarrow \quad 4x^2 - 15x + 9 = 0.$$

Collect all terms on one side and divide by 2.

STEP 3

$$(4x-3)(x-3) = 0 \quad \Rightarrow \quad x = \frac{3}{4} \text{ or } x = 3.$$

Factorize the quadratic and set each factor to zero.

STEP 4

For $x = \frac{3}{4}$, $y = 3(\frac{3}{4}) - 5 = -\frac{11}{4}$. For $x = 3$, $y = 9 - 5 = 4$. Find the corresponding y-value for each x, preserving the pairs.

Final answer

$(x, y) = (\frac{3}{4}, -\frac{11}{4})$ or $(3, 4)$.

Question 23

5 marks

June 2026 | 4MA1/2HR | Similarity: area and volume scales

23 **K**, **L** and **M** are three similar solids.

volume of **K** : volume of **L** = 125 : 216

surface area of **K** : surface area of **M** = 4 : 9

The height of **M** is y% greater than the height of **L**

Work out the value of y
Show your working clearly.

$y =$ .....

(Total for Question 23 is 5 marks)

Question 23 | Worked solution

5 marks

June 2026 | 4MA1/2HR | Similarity: area and volume scales

Solution

5 marks

STEP 1

$$h_K : h_L = \sqrt[3]{125} : \sqrt[3]{216} = 5 : 6.$$

Corresponding lengths have the cube-root ratio of volumes.

STEP 2

$$h_K : h_M = \sqrt{4} : \sqrt{9} = 2 : 3.$$

Corresponding lengths have the square-root ratio of surface areas.

STEP 3

Take $h_K = 10$ units. Then $h_L = 12$ and $h_M = 15$, so

$$y = \frac{15 - 12}{12} \times 100 = 25.$$

Align the shared K-length and compare the increase relative to L.

Final answer

$y = 25$, so the height is 25% greater.

Question 24

4 marks

June 2026 | 4MA1/2HR | Sector arc and regular polygon

24

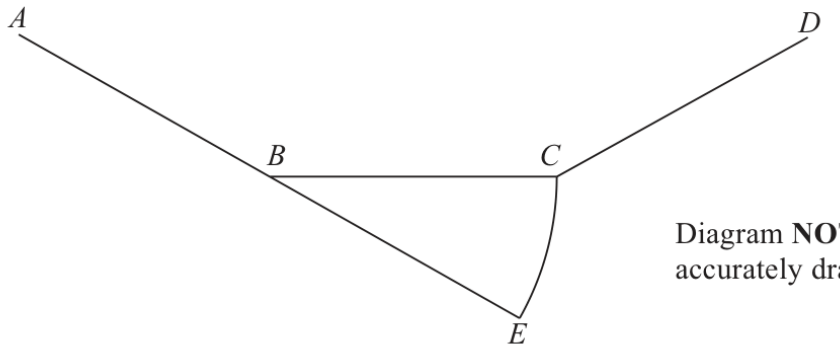


Diagram **NOT** accurately drawn

AB, BC and CD are three sides of a regular polygon.
ABE is a straight line.

BCE is a sector of a circle with centre B and radius 4.5 cm

The length of arc CE is $\frac{3}{10}\pi$ cm

Work out the sum of the interior angles of the regular polygon.

.....°

(Total for Question 24 is 4 marks)

Question 24 | Worked solution

4 marks

June 2026 | 4MA1/2HR | Sector arc and regular polygon

Solution

4 marks

STEP 1

Let $\theta = \angle CBE$. Then

$$\frac{\theta}{360}\,2\pi(4.5) = \frac{3}{10}\pi \quad \Rightarrow \quad \theta = 12^\circ.$$

The arc is theta/360 of a full circumference.

STEP 2

$\angle ABC = 180^\circ - 12^\circ = 168^\circ$, so the regular polygon has exterior angle 12°. A, B and E are collinear, so the sector angle is supplementary to the interior angle.

STEP 3

$$n = \frac{360}{12} = 30, \qquad \text{sum} = (30-2)180^\circ = 5040^\circ.$$

Exterior angles sum to 360 degrees, and an n-gon has interior-angle sum (n-2) times 180 degrees.

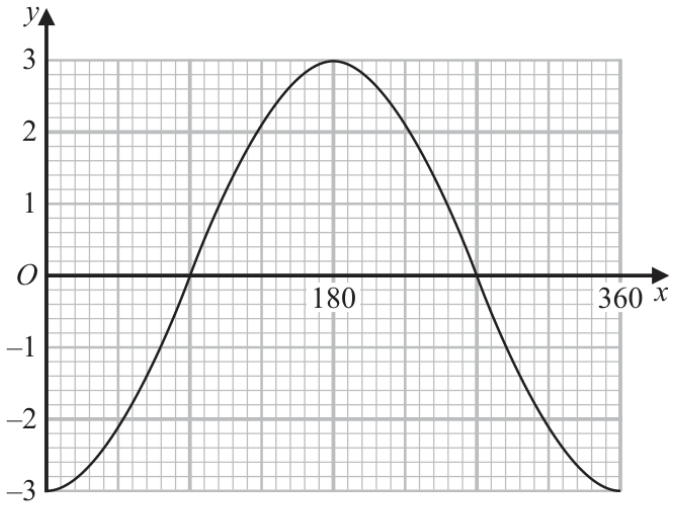
Final answer
5040°.

Question 25

4 marks

June 2026 | 4MA1/2HR | Transformations of functions

25 The graph of $y = a\sin(x + b)°$ for $0 \leqslant x \leqslant 360$ is drawn on the grid below.



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

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

$a =$ .....

$b =$ .....

(2)

A curve has equation $y = f(x)$
The point T with coordinates (p, q) lies on the curve.

(b) Find the coordinates of the image of T on the curve with equation

$$y = f(2x) + 5$$

Give your coordinates in terms of p and q

(..... , ...)

(2)

(Total for Question 25 is 4 marks)

Question 25 | Worked solution

4 marks

June 2026 | 4MA1/2HR | Transformations of functions

Part (a)

2 marks

STEP 1

The graph has maximum 3 and minimum -3, so $|a| = 3$. Since $a < 0$, $a = -3$. The amplitude is half the vertical range.

STEP 2

At $x = 0$, $y = -3$, so $-3\sin b^\circ = -3$ and $\sin b^\circ = 1$. Hence $b = 90$ for $0 < b < 360$. The minimum at x=0 fixes the phase when the amplitude is negative.

Final answer

$a = -3, \qquad b = 90.$

Part (b)

2 marks

STEP 1

To use the original input p, set $2x = p$, giving $x = p/2$. The replacement of x by 2x halves horizontal coordinates.

STEP 2

The corresponding output is $f(p) + 5 = q + 5$. Adding 5 translates every output upwards by 5.

Final answer

$(\frac{p}{2}, q + 5)$.

Question 26

6 marks

June 2026 | 4MA1/2HR | Arithmetic series

26 Here are the first four terms of an arithmetic series.

$$(k + 2) \qquad (k + 5) \qquad (k + 8) \qquad (k + 11)$$

The sum of the first $2n$ terms of the series is 4 times the sum of the first n terms of the series.

Work out the numerical value of the 100th term of the series.
Show your working clearly.

.....

(Total for Question 26 is 6 marks)

Question 26 | Worked solution

6 marks

June 2026 | 4MA1/2HR | Arithmetic series

Solution

6 marks

STEP 1

The first term is $a = k + 2$ and the common difference is $d = 3$. Successive listed terms differ by 3.

STEP 2

$$S_n = \frac{n}{2}\{2(k+2) + 3(n-1)\} = \frac{n}{2}(2k + 1 + 3n).$$

Apply the arithmetic-series sum formula.

STEP 3

$$S_{2n} = n\{2(k+2) + 3(2n-1)\} = n(2k + 1 + 6n).$$

Use 2n in place of n throughout the sum formula.

STEP 4

Using $S_{2n} = 4S_n$ and $n > 0$,

$$2k + 1 + 6n = 2(2k + 1 + 3n) = 4k + 2 + 6n.$$

Divide the equation by n, then expand the right-hand side.

STEP 5

$$2k + 1 = 4k + 2 \quad \Rightarrow \quad k = -\frac{1}{2}.$$

The n-terms cancel, leaving a linear equation for k.

STEP 6

$$u_{100} = k + 2 + 99(3) = -\frac{1}{2} + 2 + 297 = 298.5.$$

The 100th term is the first term plus 99 common differences.

Final answer
The 100th term is 298.5.

Question 27

4 marks

June 2026 | 4MA1/2HR | Successive percentage increases

27 Bryan owns a house.

During 2024, the value of Bryan's house increased by $x\%$
During 2025, the value of Bryan's house increased by $2x\%$

Overall, during 2024 and 2025, the value of Bryan's house increased by 38.88%

Work out the value of x
Show clear algebraic working.

$x =$ .....

(Total for Question 27 is 4 marks)

Question 27 | Worked solution

4 marks

June 2026 | 4MA1/2HR | Successive percentage increases

Solution

4 marks

STEP 1

$$\left(1+\frac{x}{100}\right)\left(1+\frac{2x}{100}\right)=1.3888.$$

The second increase acts on the already-increased house value.

STEP 2

$$1+\frac{3x}{100}+\frac{2x^2}{10000}=1.3888 \quad \Rightarrow \quad x^2+150x-1944=0.$$

Expand, subtract 1, and multiply by 5000.

STEP 3

$$(x-12)(x+162)=0 \quad \Rightarrow \quad x=12 \text{ or } x=-162.$$

Factorize the quadratic.

STEP 4

Reject $x=-162$, since both changes are increases, so $x>0$. The positive root gives multipliers 1.12 and 1.24, whose product is 1.3888.

Final answer

$x=12$.