# PEARSON EDEXCEL INTERNATIONAL GCSE (9–1)

**Mathematics A (Modular) — Unit 1H Higher Tier (4WM1H/01)**
**Thursday 14 May 2026 — Full Solutions & Mark Scheme**

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| **Paper Reference:** | 4WM1H/01 | **Total Marks:** | 100 Marks |
| **Tier:** | Higher Tier | **Duration:** | 2 Hours |

## Question 1 (3 Marks)

**Show that** *4&frac17; − 2⅗ = 1&frac19;/ 35*.

### FULL SOLUTION

1. Convert both mixed numbers into improper fractions:
   *4&frac17; = (4 × 7 + 1) / 7 = 29/7*
   *2⅗ = (2 × 5 + 3) / 5 = 13/5*
2. Find a common denominator, which is $7 \times 5 = 35$:
   $(29 \times 5) / 35 - (13 \times 7) / 35 = 145/35 - 91/35$
3. Subtract the numerators:
   $(145 - 91) / 35 = 54/35$
4. Convert back into a mixed number:
   *54/35 = 1&frac19;/ 35*

### MARK SCHEME

- **M1:** For a valid method to convert to improper fractions (e.g., $29/7$ and $13/5$) or an equivalent splitting strategy.
- **M1:** For finding a common denominator and showing correct numerators (e.g., $145/35 - 91/35$).
- **A1:** For concluding correctly with *54/35 = 1&frac19;/ 35* from full, clear working.

## Question 2 (3 Marks)

**Work out the value of $x$. Give your answer correct to 3 significant figures. [Given: Right-angled triangle with hypotenuse = 10 cm, adjacent angle = 65°]**

### FULL SOLUTION

Using basic trigonometry in the right-angled triangle where the hypotenuse is 10 cm, and $x$ is the side adjacent to the 65° angle:

$$\cos(65°) = \text{Adjacent} / \text{Hypotenuse} = x / 10$$

$$x = 10 \times \cos(65°)$$

$$x \approx 10 \times 0.422618 = 4.22618 \text{ cm}$$

To 3 significant figures:

$$x = 4.23$$

### MARK SCHEME

- **M1:** For a correct trigonometric equation (e.g., $\cos(65) = x / 10$ or $\sin(25) = x / 10$).
- **M1:** For rearrangement to isolate $x$ (e.g., $10 \times \cos(65)$).
- **A1:** 4.23 (accept answers between 4.22 and 4.23).

## Question 3 (5 Marks)

**(a) Find the value of $n$ for $20^{70} \times 20^{8} = 20^{n}$ (1 Mark)**

**(b) Find the value of $m$ for $36^{80} \div 36^{5} = 36^{m}$ (1 Mark)**

**(c) Find the value of $p$ for $(52^{4})^{16} = 52^{p}$ (1 Mark)**

**(d) Write down the lower bound for a distance of 100 metres measured to the nearest metre. (1 Mark)**

**(e) Write down the upper bound for a time of 16.3 seconds measured to one decimal place. (1 Mark)**

### FULL SOLUTION

(a) $n = 70 + 8 = 78$

(b) $m = 80 - 5 = 75$

(c) $p = 4 \times 16 = 64$

(d) The unit interval is 1 metre, so variation is ±0.5 m. Lower bound = $100 - 0.5 = 99.5$

(e) The unit interval is 0.1 seconds, so variation is ±0.05 s. Upper bound = $16.3 + 0.05 = 16.35$

### MARK SCHEME

- (a) **B1:** 78
- (b) **B1:** 75
- (c) **B1:** 64
- (d) **B1:** 99.5
- (e) **B1:** 16.35

## Question 4 (5 Marks)

**Work out the perimeter of the shaded shape ABCD made from a right-angled triangle ABD and a semicircle BCD. Given: AB = 10 cm, AD = 26 cm, angle ABD = 90°. Give your answer correct to 3 significant figures.**

### FULL SOLUTION

1. First, find side BD using Pythagoras' Theorem on right-angled triangle ABD:
   $AB^2 + BD^2 = AD^2 \Rightarrow 10^2 + BD^2 = 26^2$
   $100 + BD^2 = 676 \Rightarrow BD^2 = 576 \Rightarrow BD = \sqrt{576} = 24 \text{ cm}$
2. The side BD acts as the diameter of the semicircle BCD. Therefore, the radius is:
   $r = 24 / 2 = 12 \text{ cm}$
3. Find the arc length of the semicircle BCD:
   $\text{Arc length} = \pi \times r = 12\pi \approx 37.699 \text{ cm}$
4. The perimeter consists of sides AB, AD, and the curved arc BCD:
   $\text{Perimeter} = AB + AD + \text{Arc length} = 10 + 26 + 12\pi \approx 73.699 \text{ cm}$

To 3 significant figures: **73.7 cm**

### MARK SCHEME

- **M1:** For applying Pythagoras' theorem to find BD (e.g., $\sqrt{(26^2 - 10^2)}$).
- **A1:** BD = 24
- **M1:** For a process to calculate the arc length of a semicircle (e.g., $½ \times \pi \times 24$).
- **M1:** For summing 10 + 26 + their arc length.
- **A1:** 73.7 (or 73.70)

## Question 5 (4 Marks)

**E = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}, A = {2, 3, 5, 7, 11}, A ∩ B = {2, 5}, B' = {3, 4, 6, 7, 9, 11}**
**(a) Complete the Venn diagram. (3 Marks)**
**(b) Find the probability that a number chosen at random is in the set (A ∪ B)'. (1 Mark)**

### FULL SOLUTION

(a) **Venn Diagram Distribution:**
• Intersection region A ∩ B: {2, 5}
• Region A only (elements in A but not in B): {3, 7, 11}
• Region B only (elements in B but not in A): Since B contains elements NOT in B', B = {1, 2, 5, 8, 10, 12}. Subtracting intersection gives: {1, 8, 10, 12}
• Outside both circles (A ∪ B)': Remaining elements of E are {4, 6, 9}

(b) Total elements in (A ∪ B)' is 3. Total elements in E is 12.
***Probability = 3 / 12 = 1/4 = 0.25***

### MARK SCHEME

- **M1:** For placing {2, 5} in the intersection.
- **M1:** For placing {3, 7, 11} in A only, and {1, 8, 10, 12} in B only.
- **A1:** For a completely correct Venn diagram with {4, 6, 9} in the outer background.
- **B1:** 1/4 or 0.25 (or equivalent fraction).

## Question 6 (2 Marks)

**Simplify $(4x^5y^6)^3$.**

### FULL SOLUTION

Apply the power rule to each component inside the product:
$$(4)^3 \times (x^5)^3 \times (y^6)^3 = 64x^{15}y^{18}$$

### MARK SCHEME

- **M1:** For evaluating any two parts correctly (e.g., 64, $x^{15}$, or $y^{18}$).
- **A1:** $64x^{15}y^{18}$

## Question 7 (4 Marks)

**Biased 4-sided spinner. P(1) = 0.12, P(2) = x, P(3) = 2x, P(4) = 0.16. Nevan spins the spinner 500 times. Work out the expected number of times that the spinner lands on an even number.**

### FULL SOLUTION

1. The sum of all probabilities must equal 1:
   $0.12 + x + 2x + 0.16 = 1 \Rightarrow 0.28 + 3x = 1 \Rightarrow 3x = 0.72 \Rightarrow x = 0.24$
2. The even numbers on the spinner are 2 and 4. Find the total probability of landing on an even number:
   $P(Even) = P(2) + P(4) = x + 0.16 = 0.24 + 0.16 = 0.40$
3. Work out the expected frequency across 500 spins:
   $Expected\ value = 500 \times 0.40 = 200$

### MARK SCHEME

- **M1:** For forming the probability sum equation: $0.12 + x + 2x + 0.16 = 1$.
- **A1:** For finding $x = 0.24$.
- **M1:** For finding total $P(Even) = 0.40$ and multiplying by 500.
- **A1:** 200

## Question 8 (3 Marks)

**A block of wood has a mass of 480 kg. The wood has a density of 640 kg/m$^3$. Work out the volume of the block of wood.**

### FULL SOLUTION

Using the formula:

$Density = Mass / Volume \Rightarrow Volume = Mass / Density$

$Volume = 480 / 640 = 3/4 = 0.75\ m^3$

### MARK SCHEME

- **M1:** For substituting correctly into the formula: $480 / 640$.
- **M1:** For a valid division/simplification step.
- **A1:** 0.75 (or 3/4).

## Question 9 (5 Marks)

**(a) Factorise** $15g^4h - 20gh^3$ **(2 Marks)**

**(b) (i) Factorise** $x^2 + 3x - 28$ **(2 Marks)**

**(ii) Hence, solve** $x^2 + 3x - 28 = 0$ **(1 Mark)**

### FULL SOLUTION

(a) Find the highest common factor: $5gh$.

$$15g^4h - 20gh^3 = 5gh(3g^3 - 4h^2)$$

(b) (i) Find two numbers that multiply to −28 and add to +3. Those numbers are +7 and −4.

$$(x + 7)(x - 4)$$

(b) (ii) Set each factor to 0:

$$x + 7 = 0 \Rightarrow x = -7$$

$$x - 4 = 0 \Rightarrow x = 4$$

### MARK SCHEME

- (a) **M1:** For factoring out any common factor. **A1:** $5gh(3g^3 - 4h^2)$
- (b)(i) **M1:** For any factorisation of the form $(x \pm 7)(x \pm 4)$. **A1:** $(x + 7)(x - 4)$
- (b)(ii) **B1:** $x = -7, x = 4$ (dependent on a valid factor expression).

## Question 10 (3 Marks)

**Find an equation for the straight line L drawn on the grid. [Given: crosses y-axis at (0,1) and passes through (2,5)]**

### FULL SOLUTION

1. Identify the y-intercept ($c$) from the graph line: $c = 1$.
2. Find the gradient ($m$) using the points (0,1) and (2,5):
   $m = (y_2 - y_1) / (x_2 - x_1) = (5 - 1) / (2 - 0) = 4 / 2 = 2$
3. Write the linear equation in the form $y = mx + c$:
   $y = 2x + 1$

### MARK SCHEME

- **M1:** For identifying $c = 1$ or demonstrating gradient calculation via a rise/run step.
- **M1:** For finding a gradient value of 2.
- **A1:** $y = 2x + 1$ (or equivalent equation format).

## Question 11 (3 Marks)

**There are 40 counters in a bag: 25 green, 7 blue, and 8 red. Ben adds some extra blue counters and some extra red counters. The number of blue counters added is twice the number of red counters added. The probability of picking a green counter becomes 5/11. How many extra blue counters were added?**

### FULL SOLUTION

1. Let the number of red counters added be $n$. Then the number of blue counters added is $2n$.
2. Total extra counters added = $2n + n = 3n$. New total counters inside bag = $40 + 3n$.
3. Set up the probability expression for picking a green counter:
   $P(Green) = 25 / (40 + 3n) = 5 / 11$
4. Cross-multiply and solve for $n$:
   $25 \times 11 = 5 \times (40 + 3n) \Rightarrow 275 = 200 + 15n$
   $75 = 15n \Rightarrow n = 5$
5. Calculate the extra blue counters added:
   $\text{Blue counters} = 2n = 2 \times 5 = 10$

### MARK SCHEME

- **M1:** For forming an algebraic fraction equating the green probability: $25 / (40 + 3n) = 5/11$.
- **M1:** For a correct algebraic isolation step to solve for $n$ (e.g., $15n = 75$).
- **A1:** 10 (must accurately isolate the number of blue counters, not just $n = 5$).

## Question 12 (6 Marks)

**(a) Find the value of x for $(2^{x/3}) / 8^x = 64$. Show clear working. (3 Marks)**

**(b) Expand and simplify $4t(t + 5)(2t - 3)$. (3 Marks)**

### FULL SOLUTION

(a) Convert all terms into base 2:

$8^x = (2^3)^x = 2^{3x}$ and $64 = 2^6$

$2^{x/3 - 3x} = 2^6$

Equate index parameters:

$x/3 - 3x = 6$

Multiply through by 3 to clear fractional denominators:

$x - 9x = 18 \Rightarrow -8x = 18 \Rightarrow x = -18/8 = -2.25$

(b) First expand the binomial double brackets:

$(t + 5)(2t - 3) = 2t^2 - 3t + 10t - 15 = 2t^2 + 7t - 15$

Now multiply the trinomial result through by $4t$:

$4t(2t^2 + 7t - 15) = 8t^3 + 28t^2 - 60t$

### MARK SCHEME

- (a) **M1:** For converting terms to base 2 ($2^{3x}$ or $2^6$). **M1:** For linear index index equation: $x/3 - 3x = 6$. **A1:** –2.25 (or –9/4).
- (b) **M1:** For correct expansion of any two factors yielding at least 3 terms. **M1:** For multiplying through by $4t$. **A1:** $8t^3 + 28t^2 - 60t$

## Question 13 (4 Marks)

**A team plays two independent games of football. For each game, the probability that the team wins is 0.56.**
**(a) Complete the probability tree diagram. (2 Marks)**
**(b) Work out the probability that the team wins both games. (2 Marks)**

### FULL SOLUTION

(a) The probability of 'Not Win' is:

$$1 - 0.56 = 0.44$$

Fill this value across all secondary structural branch parameters.

(b) Calculate product path for Win followed by Win:

$$P(Win \cap Win) = 0.56 \times 0.56 = 0.3136$$

### MARK SCHEME

- (a) **M1:** For finding branch value 0.44. **A1:** Fully completed tree branches.
- (b) **M1:** For multiplying $0.56 \times 0.56$. **A1:** 0.3136

## Question 14 (6 Marks)

**(a) Write down the letter of the graph that could match the equation: (i)** $y = x^2 - 3x$**, (ii)** $y = -x^3 + 9x$**.**
**(b) Complete table of values and draw graph for** $y = 12 / x^2$**.**

### FULL SOLUTION

(a) (i) Positive quadratic equation passing through origin corresponds to **Graph D**.
(a) (ii) Negative cubic curve configuration passing through origin corresponds to **Graph E**.

(b) Table calculation values:
• $x = 1 \Rightarrow y = 12 / 1 =$ **12**
• $x = 2 \Rightarrow y = 12 / 4 =$ **3**
• $x = 4 \Rightarrow y = 12 / 16 =$ **0.75**
• $x = 5 \Rightarrow y = 12 / 25 =$ **0.48**

### MARK SCHEME

- (a)(i) **B1:** D ; (ii) **B1:** E
- (b) **B2:** For all 4 values correct (allow **B1** for 2 or 3 correct table entries).
- (c) **M1:** For plotting at least 5 coordinates correctly. **A1:** Smooth continuous curve.

## Question 15 (5 Marks)

**Triangle ABC: AB = 25 cm, AC = 73 cm, angle BAC = 65°.**
**(a) Work out length of BC to 3 s.f. (3 Marks)**
**(b) Work out the area of the triangle to 3 s.f. (2 Marks)**

### FULL SOLUTION

(a) Apply the Cosine Rule:

$$BC^2 = AB^2 + AC^2 - 2(AB)(AC)\cos(A)$$

$$BC^2 = 25^2 + 73^2 - 2(25)(73)\cos(65°)$$

$$BC^2 = 625 + 5329 - 3650 \times 0.422618 = 5954 - 1542.557 = 4411.443$$

$$BC = \sqrt{4411.443} \approx 66.4186 \text{ cm} \Rightarrow 66.4 \text{ cm}$$

(b) Apply SAS Area formula:

$$Area = ½ \times b \times c \times \sin(A) = ½ \times 25 \times 73 \times \sin(65°)$$

$$Area = 912.5 \times 0.906308 = 827.006 \text{ cm}^2 \Rightarrow 827 \text{ cm}^2$$

### MARK SCHEME

- (a) **M1:** Substitution into Cosine Rule. **M1:** Simplification to evaluation step. **A1:** 66.4
- (b) **M1:** Correct area formula expression set up. **A1:** 827

## Question 16 (6 Marks)

**(a) Solve $x^2 - (2\sqrt{3})x - 13 = 0$. Form: $\sqrt{a} \pm b$ where a, b integers. (3 Marks)**

**(b) Show that $\sqrt{20} / (\sqrt{5} + 2)$ can be written in the form $c - \sqrt{d}$ where c, d are integers. (3 Marks)**

### FULL SOLUTION

(a) Apply the quadratic formula where A = 1, B = $-2\sqrt{3}$, C = $-13$:

$x = [\ -(-2\sqrt{3}) \pm \sqrt{((-2\sqrt{3})^2 - 4(1)(-13))}\ ] / 2$

$x = [\ 2\sqrt{3} \pm \sqrt{(12 + 52)}\ ] / 2 = [\ 2\sqrt{3} \pm \sqrt{64}\ ] / 2 = [\ 2\sqrt{3} \pm 8\ ] / 2 = \sqrt{3} \pm 4$

(b) Simplify the numerator first: $\sqrt{20} = 2\sqrt{5}$. Rationalise by conjugate multiplication:

$[\ 2\sqrt{5} \times (\sqrt{5} - 2)\ ] / [\ (\sqrt{5} + 2)(\sqrt{5} - 2)\ ] = [\ 2(5) - 4\sqrt{5}\ ] / [\ 5 - 4\ ]$

$= 10 - 4\sqrt{5} = 10 - \sqrt{(16 \times 5)} = 10 - \sqrt{80}$

### MARK SCHEME

- (a) **M1:** Valid formula substitution step. **M1:** Discriminant evaluation to $\sqrt{64}$. **A1:** $\sqrt{3} \pm 4$.
- (b) **M1:** Convert to $2\sqrt{5}$ or multiply by conjugate fraction. **M1:** Expansion and simplification. **A1:** $10 - \sqrt{80}$.

## Question 17 (4 Marks)

**Line L is perpendicular to line with equation y = 7 + 4x. L passes through point A(0, 19/2) and crosses the x-axis at point B. Find the area of triangle AOB where O is the origin.**

### FULL SOLUTION

1. Perpendicular gradient is negative reciprocal of 4: $m = -1/4$.
2. Equation of line L with y-intercept (0, 19/2) is: $y = -1/4\ x + 19/2$.
3. Find coordinate B by setting y = 0:

   $0 = -1/4\ x + 19/2 \Rightarrow 1/4\ x = 19/2 \Rightarrow x = 38 \Rightarrow B(38, 0)$.
4. Area of right-angled triangle AOB:

   $Area = ½ \times base \times height = ½ \times 38 \times 19/2 = 19 \times 9.5 = 180.5$

### MARK SCHEME

- **M1:** Gradient step found as $-1/4$.
- **M1:** Linear equation solution yielding x-intercept = 38.
- **M1:** Area equation product calculation step.
- **A1:** 180.5

## Question 18 (5 Marks)

**v = 2(s/t) – u. s = 100 (nearest integer), t = 1.68 (2 d.p.), u = 0.5 (1 d.p.). By considering bounds, work out the value of v to a suitable degree of accuracy.**

### FULL SOLUTION

1. Identify bound metrics for each component:
   • $s \in [99.5, 100.5]$, • $t \in [1.675, 1.685]$, • $u \in [0.45, 0.55]$
2. Calculate lower bound value for v:
   $v_{lower} = 2(s_{lower} / t_{upper}) - u_{upper} = 2(99.5 / 1.685) - 0.55 = 117.55089$
3. Calculate upper bound value for v:
   $v_{upper} = 2(s_{upper} / t_{lower}) - u_{lower} = 2(100.5 / 1.675) - 0.45 = 119.55000$
4. Both bounds round to **120** to 2 significant figures (***118*** vs ***120***).

### MARK SCHEME

- **B1:** State correct bounds for at least two input items.
- **M1:** Process expression set up for lower bound.
- **M1:** Process expression set up for upper bound.
- **A1:** Bounds found as 117.55... and 119.55...
- **A1:** 120 with an explicit statement reasoning that both bounds share identical rounding outputs to 2 s.f.

## Question 19 (3 Marks)

**Cuboid PQRSTUVW: PQ = 12 cm, QR = 10 cm, RU = 9 cm. M is the midpoint of VU. Work out the size of the angle between line MP and plane PQRS to 1 d.p.**

### FULL SOLUTION

1. Let N be the floor projection point of M on edge SR. N is the midpoint of SR, so $SN = 6\ cm$.
2. Find length PN on floor right triangle PSN (where PS = 10 cm):
   $PN^2 = PS^2 + SN^2 = 10^2 + 6^2 = 136 \Rightarrow PN = \sqrt{136}\ cm$
3. Vertical distance height segment is MN = 9 cm.
4. Angle θ inside right triangle MNP calculation:
   $\tan(\theta) = MN / PN = 9 / \sqrt{136} \Rightarrow \theta = \tan^{-1}(9 / 11.6619) \approx 37.7°$

### MARK SCHEME

- **M1:** Process to find base distance squared or value (e.g., $10^2 + 6^2 = 136$).
- **M1:** Correct trigonometric fraction expression configuration using their values.
- **A1:** 37.7°

## Question 20 (4 Marks)

**Express** $[\,5/(4x-7) - 3/(3x-5)\,] \div (9x^2-16)/(6x^2-7x-5)$ **as a single fraction in its simplest form.**

### FULL SOLUTION

1. Combine terms inside the subtraction brackets:
   $[\,5(3x-5) - 3(4x-7)\,] / [\,(4x-7)(3x-5)\,] = (15x - 25 - 12x + 21) / [\,(4x-7)(3x-5)\,] = (3x - 4) / [\,(4x-7)(3x-5)\,]$
2. Factorise components of the division fraction numerator and denominator:
   - $9x^2 - 16 = (3x - 4)(3x + 4)$
   - $6x^2 - 7x - 5 = (2x + 1)(3x - 5)$
3. Change to multiplication and invert:
   $[\,(3x - 4) / ((4x-7)(3x-5))\,] \times [\,((2x + 1)(3x - 5)) / ((3x - 4)(3x + 4))\,]$
4. Cancel shared identical factors to give:
   $(2x + 1) / [\,(4x - 7)(3x + 4)\,]$

### MARK SCHEME

- **M1:** Combine subtraction fraction numerators correctly.
- **M1:** Difference of two squares factoring implementation.
- **M1:** Quadratic trinomial factor grouping implementation.
- **A1:** $(2x + 1) / [\,(4x - 7)(3x + 4)\,]$

## Question 21 (3 Marks)

**Incomplete histogram. Half of the parcels weigh between 22 kg and 34 kg. Complete the histogram by drawing the missing bar. [Given: Bar 1(2-7, FD=0.8), Bar 2(7-17, FD=1.8), Bar 3(17-22, FD=2.8), Bar 4(34-40, FD=1.0)]**

### FULL SOLUTION

1. Calculate the frequency of the visible existing bars:
   • Freq(2−7) = 5 × 0.8 = 4, • Freq(7−17) = 10 × 1.8 = 18
   • Freq(17−22) = 5 × 2.8 = 14, • Freq(34−40) = 6 × 1.0 = 6
2. Sum of current known frequencies = 4 + 18 + 14 + 6 = 42.
3. Since the remaining bar represents exactly half of all items, total missing frequency = 42.
4. Calculate Frequency Density for interval (22 to 34, width = 12):
   ***Frequency Density = 42 / 12 = 3.5***
5. Draw a horizontal bar from x = 22 to x = 34 at height 3.5.

### MARK SCHEME

- **M1:** Areas computed for at least two standard visible bars.
- **M1:** Summed frequency step equated to determine missing area = 42.
- **A1:** Correctly located horizontal bar block drawn at height metric 3.5.

## Question 22 (5 Marks)

**A bag contains x marbles. 12 are pink and the rest are yellow. Greta takes 2 marbles at random. The probability of picking one pink and one yellow is 18/47. Find the value of x.**

### FULL SOLUTION

1. Probability of picking one pink and one yellow can happen in two arrangements (PY or YP):
   $P = 2 \times [\, 12/x \times (x-12)/(x-1) \,] = 24(x-12) / [\, x(x-1) \,] = 18 / 47$
2. Simplify numerator division factor terms by 6:
   $4(x-12) / [\, x(x-1) \,] = 3 / 47 \Rightarrow 47(4x - 48) = 3(x^2 - x)$
   $188x - 2256 = 3x^2 - 3x \Rightarrow 3x^2 - 191x + 2256 = 0$
3. Factorise the quadratic equation:
   $(3x - 47)(x - 48) = 0$

Since x must be an integer metric greater than 12, **x = 48**.

### MARK SCHEME

- **M1:** Basic product path metric created: $12/x \times (x-12)/(x-1)$.
- **M1:** Combine paths into conditional equation matching 18/47.
- **M1:** Expand to standard quadratic form: $3x^2 - 191x + 2256 = 0$.
- **M1:** Valid solution step to resolve quadratic roots.
- **A1:** 48

## Question 23 (6 Marks)

**OPQ and OAB are sectors of a circle with centre O. Angle POQ = 50°. A is on OP such that OA = 1/4 OP. Shaded area is 243π/16 cm$^2$. Work out the perimeter of the shaded region in form aπ + b.**

### FULL SOLUTION

1. Let OP = R, then OA = r = ¼R.
2. Shaded area difference calculation:

   $Area = 50/360\ \pi\ (R^2 - r^2) = 5/36\ \pi\ (R^2 - 1/16\ R^2) = 5/36\ \pi \times 15/16\ R^2 = 243\pi / 16$

   $75 / 576\ R^2 = 243 / 16 \Rightarrow R^2 = 116.64 \Rightarrow R = 10.8\ cm$
3. Calculate inner radius: $r = 10.8 / 4 = 2.7\ cm$.
4. Straight borders: $AP = BQ = 10.8 - 2.7 = 8.1\ cm$. Total straight = $16.2\ cm$.
5. Arc lengths:

   • Arc AB = 50/360 × 2π(2.7) = 0.75π cm, • Arc PQ = 50/360 × 2π(10.8) = 3π cm
6. Total Perimeter = $3.75\pi + 16.2$ (or $15\pi/4 + 81/5$).

### MARK SCHEME

- **M1:** Algebraic formulation matching shaded area difference.
- **M1:** Simplify to isolate R value.
- **A1:** R = 10.8 and r = 2.7.
- **M1:** Compute both outer and inner circular arc metrics in terms of π.
- **M1:** Include straight side borders (16.2).
- **A1:** $3.75\pi + 16.2$ (or equivalent fraction expression).

## Question 24 (3 Marks)

**Express $22 - 3x^2 + 30x$ in the form $a - b(x - c)^2$ where a, b and c are integers.**

### FULL SOLUTION

1. Group x terms and factor out −3:

   $-3(x^2 - 10x) + 22$
2. Complete the square inside the brackets:

   $x^2 - 10x = (x - 5)^2 - 25$
3. Substitute back and expand:

   $-3[\,(x - 5)^2 - 25\,] + 22 = -3(x - 5)^2 + 75 + 22 = 97 - 3(x - 5)^2$

### MARK SCHEME

- **M1:** Factor out –3 correctly from x terms.
- **M1:** Completing the square step formulation: $(x - 5)^2 - 25$.
- **A1:** $97 - 3(x - 5)^2$