# 2026

# MATHEMATICS

## Specimen Paper 2

Aligned to the 2026 O-Level Mathematics syllabus 4052

**2 hours 15 minutes | 90 marks**

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Name: _____

Class: _____ Date: _____

Answer all 9 questions. Write your working and answers in the spaces provided.

An approved scientific calculator may be used. Use a ruler and geometrical instruments where needed.

Give non-exact numerical answers to 3 significant figures, and angles in degrees to 1 decimal place, unless the question states otherwise.

Show essential working. The marks for each part are shown in square brackets.

Diagrams are not drawn to scale unless stated. Use the formulae on the next page.

This is an original practice paper based on recurring question structures. It is not an official examination paper or a forecast of exact 2026 questions.

# Mathematical formulae

## Compound interest

Total amount = $P(1 + r/100)^n$

## Mensuration

Curved surface area of a cone = $\pi rl$

Surface area of a sphere = $4\pi r^2$

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

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

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

Arc length = $r\theta$, where $\theta$ is in radians

Sector area = $\frac{1}{2}r^2\theta$, where $\theta$ is in radians

## Trigonometry

$a/\sin A = b/\sin B = c/\sin C$

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

## Statistics

Mean = $\Sigma fx / \Sigma f$

Standard deviation = $\sqrt{[\Sigma fx^2 / \Sigma f - (\Sigma fx / \Sigma f)^2]}$

**1** (a) Express $\frac{x}{(x-2)} - \frac{3}{(x+1)}$ as a single fraction in its simplest form. [3]

(b) Make s the subject of $v^2 = u^2 + 2as$, where $a \neq 0$. [2]

(c) Solve the simultaneous equations $2x + 3y = 11$ and $4x - y = 1$. [3]

(d) Show that adding 1 to the product of any two consecutive positive odd integers always gives a multiple of 4. [2]

**2** The times, t minutes, taken by 60 participants to finish a challenge are grouped below.

| Time t (min) | $0 < t \leq 10$ | $10 < t \leq 20$ | $20 < t \leq 30$ | $30 < t \leq 50$ |
|---|---|---|---|---|
| Frequency | 8 | 14 | 20 | 18 |

(a) Calculate estimates of the mean and the standard deviation of the times. [2]

(b) State the class interval containing the median. [1]

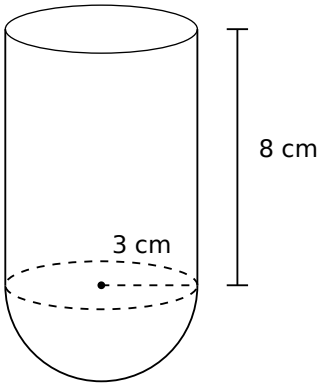
(c) Explain why the exact median cannot be found from this table. [1]

(d) Two participants are selected at random. Find the probability that both took more than 20 minutes. [2]

(e) Three participants are selected at random. Find the probability that exactly two took at most 20 minutes. [3]

(f) A histogram is drawn. The bar for $20 < t \leq 30$ has height 8 cm. Find the height of the bar for $30 < t \leq 50$. [1]

**3** An open metal vessel consists of a cylinder joined to a hemispherical base. Both have internal radius 3 cm. The cylindrical part has height 8 cm. Assume the metal has negligible thickness.



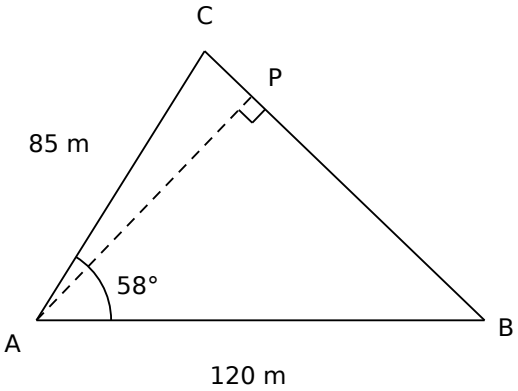

(a) Calculate the capacity of the vessel. [3]

(b) The vessel contains $60\pi$ cm$^3$ of water. Calculate the depth of the water measured vertically from the lowest point of the vessel. [3]

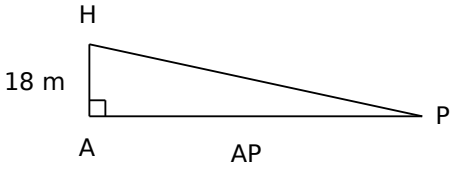
(c) The entire outside curved surface is coated at a cost of \$0.08 per cm$^2$. Calculate the cost, to the nearest cent. [3]

**4** ABC is a horizontal triangular field. AB = 120 m, AC = 85 m and angle BAC = 58°. A vertical mast AH, of height 18 m, stands at A. P is the point on the straight path BC nearest to A.

**Plan of the horizontal field**




**Vertical section AHP**




(a) Calculate BC. [3]

(b) Calculate the area of the field. [2]

(c) Calculate AP. [2]

(d) Calculate the greatest angle of elevation of H from a point on the path BC. Explain why it is the greatest angle. [3]

**5** The variables x and y are related by $y = x + 6/x$, for $0.5 \leq x \leq 5$.

| x | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|
| y | 12.5 | 7 | p | 5 | 4.9 | 5 | 5.5 | 6.2 |

(a) Find p. [1]

(b) On the grid on the next page, plot the points and draw a smooth curve. [3]

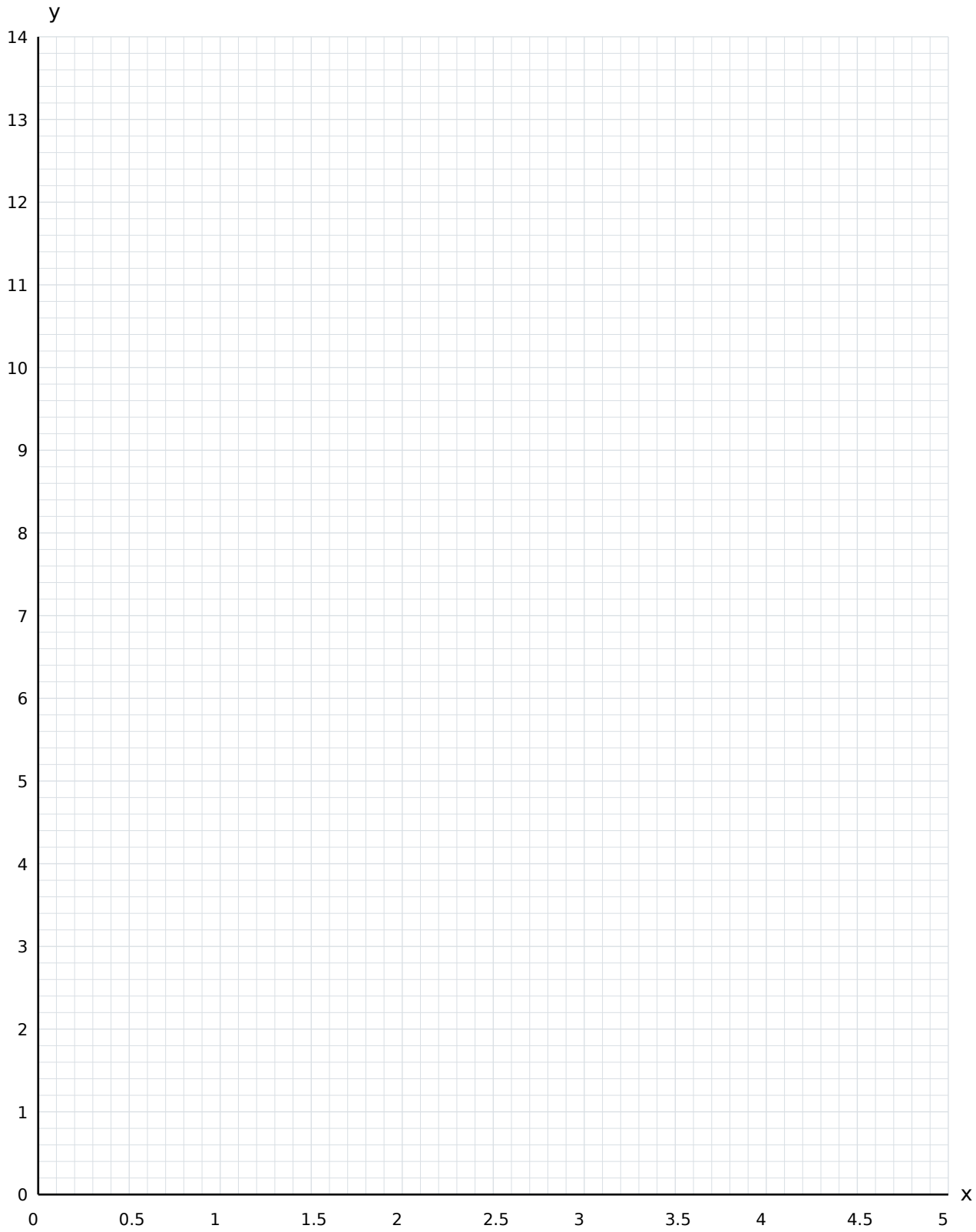
(c) Use your graph to find the two values of x for which $y = 6$. [2]

(d) By drawing a tangent, estimate the gradient of the curve at $x = 2$. [2]

(e) On the same grid, draw the line $y = 2x - 1$. [1]

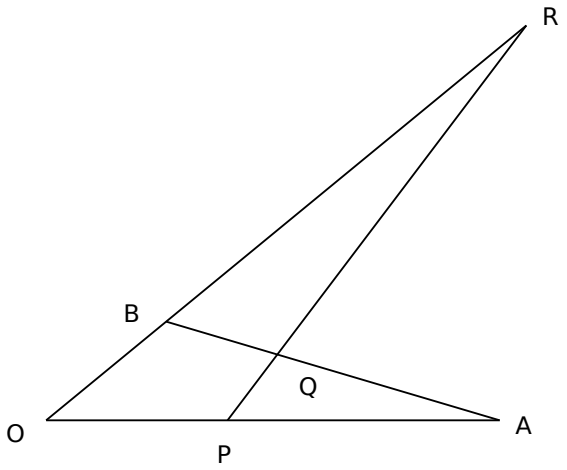
(f) Show that an intersection of the curve and line satisfies $x^2 - x - 6 = 0$. [2]
Explain why only one solution of this equation is represented on your graph.

## 5 (continued)




Use this grid for Question 5.

**6** In triangle OAB, vector OA = a and vector OB = b.
P lies on OA with OP : PA = 2 : 3. Q lies on AB with AQ : QB = 2 : 1.
The line PQ is extended to meet the line OB at R.




(a) Express vector PQ in terms of a and b. [2]

(b) It is given that vector PR = h PQ and vector OR = k b. Find h and k. [3]

(c) Find the ratio area of triangle OPQ : area of triangle OAB. [2]

(d) O is now taken as the origin, A = (10, 5) and B = (−3, 6). Find the equation of PR. [3]

**7** A cyclist travels 48 km at x km/h and returns along the same route at (x + 4) km/h. The return journey takes 30 minutes less than the outward journey.

(a) Write an expression, in hours, for the outward journey time. [1]

(b) Form an equation in x and show that it simplifies to $x^2 + 4x - 384 = 0$. [3]

(c) Solve this equation and hence find the cyclist's outward speed. [3]

(d) Calculate the return journey time in hours and minutes, to the nearest minute. [2]

(e) Explain why the average speed for the whole journey is less than the arithmetic mean of the two speeds. [1]

**8** A number grid has 7 columns. Numbers increase by 1 along each row and by 7 down each column. A cross consists of a central number x and its immediate neighbours above, below, left and right.

(a) The sum of the five numbers in a cross is 215. Find its central number. [1]

(b) Show that the product of the left and right numbers exceeds the product of the top and bottom numbers by 48, wherever the cross is placed. [3]

(c) A different sequence has nth term $T_n = n^2 + 4n + 2$. Show that $T_{n+1} - T_n = 2n + 5$. [2]

(d) Two consecutive terms differ by 51. Find the positions of these two terms. [2]

(e) Determine whether 2026 is a term of this sequence. Justify your answer. [2]

**9** A community garden is considering a rainwater collection system. The roof area is 180 $m^2$ and 75% of the rain falling on it can be collected.

The table gives rainfall in six representative months.
Rainfall (mm): 115, 135, 180, 230, 190, 150.

For this model, assume that the average monthly rainfall over a full year is the same as the average of these six values. Use 1 $m^3$ = 1000 litres.

(a) Estimate the volume of water that could be collected from the roof in one year. [2]

(b) The garden needs 220 litres of water each day. Calculate its annual requirement, using 365 days. Explain why collecting more than this volume over a year would not by itself guarantee that rainwater is always available. [2]

(c) Use the additional information on the next page to recommend a tank. Determine whether it meets the garden’s conditions. Justify your decisions and state one further assumption needed for your recommendation. [6]

## 9 (continued)

### Additional information

| Tank | Usable capacity | Diameter | Tank cost | Installation |
|---|---|---|---|---|
| A | 5000 litres | 1.8 m | $1250 | $480 |
| B | 6000 litres | 2.1 m | $1480 | $520 |

Both tanks are cylindrical and must stand upright in a square space measuring 2.0 m by 2.0 m.

The tank must hold enough water for a 21-day dry period, starting with a full tank.

Assume that rainwater replaces 70% of the annual watering requirement. Mains water costs $2.85 per 1000 litres.

The garden will buy a system only if the initial cost is recovered through water-bill savings within 12 years. Ignore maintenance, price changes and interest.

Working and recommendation for part (c):