

PRELIMINARY EXAMINATION 2025

SECONDARY FOUR

CANDIDATE
NAME

CLASS

INDEX
NUMBER

ADDITIONAL MATHEMATICS

Paper 2

4049/02

28 August 2025

2 hours 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** the questions.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

The use of an approved scientific calculator is expected, where appropriate.

You are reminded of the need for clear presentation in your answers.

The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is 90.

For Examiner's Use

90

Mathematical Formulae

1. ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial expansion

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \dots + \binom{n}{r} a^{n-r} b^r + \dots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{r!(n-r)!} = \frac{n(n-1) \dots (n-r+1)}{r!}$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$$

$$\sin 2A = 2 \sin A \cos A$$

$$\cos 2A = \cos^2 A - \sin^2 A = 2 \cos^2 A - 1 = 1 - 2 \sin^2 A$$

$$\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

Formulae for ΔABC

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

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

$$\Delta = \frac{1}{2} bc \sin A$$

Answer **all** the questions.

- 1** An object was launched from a machine. Its height, y metres above ground, t seconds after launch, can be modelled by a quadratic function $y = f(t)$. Four seconds after launch, the object reached its maximum height of 81 m and then dropped to a height of 54 m after a further three seconds.

(a) Find the initial height of the object when it was launched. [4]

(b) Without solving a quadratic equation, explain and determine how long did the object stay above 54 m? [2]

- 2 Show that the solution of the equation $12^{x+1} = 36 \times 4^{x+2}$ can be expressed as $1 + \frac{\lg a}{\lg b}$,
where a and b are integers. [5]

[5]

[2]

- 4 A curve is such that $\frac{d^2y}{dx^2} = \frac{12}{(3-2x)^2}$. Given that the curve passes through the points $\left(\frac{1}{2}, 1\right)$ and $(1, \ln(8e^2))$, show that the y -intercept of the curve can be expressed as $a \ln\left(\frac{b}{c}\right)$ where a , b and c are constants. [8]

- 5** A tangent to a circle at the point $(4, 3)$ intersects the x -axis at $x = 7$. The line with the equation $3y = 2x + 6$ is normal to the circle at another point.

(a) Find the equation of the circle. [8]

(b) Find, in exact form, the equations of the tangents to the circle that are parallel to the x -axis. [2]

- 6** A particle, P , starts moving in a straight line with a velocity of 8 m/s at a displacement of 3 m from a fixed point O . The velocity, v m/s of the particle t seconds after moving is given by $v = 5 \cos t + 2 \sin t + c$.

(a) Find the value of c . [2]

(b) Find the initial acceleration of the particle. [2]

- (c) By explaining with relevant working, show the particle changed its direction of motion during the 3rd second. [3]

- (d) Find displacement of P from O at $t = 6$. [3]

- 7 It is given that there is a term in x^2 in the expansion of $\left(\sqrt{x} - \frac{2}{x}\right)^n$, where n is a positive integer.

(a) Find the smallest possible value of n , explaining your answer. [4]

(b) In the case where $n = 7$, show that there is no constant term in the expansion of

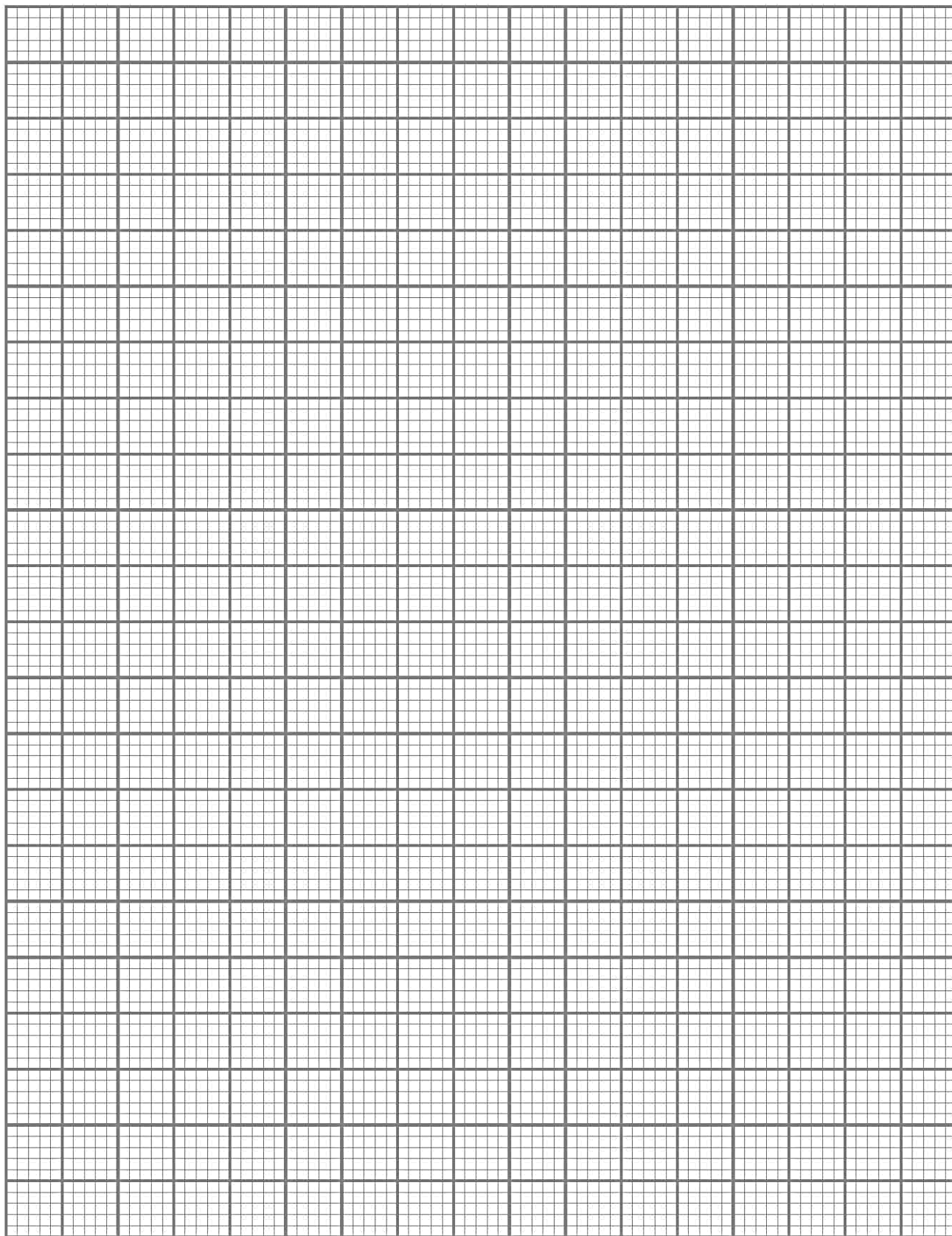
$$\left(\frac{48}{x^2} - x^4\right)\left(\sqrt{x} - \frac{2}{x}\right)^n.$$

[5]

- 8 The temperature, $\theta^{\circ}\text{C}$, of a cup of hot chocolate milk, as it cools to room temperature, can be modelled by the formula $\theta = 27 + qb^{-t}$, where q and b are constants and t is the time of cooling in minutes. Measurements of t and θ are shown in the table below.

t	2	4	6	8	10	12
θ	71	59	48	43	38	35

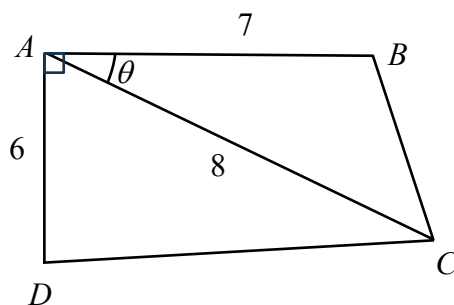
- (a) Explain how a straight line graph can be drawn to represent the formula and draw it for the given data. [4]



(b) Estimate the value of q and of b . [3]

(c) Use your graph to estimate the temperature of the cup of tea at $t = 7$. [2]

(d) What is the room temperature? Explain how you obtain your answer. [2]



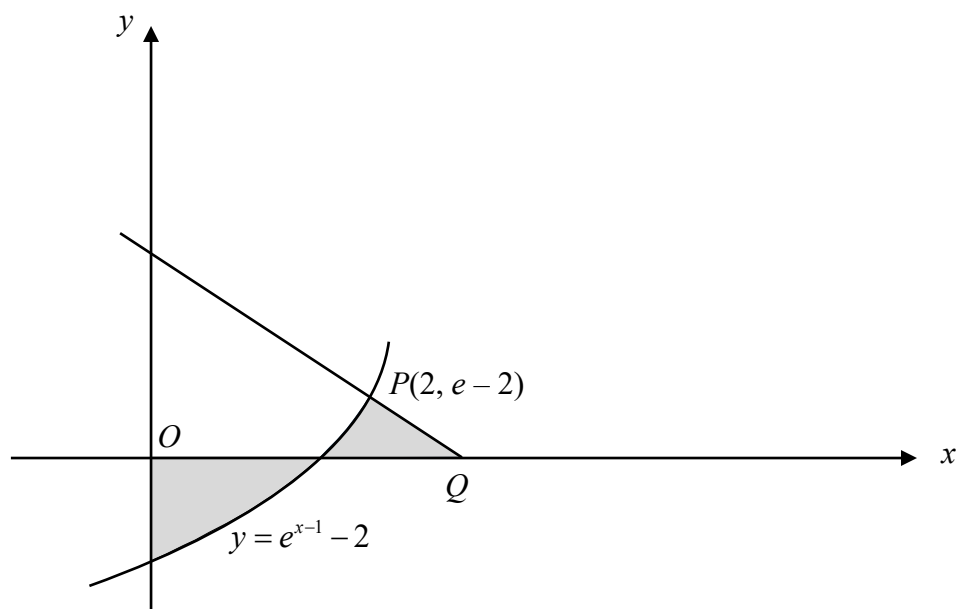
A farmer owns two triangular plots of land ABC and ADC as shown in the diagram above. It is given that $AB = 7$ m, $AC = 8$ m and $AD = 6$ m, angle BAD is a right angle and angle $BAC = \theta$ radians.

- (a) (i) Show the total area of the two plots of land, A m², can be expressed in the form $a \sin \theta + b \cos \theta$, where a and b are integers. [3]

- (ii) Express A in the form $R \sin(\theta + \alpha)$, where $R > 0$ and $0 < \alpha < \frac{\pi}{2}$. [3]

- (iii) Find the greatest possible value of A and the value of θ at which this occurs. [3]

- (b) The farmer would like to grow roses on plot ABC and hibiscus on plot ADC . Given that he wants the area of plot ABC to be twice the area of plot ADC , find the value of θ . [3]



The diagram shows part of the curve $y = e^{x-1} - 2$. The point $P(2, e-2)$ lies on the curve and the normal to the curve at P meets the x -axis at Q .

- (a) Find the x -coordinate of Q in terms of e .

[5]

(b) Find the total area of the shaded region.

[7]

End of Paper