N

SEMBAWANG SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2025
SECONDARY FOUR NORMAL (ACADEMIC)

CANDIDATE NAME			
CLASS:		INDEX NUMBER	

ADDITIONAL MATHEMATICS

4051/02

Paper 2

01 August 2025
Paper 2
1 hour 45 minutes
0800 – 0945

Additional Materials:

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
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 70.

FOR EXAMINER'S USE	
TOTAL	**70**

Setter: Ms Adeline Lim

Mathematical Formulae

1. **ALGEBRA**

Quadratic Equation

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

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

Binomial Theorem

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

where n is a positive integer and $\binom{n}{r} = \dfrac{n!}{(n-r)!\,r!} = \dfrac{n(n-1)\ldots\ldots(n-r+1)}{r!}.$

2. TRIGONOMETRY

Identities

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

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

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

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

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

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

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

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

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

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 Factorise completely $8a^3 + 125b^3$.
[3]

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2 A line has equation $y = x - 7$ and a curve has equation $y = 3x^2 - 5x + 1$.

Determine whether the line intersects, is a tangent to, or does not intersect the curve.

Give a reason for your answer.

[3]

3 Given that $\cos(y-30°)=2\sin(y-60°)$, find the value of $\tan y$ without the use of calculator.

[5]

4 The equation $x^2 - 2kx + k + 2 = 0$, where k is a constant, has real roots.

(a) Show that $k^2 - k - 2 \geq 0$.

[2]

(b) Find the range of values of k and represent the values on a number line.

[3]

5 In triangle XYZ, angle $XYZ = 90°$, $YZ = \left(4-\sqrt{3}\right)$ cm and $XY = \left(4\sqrt{3}+1\right)$ cm.

(a) Find the area of triangle XYZ, leaving your answer in the form $a\sqrt{3}-b$ where a and b are constants.

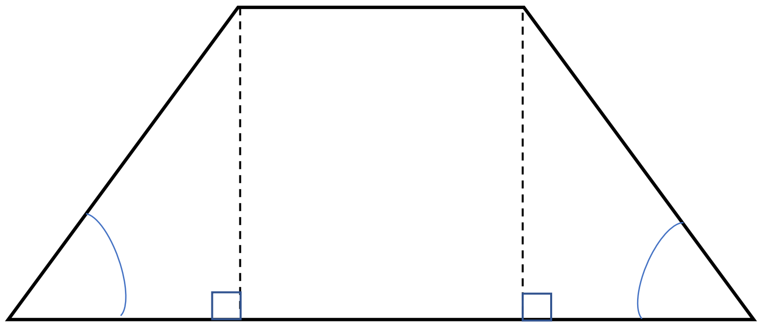
[3]

(b) Find the length of XZ, giving your answer in the simplest exact form.

[4]

6 A piece of wire of length 100 cm is bent into the shape of a trapezium $PQRS$.

Given that $PQ = SR = x$ cm, $\angle PQA = \angle SRB = 60^{\circ}$ and $PABS$ is a rectangle.



(a) Show that $PS = \dfrac{100 - 3x}{2}$. [3]

(b) Show that the area of the rectangle *ABSP, A* cm², is given by $A = \frac{\sqrt{3}}{4}\left(100x - 3x^2\right)$.

[3]

(c) Given that x can vary, find the value of x for which A is maximum.

[4]

7 The point $(-3, 0)$ is a stationary point on the graph of $y = x^3 + hx^2 + 3x + k$.

(a) Show that $h = 5$.

[3]

(b) Find the value of k.

[1]

(c) Find the x-coordinate of the other stationary point.

[2]

(d) Determine the nature of each of these stationary points.

[3]

8 **(a)** Find the radius and coordinates of the centre of the circle

$$x^2 + y^2 - 4x - 3y - 10 = 0.$$

[3]

(b) Determine whether the point (6,1) lies on the circle.

[1]

(c) Find the equation of the tangent to the circle at the point $A(4,-2)$.

[3]

(d) Given that AB is a diameter of this circle, find the coordinates of the point B.

[2]

9 **(a)** Express $6\sin t + 10\cos t$ in the form $R\sin(t+\alpha)$, where $R > 0$ and $0 < \alpha < \dfrac{\pi}{2}$ radians.

[3]

(b) The oscillation of a mass attached to a spring can be modelled by $x = 6\sin t + 10\cos t$, where x mm is the distance of the mass from its rest position A at time t seconds.

(i) Explain whether the mass can reach a distance of 18 mm from A.

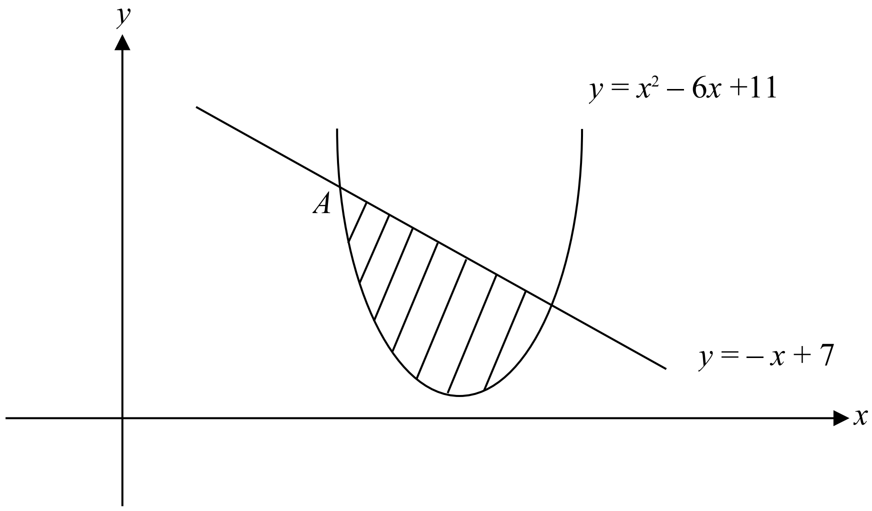
[1]

(ii) Find the time when the mass first reaches the maximum distance from A.

[2]

(c) After how many seconds does the mass first reach a height of 8 mm from *A*? [3]

10 The diagram shows the line $y = -x + 7$ intersecting the curve $y = x^2 - 6x + 11$ at the point A and B.



(a) Determine the coordinates of A and B.

[4]

(b) Hence calculate the area enclosed by the curve $y = x^2 - 6x + 11$ and the line $y = -x + 7$

[6]

End of Paper