N

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

CANDIDATE NAME			
CLASS:		INDEX NUMBER	

ADDITIONAL MATHEMATICS

4051/01
31 July 2025
Paper 1
1 hour 45 minutes
1100 – 1245

Paper 1

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

This document consists of **16** printed pages.

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 $\binom{n}{r} = \frac{n!}{(n-r)!r!} = \frac{n(n-1).....(n-r+1)}{r!}$.

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 Express $\frac{5\sqrt{7}+2}{3+\sqrt{7}}$ in the form of $p+q\sqrt{7}$, where p and q are rational numbers.

[3]

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2 Given that $\cot A = \frac{q}{2}$ where A is acute, express each of the following in terms of q.

(a) $\sec A$ [2]

(b) $\sin 2A$ [2]

3 Solve the simultaneous equations

$$xy = 2 + y^2,$$

$$2y = x - 1.$$

[5]

4 The volume, V m^3, of water in a river may be modelled by the equation $V = \frac{2}{3}\pi x^3$, where x m is the depth of the water in the river. During a period of rainfall, the volume of water in the river increases at a rate of 0.5 m^3/h.

Find the rate at which the depth of the water in the river is increasing when $x = 0.8$.

[4]

5 **(a)** Find the values of *m* and *n* if $f(x) = 2x^4 - x^3 - 19x^2 + mx + n$ has a factor of $x^2 - 9$.

[4]

(b) Hence, express f(*x*) as the product of linear factors.

[3]

6 Express $\frac{3x-2}{x(x-1)^2}$ as partial fractions.

[4]

7 Find the equation of the normal to the curve $y = (3 - x^2)\sqrt{2 + x}$ at the point where $x = 2$.

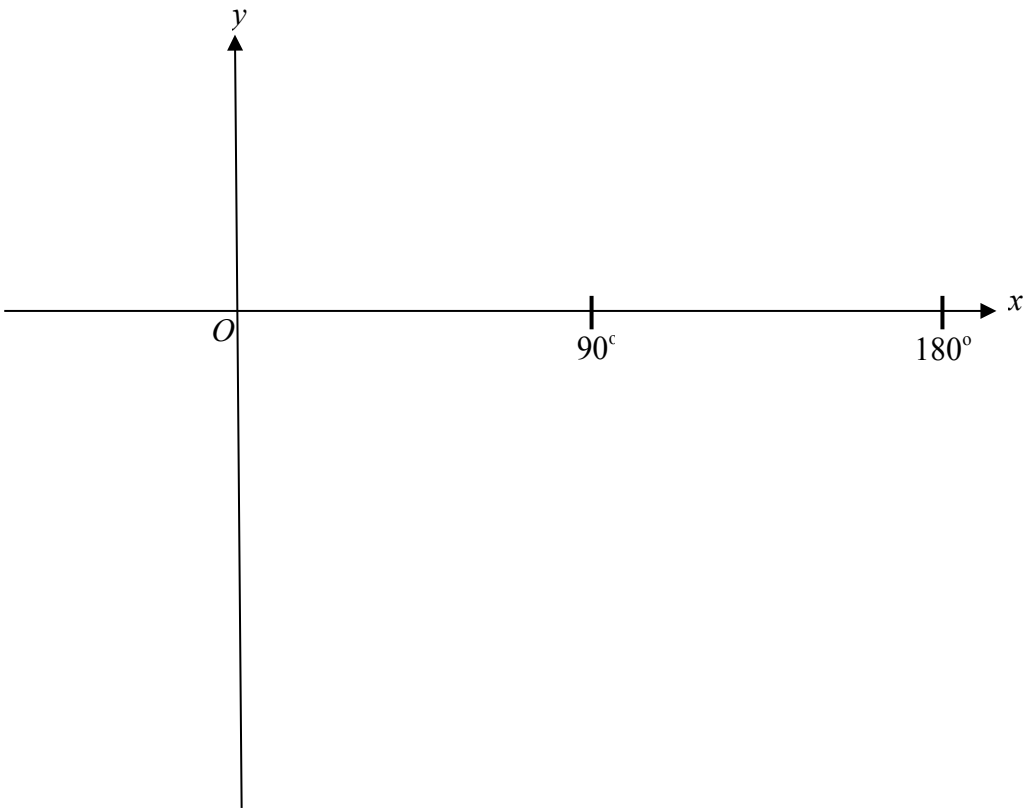
[5]

8 **(a)** Write down the period and amplitude of $y = 3\sin 2x - 2$.

[2]

(b) Sketch the graph of $y = 3\sin 2x - 2$ for $0 \le x \le 180°$.

[3]



9 Solve the equation $\cos 2x + 7\sin x - 4 = 0$ for $0^\circ < x < 360^\circ$.

[4]

10 (a) Given that $f'(x) = 3x^2 + 4x - 4$ and $f(1) = 5$, find $f(x)$.

[3]

(b) Hence find the value of $\int_1^2 f(x)\,dx$.

[2]

11 **(a)** State, in terms of π, the principal value of

(i) $\tan^{-1}1$,

[1]

(ii) $\sin^{-1}\left(-\frac{\sqrt{3}}{2}\right)$.

[1]

(b) Explain why the principal value of $\cos^{-1}\left(-\frac{\sqrt{2}}{2}\right)$ cannot be $-\frac{\pi}{4}$.

[1]

(c) **(i)** Prove that $\frac{1}{\sin x + 1} - \frac{1}{\sin x - 1} = 2\sec^2 x$.

[3]

(ii) Hence solve the equation $\frac{1}{\sin 2x + 1} - \frac{1}{\sin 2x - 1} = 3$ for $0 < x < \pi$.

[4]

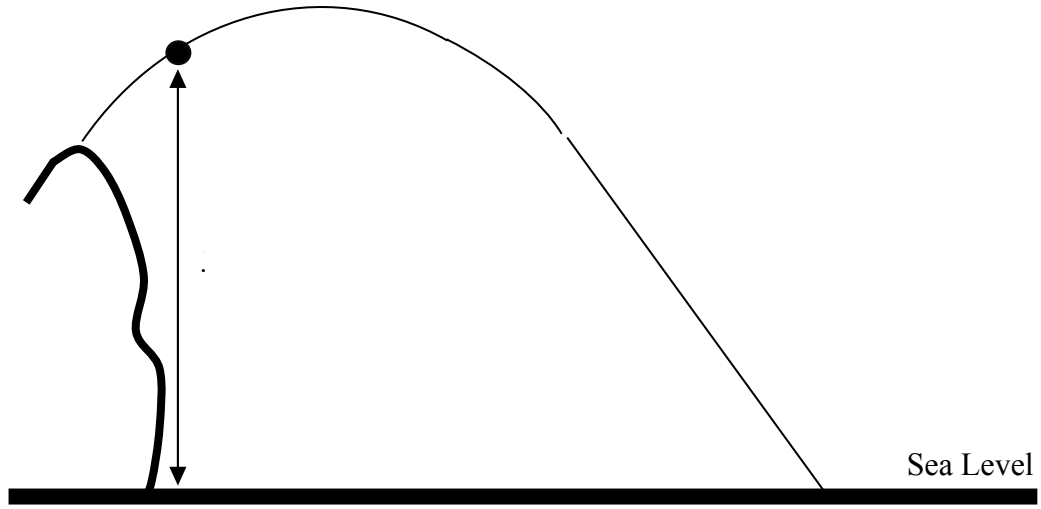
12 **(a)** Differentiate $\left(2\sqrt{x}-3\right)^7$.

[2]

(b) Hence find $\int_1^4 \frac{\sqrt{x}\left(2\sqrt{x}-3\right)^6}{x}\,\mathrm{d}x$.

[4]

13 A stone is thrown from a cliff into the sea. Its height, y metres, above the sea level at time



x seconds is given by $y = -x^2 + 2x + 9$.

(a) Express y in the form of $y = a(x-h)^2 + k$. Hence state the maximum height of the stone above the sea level and the time taken to reach this height.

[4]

(b) Hence or otherwise, solve the equation $-x^2 + 2x + 9 = 0$. Explain the significance of the positive value of x.

[4]

End of Paper