SINGAPORE CHINESE GIRLS' SCHOOL
PRELIMINARY EXAMINATION 2025
SECONDARY FOUR
O-LEVEL PROGRAMME

CANDIDATE NAME								
CLASS	4			REGISTER NUMBER				
CENTRE NUMBER					INDEX NUMBER				

ADDITIONAL MATHEMATICS **4049/02**

Paper 2

Friday **29 August 2025** **2 hours 15 minutes**

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class, register number, centre number and index number at the top of this page.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, 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 electronic 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 EXAMINERS USE

Q1		**Q5**		**Q9**			
Q2		**Q6**		**Q10**			
Q3		**Q7**		**Q11**			
Q4		**Q8**				90	

The Question Paper consists of **19** printed pages and **3** blank pages.

Mathematical Formulae

1. ALGEBRA

Quadratic Equation

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

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

Binomial Expansion

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

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

2. TRIGONOMETRY

Identities

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

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

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

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

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

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

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

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

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

Formulae for ΔABC

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

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

$$\Delta = \tfrac{1}{2} ab \sin C$$

1. In an experiment, 5 million cells were stored in a container. It was observed that 40% of the cells are dying every minute. The number of cells remaining, N, after t minutes, is given by $N = Ae^{kt}$, where A and k are constants.

(a) Explain why $k = \ln \frac{3}{5}$. [2]

(b) Find the time taken when the number of cells decreases to 2000. [3]

2. **(a)** Use the substitution $u = 7^x$, solve the equation $7^{2x+2} - 4\left(7^{x+1}\right) - 5 = 0$ and show that the solution may be written in the form $\log_a b - 1$ where a and b are integers to be determined. [4]

(b) Solve the equation $\log_3(2x-1) - \log_9(x^2+2) = \log_{25} 5$. [5]

3. A curve has the equation $y = x^3 - 3x^2 + 3x - 7$.

(a) Find the coordinates of the stationary point on the curve. [3]

(b) Observe the changes in the sign of the gradient of the curve and determine the nature of this stationary point. [2]

4. A tank is firing rounds during a target practice. The height, h metres, of a projectile above the ground during flight is governed by the equation $h = 2 + \frac{4}{5}t - \frac{1}{250}t^2$, where t is the time in seconds for the projectile in flight.

(a) Express h in the form $a + b(t - c)^2$, where a, b and c are constants to be determined. [2]

(b) Hence state the maximum height attained by the projectile and the time at which this occurs. [2]

(c) Find the length of time for which the height of the projectile is at least 32 metres above the ground. [3]

5. **(a)** When the expression $x^3 + 2kx + 2$ is divided by $x + 2$, the remainder is 3 less than the remainder obtained when the expression is divided by $x - 1$.
Find the value of k. [3]

(b) Solve the equation $2x^3 - 5x^2 - 3x + 10 = 0$, expressing non-integer roots in exact form. [4]

6. **(a)** By considering the general term in the binomial expansion of $\left(x^4 - \dfrac{1}{kx^2}\right)^6$, where k is a positive constant, explain why there are only even powers of x in this expansion. [3]

(b) Given that the term independent of x in the binomial expansion of $\left(x^4 - \dfrac{1}{kx^2}\right)^6$ is $\dfrac{5}{27}$, show that k is 3. [2]

(c) Hence find the term independent of x in $\left(2-3x^{6}\right)\left(x^{4}-\dfrac{1}{kx^{2}}\right)^{6}$. [4]

7. A particle, P, travels in a straight line so that at time t seconds, its velocity, v m/s, is given by

$$v = \cos(\frac{\pi}{4}t + \frac{\pi}{6}).$$

The initial displacement of P from a fixed point O is $\frac{1}{\pi}$ m.

(a) Find the initial velocity of P, giving your answer in exact value. [1]

(b) Find the first two values of t when P comes to instantaneous rest. [3]

(c) Find the distance travelled by P in the first 4 seconds. [4]

8. **(a)** Prove that $\sin^3 x \sec^2 x + \sin x = \tan x \sec x$. [4]

(b) Solve the equation $\sin^3 x \sec^2 x + \sin x = 5$ for $0 \leq x \leq 360°$. [4]

Continuation of working space for Question 8.

9. **(a)(i)** Find the equation of the normal to the curve $y = \dfrac{2x-6}{x-2}$ at the point where the curve meets the y-axis. [4]

(a)(ii) Determine, with explanation, whether y is an increasing or decreasing function for $x > 2$. [2]

(b) A curve is such that $\frac{\mathrm{d}^2 y}{\mathrm{d}x^2} = (3x+1)^2$ and the point Q (2, 36) lies on the curve. The gradient of the curve at Q is 45. Find the equation of the curve. [5]

10. The number, n, of a certain type of bacteria increases with time t minutes.
Recorded values of n and t are shown in the table below.

t	2	4	6	8	10
n	3215	3446	3693	3959	4243

It is known that n and t are related by the formula $n = n_0(2)^{kt}$, where n_0 and k are constants.

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

Use your graph to estimate

(b) the initial number of bacteria, [2]

(c) the value of k, [2]

(d) the time taken for the number of bacteria to increase by 25%. [2]

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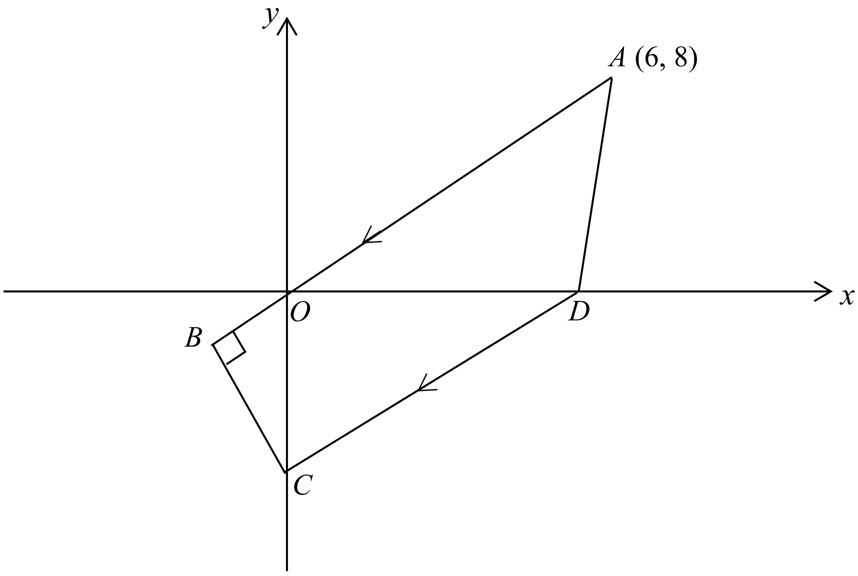

The diagram shows a trapezium with vertices $A(6, 8)$, B, C and D.
The sides AB and DC are parallel and angle ABC is 90°.
AB passes through the origin O and the length of AB is 15 units.
The points C and D lie on the y-axis and x-axis respectively.

(a) Show that the coordinates of B are $(-3, -4)$. [4]

(b) Find the coordinates of C and of D. [5]

(c) Find the area of the trapezium $ABCD$. [2]

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