Candidate Name:	Class:	Index No.:

FUHUA SECONDARY SCHOOL
Secondary 4 Express/ 5 Normal (Academic)
PRELIMINARY EXAMINATION 2025

4E5N

ADDITIONAL MATHEMATICS 4049/02

Paper 2

DATE	**29 August 2025**
TIME	**1000 – 1215**
DURATION	**2 hours 15 minutes**

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, 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			PARENT'S SIGNATURE
Statements/**W**orkings		**/ 90**	
Accuracy (incl. Units)			
Presentation			

Setter: **Mr Liu Yaozhong**
Ms Tan Tuan Ling
Vetter: **Ms Lim Fen Niu**

This document consists of 23 printed pages and 1 blank page.

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

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

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

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

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

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

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

1 **(a)** A polynomial $P(x)$ leaves a remainder of 1 when divided by $x-1$ and a remainder of -1 when divided by $2x-1$. Find the remainder when $P(x)$ is divided by $2x^2-3x+1$. [3]

(b) In the expansion of $(p-3x)\left(1-\frac{1}{4}x\right)^8$, the coefficient of x is equal to the coefficient of x^3. Find the value of the constant p. [5]

2 **Do not use a calculator in this question.**

(a) **(i)** By using $\tan 2A$, show that $\cot 67.5° = -1 + \sqrt{2}$. [6]

(ii) Hence, find the exact value of $\operatorname{cosec}^2 67.5°$. [2]

(b) Given that $\frac{\sin(A+B)}{\sin(A-B)} = \frac{2}{3}$, prove that $5\tan B + \tan A = 0$. [4]

3 **(a)** Show that $x-1$ is a factor of $2x^3-5x^2+x+2$.
Hence, factorise $2x^3-5x^2+x+2$ completely. [5]

(b) Solve the equation $2\left(e^{2y-2}\right)-5\left(e^{y-1}\right)+2e^{1-y}+1=0$.
Leave your answers in exact form. [5]

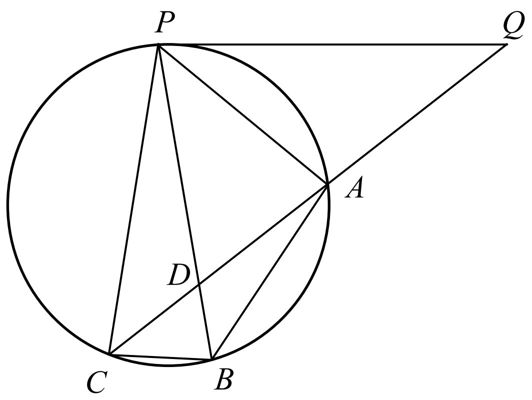
4 The graph of $y = a\sin bx + c$ has a turning point at $\left(\frac{\pi}{4}, 0\right)$ and the next turning point after this has coordinates $\left(\frac{3\pi}{4}, 6\right)$.

(a) Find the values of the constants a, b and c. [3]

(b) Hence, sketch the graph of $y = a\sin bx + c$ for $0 \le x \le 2\pi$. [2]

(c) By drawing a suitable straight line on the same axes, find the number of solutions of the equation $a\sin bx = -\frac{3}{2\pi}x$. [3]

5 The diagram shows a point P on a circle. PQ is a tangent to the circle at P.
Points A, B and C lie on the circle such that PA bisects angle QPB.
QAC is a straight line. The lines QC and PB intersect at D.



(a) Prove that $AB = AP$. [2]

(b) By first showing that triangle *CDP* is similar to triangle *CBA*, show that $PA \times CD = CB \times DP$. [5]

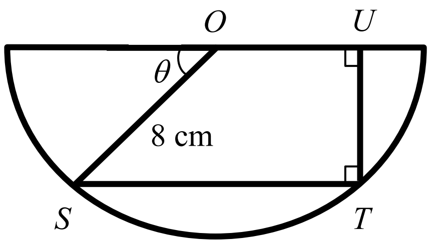
6 A chicken is taken out from a freezer to defrost. The temperature, $T\,°\mathrm{C}$, of the chicken, t hours after it is taken out from the freezer, is given by the formula $T = 20 - 40\mathrm{e}^{kt}$, where k is a constant. The temperature of the chicken is $-1.95\,°\mathrm{C}$ after it has been taken out from the freezer for 1 hour.

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

(b) Find the time taken for the temperature of the chicken to increase by $12°\text{C}$ from the time when it was taken out from the freezer. [3]

(c) Explain, with working, why the temperature of the chicken can never reach $20°\text{C}$. [2]

7 The diagram shows a trapezium *STUO* inscribed in a semicircle with centre *O* and radius 8 cm. *OS* makes an angle θ radians with the diameter. *ST* is parallel to the diameter. *UT* is perpendicular to lines *ST* and *OU*.



(a) Show that the perimeter, *P* cm, of the trapezium is given by $P = 8 + 24\cos\theta + 8\sin\theta$. [3]

(b) By expressing the perimeter of the trapezium in the form $P = a + R\sin(\theta + \alpha)$, where $0 < \alpha < \frac{\pi}{2}$, find the maximum possible perimeter of the trapezium and the corresponding value of θ. [4]

8 A particle, travelling in a straight line, has velocity v m/s, at time t seconds, $t \geq 0$, given by $v = 4\cos^2\left(\frac{t}{2}\right) - 3$.

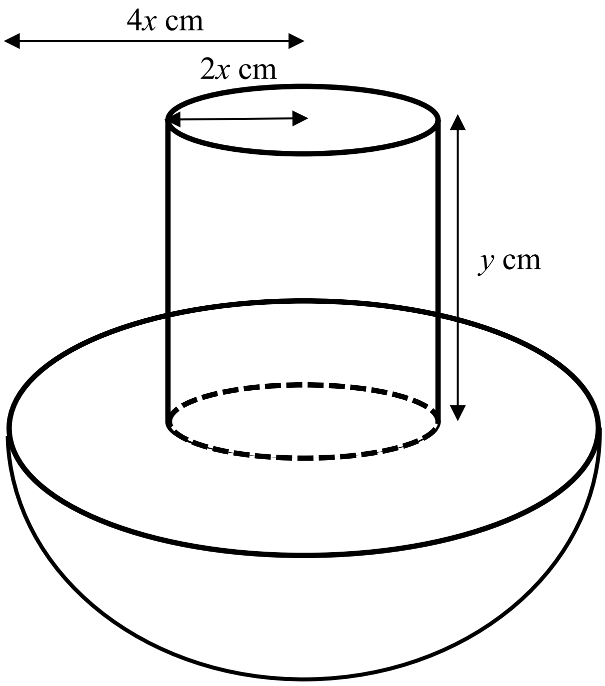
Find

(a) the initial velocity of the particle. [1]

(b) the time when the acceleration first reaches -2 m/s^2. [3]

(c) the total distance travelled by the particle in the first 4 seconds. [7]

9 The diagram shows a solid which consists of a cylinder placed on top of a hemisphere. The radius of the cylinder is $2x$ cm and its height is y cm. The hemisphere has a radius of $4x$ cm. The total volume of the solid is $200\pi\,\text{cm}^3$.



(a) Express y in terms of x, simplifying the expression. [3]

(b) Show that the total surface area, A cm^2, of the solid is $A = 40\pi\left(\frac{5}{x} + \frac{2x^2}{15}\right)$. [3]

(c) Given that x can vary, find the stationary value of A. [4]

(d) Mr Chan intends to paint the solid with a total surface area found in part **(c)**. Determine if the amount of paint needed is a maximum or a minimum. [2]

10 **(a)** The equation of a curve is given by $y = P - Q\cos 4x - \frac{1}{2}\sin 2x$.

Given that $\frac{\mathrm{d}^2 y}{\mathrm{d}x^2} + 4y = 15\cos 4x - 8$, find the values of the constants P and Q. [4]

(b) With the values of the constants P and Q found in part **(a)**, find the equation of the normal to the curve at $x = \frac{\pi}{2}$. Leave your equation in terms of π. [4]

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