Candidate Name:	Class:	Index No.:

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

4E5N

ADDITIONAL MATHEMATICS 4049/01

Paper 1

DATE	**26 August 2025**
TIME	**1050 – 1305**
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: **Ms Gao Conger** **Vetter:** **Ms Lim Fen Niu**

This document consists of 24 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 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 $\binom{n}{r} = \dfrac{n!}{r!(n-r)!} = \dfrac{n(n-1)\ldots(n-r+1)}{r!}$

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 Express $\dfrac{x^3 - 4x^2 - 24x + 41}{x^2 - 4x - 21}$ in partial fractions. [5]

2 **(a)** In a quiz question, the quadratic equation $k\left(x^2+1\right)-8x-6x^2=0$ is given.

Find the range of values of the constant k, for which the equation has no real roots. [4]

(b) Another question in the quiz is shown below.

> Find the range of values of the constant k, for which the curve $y=(k-6)x^2-2x$ lies completely above the line $y=6x-k$.

Jeremy stated that the range of values of k found in part **(b)** is the same as that in part **(a)**. Is Jeremy correct? Explain your answer clearly. [2]

3 Solve the simultaneous equations. [4]

$$2x + y = 10$$

$$\frac{3}{y} + \frac{2}{x} = 2$$

4 In triangle ABC, $BC = \left(\sqrt{7} - \sqrt{2}\right)$ cm and angle $ABC = 30°$.

The area of triangle ABC is $\left(4\sqrt{7} - \sqrt{2}\right)$ cm^2.

Without using a calculator, express the length of AB in the form $\left(p + q\sqrt{14}\right)$ cm, where p and q are constants, and state the value of p and of q. [4]

5 A circle C_1, with centre C, has equation $x^2 - 8x + y^2 + 2y - 17 = 0$.

(a) Find the coordinates of C and the radius of the circle. [3]

(b) Determine whether the point $S(-1, -5)$ lies inside, outside or on the circle.
Show your working clearly. [2]

(c) Given that $P(7,-6)$, $Q(9,2)$ and R are three points on the circle, and PQ is perpendicular to QR, find the coordinates of R. [3]

(d) Another circle C_2, is a reflection of C_1 in the x-axis.
Write down the coordinates of the centre of C_2. [1]

6 **(a)** Prove that $\dfrac{\sin x}{\sec x + 1} + \dfrac{\sin x}{\sec x - 1} = 2\cot x$. [4]

(b) Hence, solve the equation $\dfrac{\sin(2\theta - 50°)}{\sec(2\theta - 50°) + 1} + \dfrac{\sin(2\theta - 50°)}{\sec(2\theta - 50°) - 1} = \sqrt{3}$,

for $-90° \leq \theta \leq 90°$. [4]

7 **(a)** Find $\dfrac{d}{dx}\left(\dfrac{\ln 4x}{x}\right)$. [2]

(b) Hence, find $\displaystyle\int \frac{\ln 4x}{x^2}\,dx$. [3]

(c) Find the range of values of x for which $\mathrm{f}(x) = \dfrac{\ln 4x}{x}$ is increasing. [3]

8 The equation of a curve is $y=(1-3x)^6\left(x^2+2\right)$.

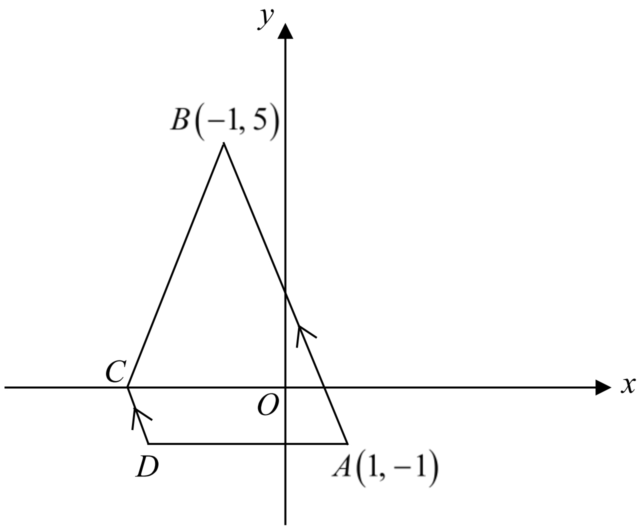
(a) Find $\frac{\mathrm{d}y}{\mathrm{d}x}$ in the form $\frac{\mathrm{d}y}{\mathrm{d}x}=2(1-3x)^p\left(qx^2+kx-18\right)$, where p, q and k are constants. [3]

(b) Explain why the curve has only one stationary point and find the x-coordinate of the stationary point. [4]

Continuation of working space for question **8(b)**.

(c) Determine the nature of this stationary point. [2]

9 The diagram shows a trapezium with vertices $A(1, -1)$, $B(-1, 5)$, C and D. AB and DC are parallel, and AD is parallel to the x-axis. The perpendicular bisector of AB crosses the x-axis at C.

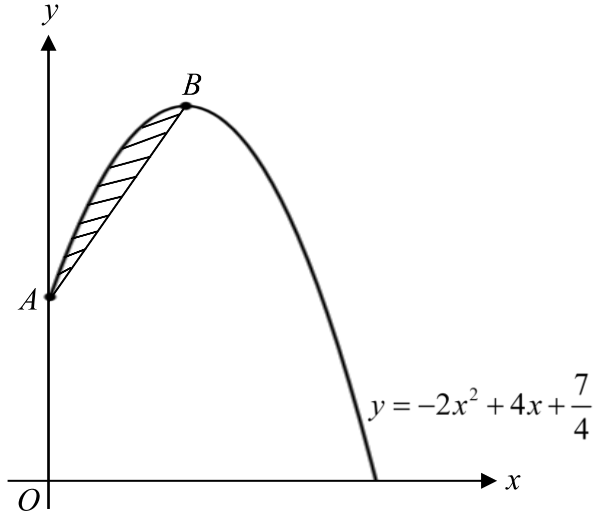


(a) Find the coordinates of C. [4]

(b) Find the area of the trapezium *ABCD*. [4]

10 **(a)** By expressing $-2x^2+4x+\frac{7}{4}$ in the form $a(x+b)^2+c$, where a, b and c are constants, explain why the value of $-2x^2+4x+\frac{7}{4}$ cannot be 4. [4]

The diagram shows part of the curve $y=-2x^2+4x+\frac{7}{4}$. The curve intersects the y-axis at A, and the highest point of the curve is B.



(b) Find the area of the shaded region bounded by the curve and the line AB. [5]

11 The table shows the values of two variables x and y from an experiment.

The two variables are connected by the equation $\frac{\sqrt{x}}{y} = px + q\sqrt{x}$, where p and q are constants. The values of y are corrected to 2 decimal places.

x	5	15	25	30	40
y	0.37	0.30	0.26	0.25	0.23

(a) Draw, on the grid provided on the next page, a straight line graph of $\frac{1}{y}$ against $\sqrt{x}$. [3]

(b) Use your graph to estimate the value of p and of q. [2]

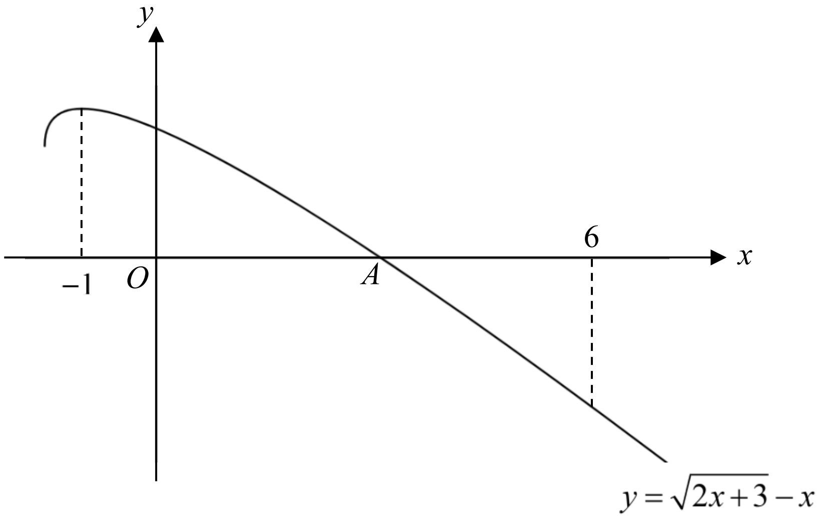
(c) Use your graph to estimate the value of y when $x = 19$. [2]

12 The gradient of a curve is given as $\frac{\mathrm{d}y}{\mathrm{d}x} = A\mathrm{e}^{3x} + \mathrm{e}^{-x}$, where A is a constant.

(a) The curve passes through the point $(0, -1)$. Find the equation of the curve in terms of A. [3]

(b) Given that $9y + 8\mathrm{e}^{-x} + 12 = \frac{\mathrm{d}^2 y}{\mathrm{d}x^2}$, find the value of A. [2]

13 The diagram shows part of the curve $y=\sqrt{2x+3}-x$, and two vertical lines $x=-1$ and $x=6$.



(a) Explain why the curve intersects the x-axis at only one point, A.
Find the x-coordinate of point A. [3]

(b) Point B is moving along the curve such that its y-coordinate is decreasing at a constant rate of 0.6 units per second. Find the rate of change of point B's x-coordinate at where the curve intersects the x-axis. [3]

(c) Jenny claimed that $\int_{-1}^{6}\left(\sqrt{2x+3}-x\right)\mathrm{d}x$ can be used to find the area bounded by the curve, the two vertical lines and x-axis.

Do you agree with her? Explain your answer clearly. [2]