Name: .... Register no: .... Class: ....

NGEE ANN SECONDARY SCHOOL

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PRELIMINARY EXAMINATION

ADDITIONAL MATHEMATICS 4049/01

Paper 1

28 August 2026
2 hours 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, register number and class 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

Total	**/90**

Checked by student: ………………………………. Date: …………………

This document consists of **21** 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

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

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

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

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

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

1 The percentage Gross Domestic Product (GDP) growth of a country from 2014 to 2024 can be modelled by the quadratic equation $\mathrm{G}(t) = 0.7t^2 - 7t + 11.2$, where t is the number of years after 2014.

(a) By completing the square, find the year in which the percentage growth is the lowest, and state this minimum percentage GDP growth. [4]

(b) Explain why this model may not be suitable for predicting the country's percentage GDP growth in the long run. [1]

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

It is given that $\sqrt{2a} = \sqrt{b} + 12$, where a and b are positive real numbers.

(a) Show that $2a - 3b = 216 - 2\left(\sqrt{b} - 6\right)^2$. [4]

(b) Hence state the least possible positive value of $\dfrac{1}{2a - 3b}$. [1]

3 **(a)** Express $\dfrac{1}{n\left(n+1\right)}$ in partial fractions. [3]

(b) Hence show that $\dfrac{1}{3(4)}+\dfrac{1}{4(5)}+\dfrac{1}{5(6)}+...+\dfrac{1}{\left(n-1\right)n}+\dfrac{1}{n(n+1)}=\dfrac{n-2}{3(n+1)}$. [3]

4 **(a)** Find the coefficient of x^3 in the binomial expansion of $\left(\frac{1}{x}-\frac{x^2}{2}\right)^{12}$. [3]

(b) The coefficients of x and x^2 in the binomial expansion of $(3+2x)^n$ are equal. Find the value of *n*. [4]

5 **(a)** The graph of $y = a + \log_b x$, where a and b are constants, passes through the points with coordinates $(9, 0)$ and $(243, 3)$.

Find the values of a and b, and hence express x in terms of y. [5]

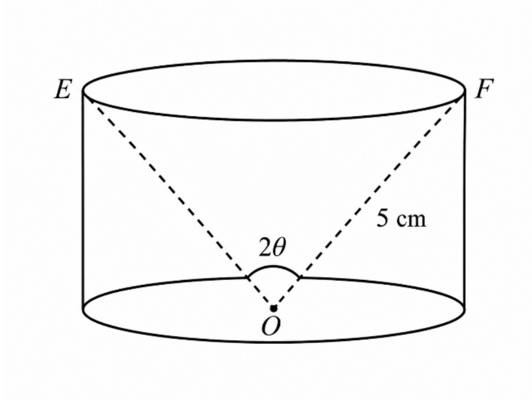
(b) One student was infected with HFMD in a school of 2900 students. The spread of the disease through the school population was given by $N = \dfrac{2900}{1+2899e^{-0.65t}}$, where N was the total number of students infected after t days. The school would suspend lessons for a week when more than 40% of the students were affected.

Find, correct to the nearest whole number, the number of days after the first student was infected with HFMD that the school would suspend lessons. [4]

6 **(a)** Prove that $\tan x + \dfrac{1}{\tan x} = \dfrac{1}{\sin x \cos x}$. [2]

(b) Hence solve $\dfrac{2}{\sin x \cos x} = 1 + 3\tan x$ for $0 \leq x \leq \pi$. [4]

7



The diagram shows an open cylinder tank with O as the centre of the base and $0° < \theta < 90°$. It is given that angle $EOF = 2\theta$ and OF = 5 cm.

(a) Prove that the total surface area of the cylinder is $S = \dfrac{25\pi}{2}\left(2\sin 2\theta - \cos 2\theta + 1\right)$. [4]

(b) Express S in the form $\frac{25\pi}{2}\left(R\sin\left(2\theta-\alpha\right)+1\right)$, where R > 0 and α is an acute angle. [3]

(c) Hence find the maximum total surface area of the cylindrical tank and the corresponding value of θ. [2]

8 The chickens in a farm are infected by a certain bird flu. The number of chickens (in thousands) in the farm is modelled by $N = \dfrac{27}{2 + \alpha t e^{\beta t}}$, where t is the number of days elapsed since the start of the spread of the bird flu and α and β are constants.

(a) Express $\ln\left(\dfrac{27-2N}{Nt}\right)$ as a linear function of t in terms of α and β. [4]

(b) It is given that the slope and the intercept on the horizontal axis of the graph of the linear function obtained in **(a)** are -0.1 and $10\ln 0.03$ respectively.

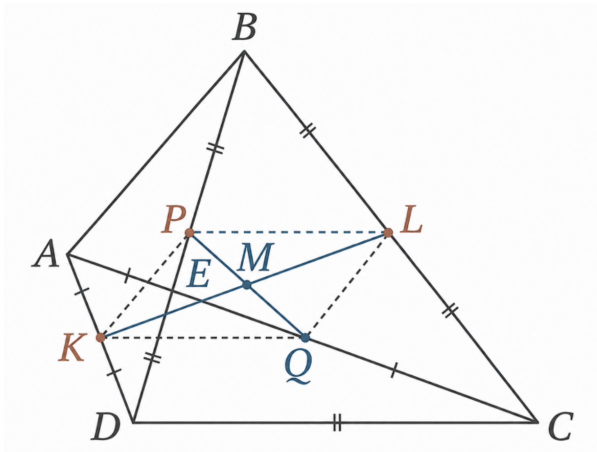
Find α and β. [3]

9 The points A and B have coordinates $(5,7)$ and $(13,1)$ respectively. A point P moves such that $PA = PB$. The set of all possible positions of P satisfying $PA = PB$ forms a straight line, L.

(a) Show that the equation of L is given by $y=\frac{4}{3}x-8$. [3]

(b) L intersects the x-axis at H and the y-axis at K.
A circle C passes through the three points O, H and K, where O is the origin.
Linabell claims that the circumference of C is greater than 30 units.
Determine if Linabell is correct. [4]

10



In the diagram, *AB*, *BC*, *CD*, *DA*, *AC*, and *DB* are walkways connecting four blocks of apartments. An urban planner plans to build some facilities at *K*, *L*, *P* and *Q*, which are midpoints of *AD*, *BC*, *BD* and *AC* respectively.

Show that

(a) $PK = LQ$, [3]

(b) KL bisects PQ. [4]

11 A curve, C, has equation $y=(2x+8)^{\frac{3}{2}}+3x^2$, where $x>-4$.

(a) Find $\frac{\mathrm{d}y}{\mathrm{d}x}$. [1]

(b) Duffy claims that two of the tangents to C are parallel to the straight line $6x+y+4=0$. Determine if Duffy is correct. Show your working clearly. [6]

12 **(a)** Show that $\frac{\mathrm{d}}{\mathrm{d}x}\left(\sin^3 2x\right) = 6\sin^2 2x\cos 2x$. [1]

(b) Hence find $\int \cos^3 2x \ \mathrm{d}x$. [5]

13 A particle is travelling in a straight line. It passes a fixed point A with a velocity of -7 m/s. Its acceleration, after passing A is given by $a = 8 - 2t$ for $0 \le t \le T$.
On reaching its maximum speed at time T seconds, the particle begins to decelerate at a constant rate of 1.5 m/s^2 until it comes to a rest at point B.

(a) Show that the particle first came to instantaneous rest when $t = 1$. [3]

(b) Find the maximum velocity attained by the particle and the value of T. [2]

(c) Find the total distance travelled by the particle from A to B. [4]

END OF PAPER

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