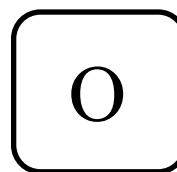




ZHONGHUA SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2026
SECONDARY 4 EXPRESS/ SECONDARY
5 NORMAL (ACADEMIC)



Candidate Name	Class	Register Number

ADDITIONAL MATHEMATICS

4049/01

Paper 1

26 August 2026
2 hours 15 minutes

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

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number 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.

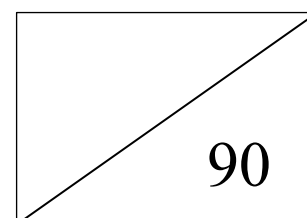
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

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 of the marks for this paper is 90.



Setter: Mdm Seoh Bee Hua
Vetter: Mr Francis Tan

1. ALGEBRA

Quadratic Equation

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

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

Binomial expansion

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

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

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 $\triangle ABC$

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

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

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

The magnitude, M , is related to the amplitude, A mm, of the seismic wave recorded by a seismograph according to the model.

$$M = \lg\left(\frac{A}{0.001}\right)$$

It was observed that two earthquakes happened within a month.

- (a) Find the magnitude of the first earthquake where the amplitude of the seismic wave was recorded at 1200 mm. [1]

- (b) The second earthquake has a magnitude of 4.6, find the amplitude, A mm, of the seismic wave recorded. [2]

- (c) A researcher proposed a new model to measure the magnitude of an earthquake.

$$M = \log_3\left(\frac{A}{9}\right)$$

- Using this new model, find the magnitude of the first earthquake with an amplitude of 1200 mm. [2]

- 2 Show that the curve $y = -3x^2 + 5x - 4$ lies completely below the line $y = x - 2$. [4]

3 **(a)** Differentiate $e^{2x}(3x-1)$ with respect to x . [2]

(b) Hence find $\int 4xe^{2x} dx$. [3]

4 **(a)** Prove that $\frac{1 - \cos 2A}{\sin 2A} + \frac{\sin 2A}{1 + \cos 2A} = 2 \tan A$. [2]

(b) Hence solve the equation

$$\frac{1 - \cos 2A}{\sin 2A} + \frac{\sin 2A}{1 + \cos 2A} = \frac{2}{7} \cot A$$

for $-90^\circ \leq A \leq 90^\circ$. [4]

- 5** A straight line graph is drawn for $\lg y$ against x to represent the curve $y = k^{x+h}$.
- (a)** Given that the line passes through the points $(0, 3)$ and $(10, 23)$ find the value of k and of h . [4]

- (b)** Hence, find the value of x when $\lg y = 4x$. [2]

6 The equation of a curve is $\frac{x^2}{2} + (y - k)^2 = 2$, where k is a constant.

(a) Find the set of values of k for which the line $y = 2x$ meets this curve. [5]

(b) In the case where the line $y = 2x$ is tangent to the curve, deduced the value(s) of k , giving your answer in the form of $a\sqrt{b}$ where a and b are integers. [1]

- 7 **(a)** Find the first 4 terms in the expansion of $\left(2 - \frac{ax}{4}\right)^5$ in ascending powers of x , simplifying each term. [4]

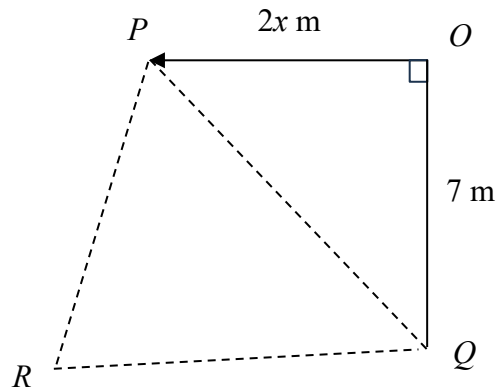
- (b)** Given that there is no term in x in the expansion of $(5 - 2x)\left(2 - \frac{ax}{4}\right)^5$, find the value of the constant a . [3]

- 8** A delivery company uses three drones, P , Q and R , for a coordinated flight test.

Drone Q is hovering at a fixed point 7 m due south of a control point O . Drone P flies due west from O .

At time t seconds, drone P is $2x$ metres west of O , x is increasing at a constant rate of 5 m/s.

Drone R is programmed to continuously maintain an equilateral triangle formation with drones P and Q throughout the flight.



- (a)** Show that the distance between the two drones, PQ , is $\sqrt{4x^2 + 49}$ metres. [1]

- (b)** Find the rate of change of the distance PQ , in m/s, when $x = 12$. [4]

- (c) The communication software requires the area enclosed by the three drones to increase at a rate of at least $250 \text{ m}^2/\text{s}$.

Given that area of $\Delta PQR = \frac{1}{2} \times PR \times QR \times \sin \angle PRQ$, determine the shortest time taken for drone P to meet the requirement. [5]

9 The curve $y = \frac{5}{\sqrt{x}} + x - 2$ has a stationary point A where $x > 0$.

(a) Show that the x -coordinate of the stationary point A is $\sqrt[3]{\frac{25}{4}}$. [3]

(b) Determine the nature of the stationary point A . [3]

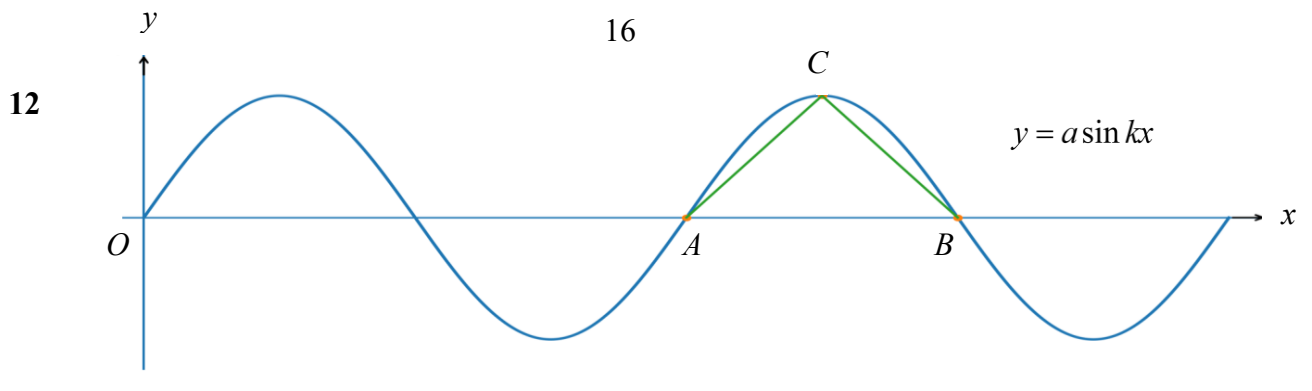
- 10** The equation of a curve is $y = 2\cos^2 3x - \sin 4bx + 2$, where x is in radian and b is a positive constant.
- (a)** Find, in terms of b , the equation of the normal to this curve at the point $A(0, 4)$. [6]

- (b)** This normal is parallel to another line $8y - x = 6$. Find the value of b . [2]

- 11 (a)** Express $\frac{4x^2 + 5x - 21}{x^2(2x - 3)}$ as the sum of 3 partial fractions. [5]

- (b)** Use your answer to **part (a)** to show that

$$\int_2^4 \frac{4x^2 + 5x - 21}{x^2(2x - 3)} dx = \ln a + b, \text{ where } a \text{ and } b \text{ are constants.} \quad [5]$$



The diagram shows part of the curve $y = a \sin kx$ where a and k are positive constants and x is in radians.

The curve crosses the positive x -axis at A and B .

Point A is the second positive x -intercept and point B is the next positive x -intercept after point A .

- (a) (i) Find, in terms of k , the coordinates of A and of B . [2]

Point C is the maximum point on the curve between A and B .

Points A , B and C form an isosceles triangle as shown in the diagram where

$$\text{angle } ABC = \text{angle } BAC = \frac{\pi}{6}.$$

- (ii) Show that $a = \frac{\sqrt{3}\pi}{6k}$. [3]

- (b) Given that the amplitude of the curve $y = a \sin kx$ is $3^{\frac{3}{2}}$, find the period of the curve. [3]

- 13** A circle has a diameter AB where A is the point $(-2, 2)$. The point $P(2, 10)$ also lies on the circle. The tangent to the circle at B has equation $3y + 4x = k$ where k is a constant.

(a) Find the equation of the perpendicular bisector of AP . [2]

(b) Find the equation of the circle. [5]

(c) Hence, find the value of k .

[2]

-End of paper-

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