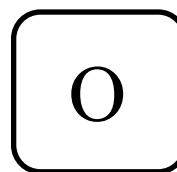




ZHONGHUA SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2026
SECONDARY 4 EXPRESS/ SECONDARY
5 NORMAL (ACADEMIC)



Candidate Name	Class	Register Number

ADDITIONAL MATHEMATICS

4049/02

Paper 2

27 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.

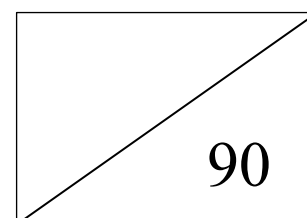
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

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: Mr Pang Hong Ming
Vetter: Mr Francis Tan

*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

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

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 $\triangle ABC$

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

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

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

- 1** Without using a calculator, find the values of p and q , for which the solution of the equation $x\sqrt{108} - \sqrt{75} = x\sqrt{5}$ is $\frac{p+q\sqrt{15}}{103}$. [5]

- 2** **(a)** It is given that $f(x) = 2x^3 - 17x^2 + 41x - 30$.
Show that $(2x - 3)$ is a factor of $f(x)$. [1]
- (b)** Express $f(x)$ as a product of three linear factors. [3]
- (c)** Hence, solve $f(x) = 0$. [1]

2 (d) Information about another function $g(x)$ is given below.

1. $g(x)$ gives a remainder of 2 when divided by $(x-3)$.
2. $g(x)$ gives a remainder of 2 when divided by $(3x-1)$.
3. $g(x)$ is a quadratic function.

Suggest a possible function for $g(x)$ in the form $ax^2 + bx + c$.

[2]

(e) Factorise $x^6 + 27y^3$.

[1]

[Turn over

- 3 For a particular curve, $\frac{d^2y}{dx^2} = 6\sin 2x - 4\cos x$.

The curve passes through the point $Q(0, 5)$ and the gradient of the curve at Q is 2.

Find the equation of the curve.

[5]

4 (a) State the range of principal values for

(i) $\sin^{-1} x$, [1]

(ii) $\tan^{-1} x$. [1]

(b) Without using a calculator, evaluate $\frac{\sin 60^\circ \times \tan 45^\circ}{\cos 30^\circ} + \cos^2 45^\circ$. [3]

[Turn over

- 5 A farmer wants to enclose a rectangular pen against a long, straight barn wall. The barn wall forms the entire top side of the pen, so no fencing is needed there.

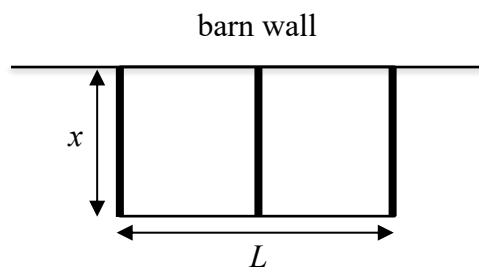
Fencing is required for:

- the bottom longer side (length L metres), using standard fencing at \$1 per metre.
- the two shorter sides and one internal dividing fence (each of length x metres), using reinforced fencing at \$4 per metre.

The internal dividing fence runs parallel to the shorter sides and splits the pen into two equal sections.

The farmer has a total budget of \$120.

The diagram below shows the rectangular pen.



- (a) Show that the total area of the pen, $A \text{ m}^2$, is given by $A = 120x - 12x^2$. [3]

- (b) Hence, find the maximum area of the pen. Justify that the area found is a maximum. [4]

- 6** A particle travels in a straight line such that the velocity of the particle, v m/s, t seconds after leaving a fixed point O , is given by $v = t^2 - 9t + 20$.

Find the total distance travelled by the particle in the interval $t = 0$ to $t = 7$. [7]

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Question 7 is on the next page.

[Turn over

- 7 **(a)** Solve the equation $3^{2x} - 4(3^x) + 3 = 0$.

[3]

- 7 **(b)** Solve the simultaneous equations.

$$\frac{y}{x^2} = 2$$

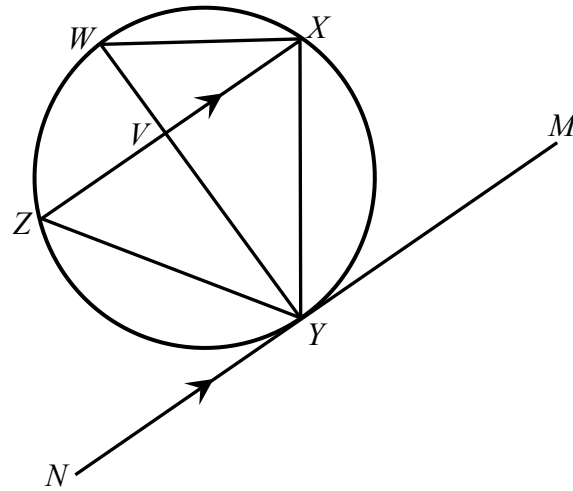
$$\log_2 y + \log_2 (x+2) = 4 + \log_2 x \quad [5]$$

8 **(a)** Given that $y = \frac{x^2 - 4x + 3}{(x - 2)^2}$, show that $\frac{dy}{dx} = \frac{2}{(x - 2)^3}$. [3]

(b) Find the range of values that the curve $y = \frac{x^2 - 4x + 3}{(x - 2)^2}$ is increasing. [2]

- 8 (c) Hence, determine whether the gradient of the curve $y = \frac{x^2 - 4x + 3}{(x - 2)^2}$ is [3]
increasing or decreasing for $x \neq 2$.

9



The diagram shows a circle passing through the vertices of triangles XYZ and WXY . MN is a tangent to the circle at Y and the chord XZ is parallel to the tangent MN . The chords WY and XZ intersect at V .

(a) Prove that triangle XYZ is an isosceles triangle.

[2]

- 9 (b) Show that triangle YXW is similar to triangle YVX . [3]

- (c) Given that WY is the diameter of the circle and the ratio of $WX : XY = 3 : 4$, find the ratio of $ZY : ZX$. [3]

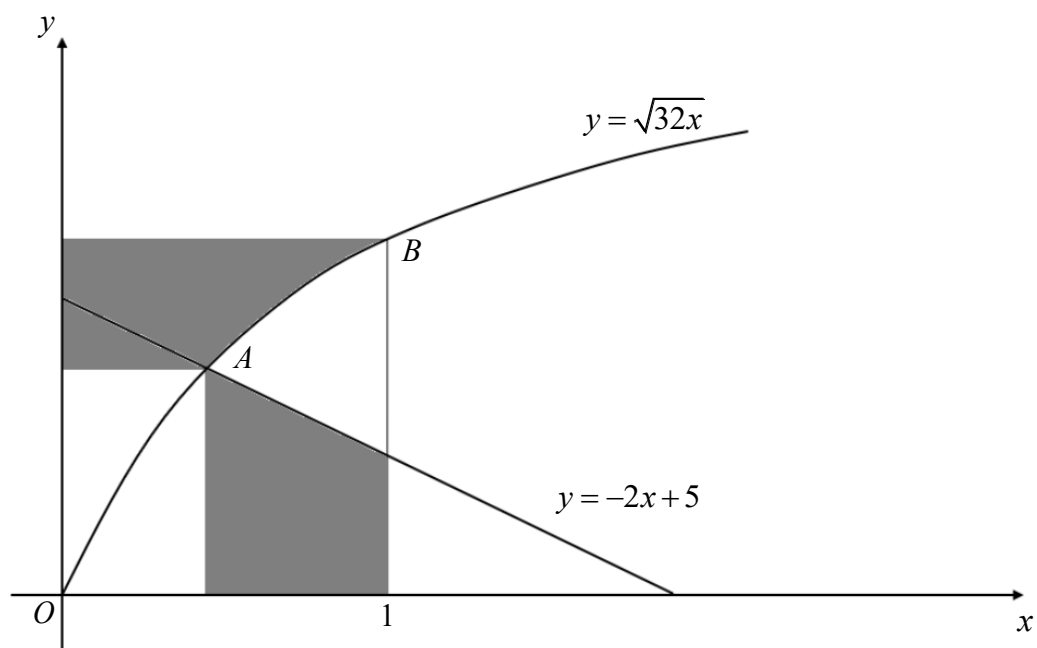
- 10** A student stands on the roof of a building and throws a ball upward. The height of the ball above the ground, h metres, at time t seconds after it is thrown, is modelled by $h = 15 - 5t^2 + 10t$.

(a) Express h in the form $h = a(t-b)^2 + c$, where a, b and c are constants. [3]

(b) Hence, find the maximum height reached by the ball and the time at which this occurs. [2]

- 10 (c)** A bird is perched at a height of $(k+10)$ metres above the ground. The ball hits the bird at $t = 1 + \frac{k}{5}$ seconds. Find the value of k . [4]

- 11 The diagram shows part of the graph of the curves $y = \sqrt{32x}$ and $y = -2x + 5$. The two graphs intersect at point A .



- (a) Show that the coordinates of A and B are $(0.5, 4)$ and $(1, 4\sqrt{2})$ respectively. [2]

- (b) Calculate $\int_{0.5}^1 (\sqrt{32x} + 2x - 5) \, dx$, leaving your answer in the form $\frac{a\sqrt{2} - b}{12}$, where a and b are integers. [4]

- (c) Hence, or otherwise, find the total area of the shaded regions, giving your answer correct to 3 decimal places. [2]

- 12** The temperature, T °C, inside a greenhouse over a 24-hour period is modelled by

$$T = 15 + 6 \sin\left(\frac{\pi t}{12}\right) + 8 \cos\left(\frac{\pi t}{12}\right)$$

where t is the number of hours after 00 00 hrs.

A plant will begin flowering when the temperature first reaches 24°C.

- (a)** By expressing $6 \sin\left(\frac{\pi t}{12}\right) + 8 \cos\left(\frac{\pi t}{12}\right)$ in the form $R \sin\left(\frac{\pi t}{12} + \alpha\right)$, where $0 < \alpha < \pi$, find the time, to the nearest minute, at which the plant begins flowering. [6]

- (b)** Find the maximum temperature inside the greenhouse and state the first time at which it occurs, to the nearest minute. [3]

- (c) Find the value(s) of t when the temperature inside the greenhouse is 10°C . [3]

END OF PAPER

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