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**ANG MO KIO SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2025
SECONDARY THREE EXPRESS**

ADDITIONAL MATHEMATICS

4049

**06 October 2025
2 hours 15 minutes**

Setter:

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

READ THESE INSTRUCTIONS FIRST

Write your name, index 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 paper clips, glue or correction fluid.

Answer **all** questions.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in 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.

At the end of the examination, fasten all your work securely together.
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**.

For Examiner's Use
90

This document consists of **18** printed pages.

[Turn Over

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

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

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 $\triangle ABC$

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

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

$$\Delta = \frac{1}{2}ab \sin C$$

- 1 A right-angled triangle has an area of $(14 + 8\sqrt{3}) \text{ cm}^2$. Given that the base of the triangle has a length of $(1 + \sqrt{3}) \text{ cm}$, find without using a calculator, the height of the triangle giving your answer in the form $(a + b\sqrt{3})$, where a and b are integers. [4]

- 2 (a) The equation of a curve is $y = -3x^2 + 6mx - 3m^2 - 1$ where m is a constant.
Show that the curve is negative for all real values of x .

[4]

- (b) Find the values of the k for which $kx^2 + 8x + k + 6 = 0$ has equal real roots.

[4]

- (c) Find the range of values of m such that the roots of $2x^2 + 3x + m = 0$ are real. [3]

- (d) Solve $2x^2 + x - 1 \leq 0$. [2]

3 (a) Solve the simultaneous equations

$$\begin{aligned}x - 2y &= 5, \\ 2x^2 - 3y &= 3xy - 6.\end{aligned}$$

[5]

- (b) By using a suitable substitution, solve $3^{2x+1} + 26(3^x) - 9 = 0$. [4]

- 4 The value of a new EV car is \$160 000. After t months, the car depreciated by an amount $\$P$, given by $P = 1000e^{0.2t}$. Find

(i) the value of the car after 15 months, to the nearest hundred dollars, [3]

(ii) the number of months, to the nearest month, when its depreciation exceeded \$90 000. [3]

5 Express $\frac{2x-5}{x(x^2+1)}$ in partial fractions.

[5]

6 (a) (i) Find the first four terms, in ascending powers of x , of the expansion of $(1+x^2)^9$. [2]

(ii) Hence find the coefficient of x^4 in the expansion of $(1-x^2)(1+x^2)^9$. [2]

(b) Find the term independent of x in the expansion of $\left(x + \frac{1}{2x^2}\right)^{12}$. [5]

7 (a) Show that $(x-3)$ is a factor of $f(x) = 6x^3 - 5x^2 - 34x - 15$. [2]

(b) Solve the cubic equation $f(x) = 0$. [4]

(c) Hence show that the equation $6y^6 - 5y^4 - 34y^2 - 15 = 0$ has only 2 real roots. [2]

8 (a) Find the amplitude and the period of $y = 1 - \cos 2x$. [2]

(b) Hence sketch the graph of $y = 1 - \cos 2x$ for $0^\circ \leq x \leq 270^\circ$. [2]



(c) Given that $\tan A = -\frac{12}{5}$ and that $\tan A$ and $\cos A$ have opposite signs, find the value of

(i) $\cos A$, [1]

(ii) $\operatorname{cosec} A$, [2]

(iii) $\sin 2A$. [2]

9 (a) Solve $7^{x+2} = 21$.

[3]

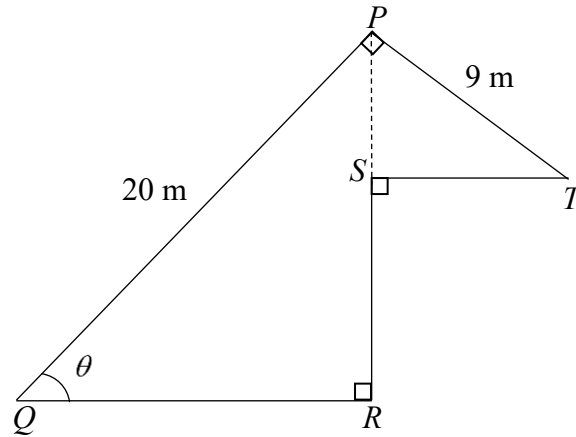
(b) Solve $\log_3(10-9x) - 4\log_9 x = 2$.

[4]

10 (a) Prove that $\frac{\sec^2 x + 2 \tan x}{1 + 2 \sin x \cos x} = \sec^2 x$. [4]

- (b) Hence solve the equation $\frac{\sec^2 x + 2 \tan x}{1 + 2 \sin x \cos x} = 4$ for $0^\circ \leq x \leq 360^\circ$. [4]

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A playground is to be built in the shape of the figure shown above in which PSR is a straight line. It is given that $PT = 9$ m, $PQ = 20$ m, angle $QPT = \text{angle } TSR = \text{angle } SRQ = 90^\circ$ and angle $PQR = \theta$, where θ is an acute angle in degrees.

- (i) Show that the perimeter of the playground, L m, can be expressed as

$$L = 29 + 11 \cos \theta + 29 \sin \theta.$$

[3]

- (ii) Express $L = 29 + 11 \cos \theta + 29 \sin \theta$ in the form of $a + R \cos(\theta - \alpha)$, where $R > 0$ and α is acute. [4]

- (iii) Given $L = 59$ m, find the values of θ . [3]

- (iv) Find the maximum value of the perimeter and the corresponding value of θ . [2]

END OF PAPER