AHMAD IBRAHIM SECONDARY SCHOOL
GCE O-LEVEL PRELIMINARY EXAMINATION 2025

SECONDARY 4 EXPRESS

Name:	Class:	Register No.:

ADDITIONAL MATHEMATICS **4049/01**
Paper 1 **12 August 2025**

Candidates answer on the Question Paper. **2 hours 15 minutes**

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 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.

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 number of marks for this paper is 90.

For Examiner's Use
/90

This document consists of **19** 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

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

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 It is given that P, Q and R are the angles of a triangle.

(a) Show that $\cos P = -\cos(Q + R)$. [2]

(b) Given that $Q = 45°$ and $R = 60°$, find $\cos P$ in the form $\frac{1}{4}(\sqrt{a} - \sqrt{b})$, where a and b are integers. [3]

2 Baking powder is poured onto a flat surface at a constant rate of $2\pi\ \text{cm}^3\text{s}^{-1}$ and formed a right circular cone. The radius of the cone is always $\dfrac{1}{18}$ of its height. Find the rate of change of the radius of the cone after 3 seconds of pouring. [5]

3 **(a)** Determine the set of values of m for which the equation $2x^2+4x+2m=6mx-2$ has real roots. [4]

(b) Hence state what can be deduced about the curve $y=2(x+1)^2$ and the line $y=6x-2$. Justify your statement. [2]

4 **(a)** Show that $\dfrac{\mathrm{d}}{\mathrm{d}x}\left(\ln\left(\cos x\right)\right) = -\tan x$. [2]

(b) Differentiate $x\tan x$ with respect to x. [2]

(c) Using the results from part **(a)** and **(b)**, find $\int x\sec^2 x \,\mathrm{d}x$ and hence show that $\int_0^{\frac{\pi}{4}} x\sec^2 x \,\mathrm{d}x = \dfrac{\pi}{4} - \dfrac{1}{2}\ln 2$. [4]

5 **(a)** In the expansion of $(2+x)^n$, where n is a positive integer, the coefficient of x^2 is twice the coefficient of x. Find the value of n. [3]

(b) Find the value of the term that is independent of x in the expansion of $\left(2x-\dfrac{1}{4x^4}\right)^{15}$. [4]

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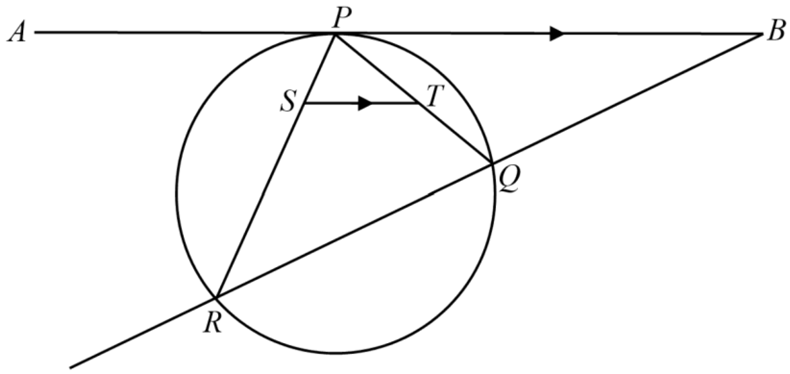


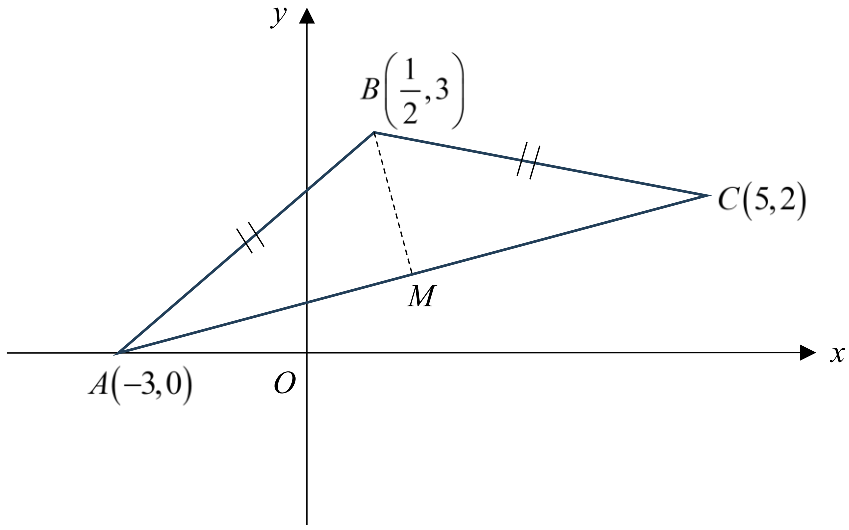
The diagram shows a circle passing through the points P, Q and R. The point Q lies on the line RB. AB is a tangent to the circle at P. The points S and T lie on PR and PQ respectively. Given that AB is parallel to ST, prove that

(a) triangle PST is similar to triangle PQR, [3]

(b) $PQ \times PT = PR \times PS$, [2]

(c) Determine if *STQR* is a cyclic quadrilateral. [4]

7



The diagram shows an isosceles triangle ABC in which $A(-3,0)$, $B\left(\frac{1}{2},3\right)$ and $C(5,2)$. M is the foot of perpendicular from B to AC.

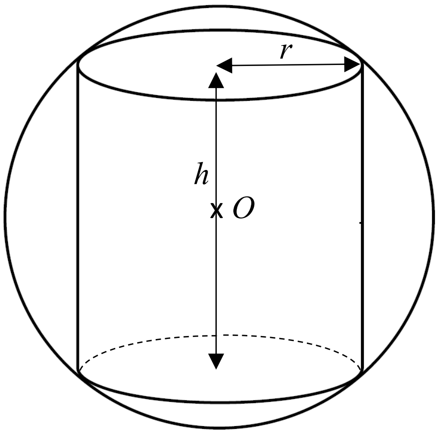
(a) Find the coordinates of M. [1]

(b) Find the equation of the perpendicular bisector of AC. [2]

(c) Given that *ABCD* is a kite with $BM = \frac{2}{7}BD$, find the coordinates of *D*. [3]

(d) Find the area of the kite *ABCD*. [2]

8



A prototype consists of a cylindrical container of height h cm and radius r cm inscribed in a hollow sphere with centre O.

The sphere has a surface area of 6400π cm^2 and both the sphere and container have negligible thickness.

(a) Show that the volume of the cylinder container, V cm^3, is given by [3]

$$V = 2\pi r^2\sqrt{1600 - r^2}\ .$$

(b) Given that r can vary, find the value of r for which the volume V is stationary. [5]

(c) A scientist plans to launch this prototype into outer space carrying as much fuel as possible. Explain whether the prototype can satisfy the scientist's requirement. [2]

9 It is given that $f(x) = 4 + \cos\left(\dfrac{x}{2}\right)$ and $g(x) = -2\sin x$.

(a) State the period and amplitude of f(x). [2]

(b) State the period and amplitude of g(x). [1]

(c) Sketch, on the same axes, the graphs of y = f(x) and y = g(x) for $0° \leq x \leq 360°$. [3]

10 **(a)** Express $\dfrac{1-3x-3x^2}{x\left(x+1\right)^2}$ in partial fractions. [5]

(b) Hence find $\displaystyle\int \frac{1-3x-3x^2}{2x\left(x+1\right)^2}\,dx$. [4]

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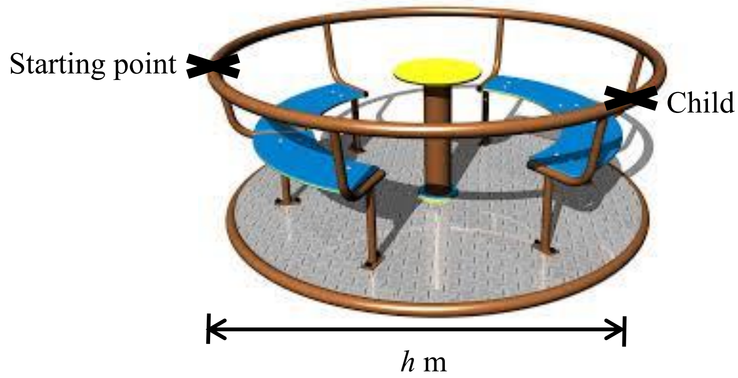

The horizontal distance of a child on a carousel, h m, from the starting point is modelled by the equation, $h = 2(1 - \cos kt)$, where k is a constant and t is the time in seconds after the child leaves the starting point. The time to complete one revolution is 20 seconds.

(a) Explain why this model suggests that the diameter of the carousel is 4 m. [1]

(b) Show that the value of k is $\dfrac{\pi}{10}$ radians per second. [2]

(c) As the carousel turns, it is possible for the child on the carousel to view a landmark, provided that the horizontal distance of the child is within 1 m from the starting point.

Find the duration of time for which the child will not be able to view the landmark during one revolution. [5]

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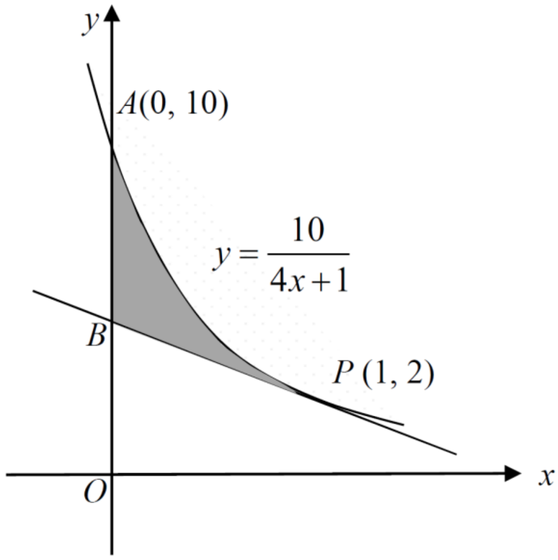

The diagram shows part of the curve $y = \dfrac{10}{4x+1}$ intersecting the y-axis at $A(0, 10)$. The tangent to the curve at the point $P(1, 2)$ intersects the y-axis at B.

(a) Show that the coordinates of B is (0, 3.6). [4]

(b) Find the **exact** area of the shaded region. [5]

END OF PAPER