NAME: ______________________________ (   ) CLASS: 4 (   )

ANGLICAN HIGH SCHOOL
SECONDARY FOUR
PRELIMINARY EXAMINATIONS 2025

S4

ADDITIONAL MATHEMATICS

4049/01

Paper 1

22 August 2025
2 hours 15 minutes

Candidates answer on the Question Paper.
Additional Material: Graph Paper (1 sheet)

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 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.

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 Examiners' Use

<table>
<tr><th>Question</th><th>Marks</th><th>Question</th><th>Marks</th><td rowspan="2">Clarity / Logic</td><td rowspan="2"></td></tr>
<tr><td>1</td><td></td><td>8</td><td></td></tr>
<tr><td>2</td><td></td><td>9</td><td></td><td rowspan="2">Precision / Accuracy</td><td rowspan="2"></td></tr>
<tr><td>3</td><td></td><td>10</td><td></td></tr>
<tr><td>4</td><td></td><td>11</td><td></td><td rowspan="2">Units</td><td rowspan="2"></td></tr>
<tr><td>5</td><td></td><td>12</td><td></td></tr>
<tr><td>6</td><td></td><td>13</td><td></td><td colspan="2" rowspan="3">Total:
90</td></tr>
<tr><td>7</td><td></td><td>14</td><td></td></tr>
<tr><td colspan="4">Parent's Name & Signature:

Date:</td></tr>
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This paper consists of **18** 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

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

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

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

1 **(a)** Find the range of values of p for which $y = x^2 - x - 2$ lies entirely above the line $y = p(x+2)$. [4]

(b) Hence, deduce, without finding the discriminant, the number of intersection points when $p = 3$. [1]

2 By using substitution or otherwise, find the values of x for which $2^{2x-1} = 2^{x+3} - 24$, giving your answer where appropriate, to one decimal place. [5]

3 A closed circular cylinder has a volume of $\left(66\sqrt{2}+2\sqrt{3}\right)\pi$ cm^3, a radius of $\left(\sqrt{2}+2\sqrt{3}\right)$cm and a height h cm. Express h in the form of $p\sqrt{2}+q\sqrt{3}$ where p and q are integers. [4]

4 Express $\dfrac{2x^3-2x^2+7x-12}{x^3+4x}$ in partial fractions. [6]

5 Given the curve $y = kx^2 + 2kx - 3$, where k is a constant.

(a) By expressing y in the form $k(x+b)^2 - 1$, determine the value of k and of b. [3]

(b) Hence, show that the curve is always below the x-axis. [2]

(iii) State the turning point of the curve and determine the nature of this point. [2]

6 The binomial expansion of $(1+px)^n$ where $n > 0$, in ascending powers of x is

$$1-12x+28p^2x^2+qx^3+...$$

Find the value of p, of n and of q. [6]

7 **(a)** The surface area of a solid cube is increasing at $0.2\,\text{cm}^2/\text{s}$. Find the rate of increase of the volume when the length of a side is 1 cm. [4]

(b) A curve has the equation $y = \mathrm{e}^{1-8x}(\cos 2x)$, where $0 \le x \le \frac{\pi}{4}$. Find the gradient of the curve at the point where $y = 0$, leaving your answer in exact form. [4]

8 The equation of a curve is $y=-\frac{5}{8}x+\frac{6}{x}$, where $x>0$. Given that the gradient of the normal at point P is 1, find

(a) the coordinates of *P,* [4]

(b) the equation of the normal at the curve at *P*. [2]

9 **(a)** Solve the equation $\log_2(x+2)-\log_{\sqrt{2}}(x-1)=1$. [4]

(b) It is given that $\lg a-\lg b=\lg(a+b)$.

(i) Express a in terms of b. [2]

(ii) State the range of b. [1]

10 Given that $\sin A$ and $\cos B$ are in the same quadrant such that $\sin A = \frac{3}{5}$ and $\cos B = -\frac{5}{13}$.

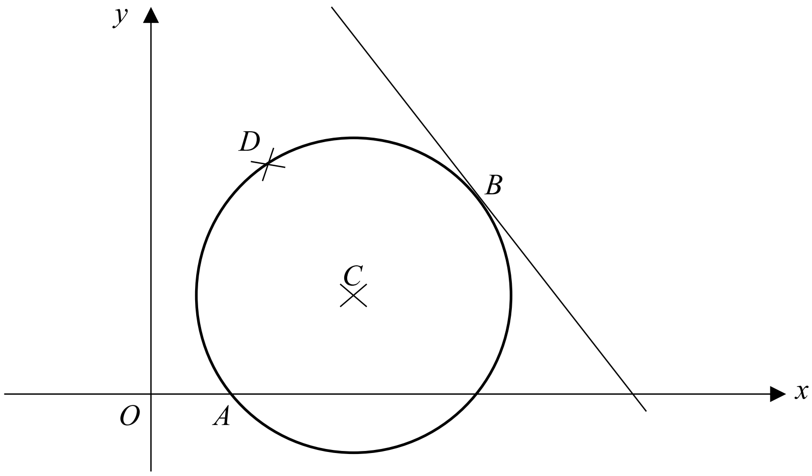
Find, without using a calculator, the value of

(a) $\cos(A-B)$, [2]

(b) $\cos\frac{A}{2}$. [3]

11 Points A, $B(5,4)$ and D lie on a circle with centre C and AB is the diameter of the circle.

The line $y=-x+9$ is a tangent at point $B(5,4)$ on the circle.



(a) Given that point P lies on BA extended and the x-coordinate of point P is -1, find the coordinates of P. [2]

It is given that the distance BP is three times the distance BC.

(b) **(i)** Show that centre C is $(3,2)$. [1]

(ii) Hence, find the equation of the circle. [2]

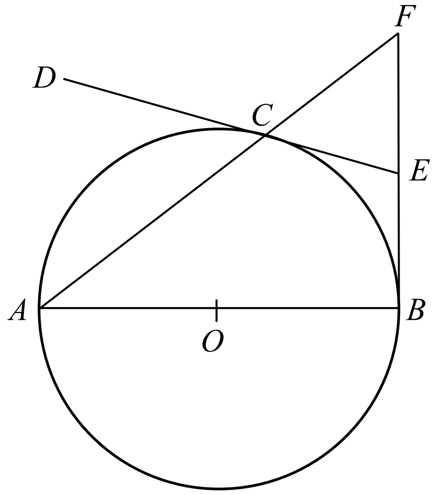
(c) Given that triangle BCD is a right-angled triangle, find the coordinates of D. [3]

12 **(a)** Given that $y = \ln\left(\sin^2 x\right)$, show that $\dfrac{dy}{dx} = 2\cot x$. [2]

(b) Hence, show that the value of $\int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \left(\cot x - \cos^2 2x\right) dx = a + b\ln 2$, where a and b are constants.

[4]

13 In the diagram, AB is a diameter of the circle with centre O. DE and BF are tangents to the circle at C and B respectively. DCE and BEF are straight lines. Prove that



(a) ΔABC and ΔBFC are similar, [3]

(b) hence or otherwise, show that ΔCFE is an isosceles triangle. [4]

14 The mass, m grams, of the decomposition of a radio-active substance is given by the formula $m = ae^{-bt}$, where a and b are constants, and t is the number of weeks after the initial measurement of the mass. Experimental values of t and m are given in the table below.

t	1	2	3	4	5
m	1.51	0.454	0.137	0.0183	0.0124

(i) What does the constant a refer to? [1]

(ii) By drawing a suitable straight line graph using the data provided, estimate the value of a and of b. [7]

(iii) It is discovered that one of the readings of the mass, m, is incorrect. Using your graph, estimate the correct value for this incorrect reading. [2]