Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

ADDITIONAL MATHEMATICS **4037/22**

Paper 2 **October/November 2023**

2 hours

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION
- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

DC (AP) 331321

Mathematical Formulae

1. ALGEBRA

Quadratic Equation

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

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

Binomial Theorem

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

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

Arithmetic series $u_n = a + (n-1)d$

$$S_n = \frac{1}{2}n(a+l) = \frac{1}{2}n\{2a + (n-1)d\}$$

Geometric series $u_n = ar^{n-1}$

$$S_n = \frac{a(1-r^n)}{1-r} \quad (r \neq 1)$$

$$S_\infty = \frac{a}{1-r} \quad (|r| < 1)$$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$
$$\sec^2 A = 1 + \tan^2 A$$
$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

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 **(a)** A straight line passes through the points (4, 23) and (−8, 29). Find the point of intersection, P, of this line with the line $y = 2x + 5$. [5]

(b) Find the distance of P from the origin. [2]

2 Find the non-zero value of k for which the line $y = -2x - 6k - 1$ is a tangent to the curve $y = x(x+2k)$. [5]

3 DO NOT USE A CALCULATOR IN THIS QUESTION.

A cylinder has base radius $(2+\sqrt{3})$ m and volume $\pi(16+9\sqrt{3})\,\text{m}^3$. Find the exact value of its height, giving your answer in its simplest form. [4]

4 Solve the following equations.

(a) $\dfrac{(e^{x+1})^2}{\sqrt{e^x}} = 10$ [4]

(b) $2\log_9 y - \log_9 (4y - 9) = \dfrac{1}{2}$ [5]

5 **(a)** Find the equation of the normal to the curve $y = x^3 - 7x^2 + 12x - 5$ at the point (1, 1). [5]

(b) Find the x-coordinates of the two points where the normal cuts the curve again. Give your answers in the form $x = a \pm \sqrt{b}$ where a and b are integers. [5]

6 Find the exact value of $\int_2^3 \frac{(x+2)^2}{x}\,dx$. [6]

7 A particle is travelling in a straight line. Its displacement, s metres, from the origin at time t seconds is given by $s = 1.5e^{2t} + 2e^{-2t} - t$.

(a) Find expressions for the velocity, $v\,\mathrm{ms}^{-1}$, and acceleration, $a\,\mathrm{ms}^{-2}$, of the particle. [3]

(b) Find the time, T seconds, when the particle is at rest. [4]

(c) Find the acceleration of the particle at time T seconds. [2]

8 A curve has equation $y = x\sin 2x$.

(a) Find $\frac{\mathrm{d}y}{\mathrm{d}x}$. [2]

(b) Find the equation of the tangent to the curve at $x = \frac{\pi}{4}$. [3]

(c) Use your answer to **part (a)** to find the exact value of $\int_0^{\frac{\pi}{6}} 2x\cos 2x\,dx$. [5]

9 **(a)** An arithmetic progression has twelve terms. The sum of the first three terms is -36 and the sum of the last three terms is 72. Find the first term and the common difference. [5]

(b) The first three terms of a geometric progression are 1, 1.2 and 1.44. Find the smallest value of n such that the sum of the first n terms is greater than 500. [5]

10 **(a)** By writing $\cot x$ and $\tan x$ in terms of $\cos x$ and $\sin x$, show that

$$\frac{\sin x}{1-\cot x}+\frac{\cos x}{1-\tan x}=\sin x+\cos x.$$ [5]

(b) Solve the equation $9\cot x + 3\operatorname{cosec} x = \tan x$, for $0° < x < 360°$. [5]

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