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Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

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ADDITIONAL MATHEMATICS **4037/23**

Paper 2 **October/November 2024**

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.

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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

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

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

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

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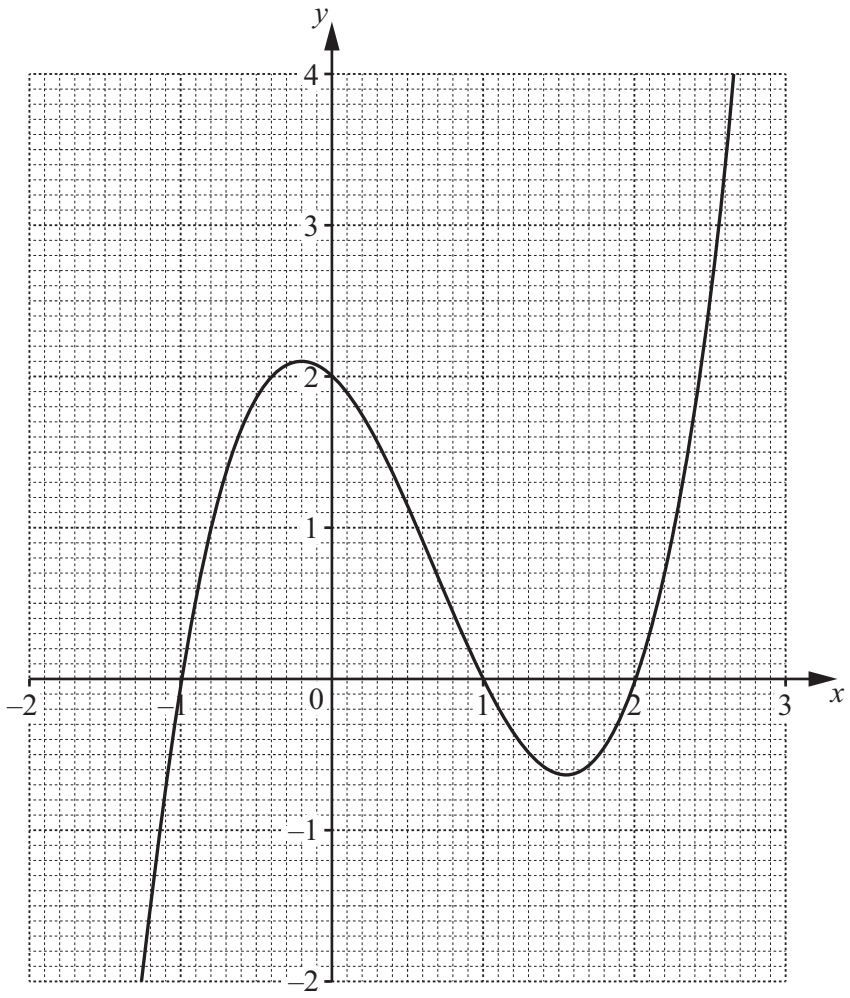

The diagram shows the graph of $y = (x+1)(x-1)(x-2)$. Use the graph to solve the inequality $(x+1)(x-1)(x-2) < 1$. [3]

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2 The function f is defined by $f(x) = 1 - 4x - x^2$ for all real values of x.

(a) Write $f(x)$ in the form $a - (x + b)^2$, where a and b are constants. [2]

(b) Find the range of f. [1]

The function g is defined by $g(x) = 1 - 4x - x^2$ for $x \geqslant k$, where k is a constant.

(c) State the least possible value of k such that g has an inverse. [1]

(d) Using your value of k, find $g^{-1}(x)$, stating its domain and range. [5]

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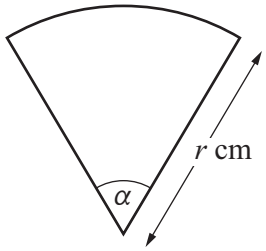
3 **(a)** Show that $(2\tan\theta+\sec\theta)(2\tan\theta-\sec\theta) = 3\tan^2\theta - 1$. [2]

(b) Hence solve the equation $(2\tan\theta+\sec\theta)(2\tan\theta-\sec\theta) = 1$ for $0° \leqslant \theta \leqslant 180°$. [4]

4 The diagram shows a design for a logo. The logo is a sector of a circle, radius r cm, with angle α radians.



The area of the logo is $9\,\text{cm}^2$.

(a) Show that the perimeter, P cm, of the logo is given by

$$P = 2r + \frac{18}{r}.$$ [3]

(b) Given that r can vary, find the stationary value of P and determine its nature. [5]

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5 The tangent to the curve $y = \frac{\sqrt{x+1}}{x}$ at the point where $x = 3$ meets the line $y = x - 16$ at the point A. Find the coordinates of A. [8]

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6 **(a)** Find $\int \frac{1}{\sqrt{3x+2}} \mathrm{d}x$. [2]

(b) Find, in terms of a, $\int_{0.5}^{a} \mathrm{e}^{(1-2x)} \mathrm{d}x$. [3]

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7 **(a)** In the expansion of $\left(x+x^2\right)^8$ in ascending powers of x, the 3rd and 6th terms are equal.

Find the value of x. [3]

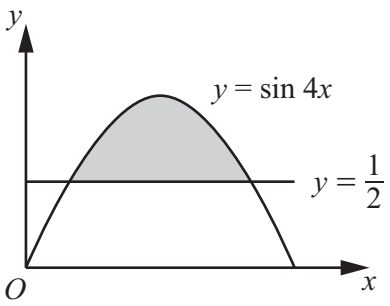
(b) In the expansion of $\left(x+\frac{2}{x}\right)^n$ in decreasing powers of x, the 6th term is a constant.

(i) Find the value of the positive integer n. [2]

(ii) Find the value of the 6th term. [2]

8 **(a)** Solve the equation $\sin 4x = \frac{1}{2}$ for $0 \leqslant x \leqslant \frac{\pi}{4}$, giving your answers in terms of π. [2]

(b)



The diagram shows parts of the graphs of $y = \sin 4x$ and $y = \frac{1}{2}$.

Find the exact area of the shaded region enclosed by the curve and the line. [5]

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9 DO NOT USE A CALCULATOR IN THIS QUESTION.

Write $\dfrac{16+11\sqrt{10}}{2+\sqrt{10}}+1$ in the form $p+q\sqrt{10}$, where p and q are integers. [4]

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10 (a) Suzma is training for a marathon. In the first week she runs 10 km. Then each week she runs a distance that is 10% greater than the week before.

The total distance that Suzma has run by the end of n whole weeks is more than 200 km. Find the smallest possible value of n. [4]

(b) A geometric progression has 1st term a and common ratio r, where $a \neq 0$ and $r \neq 1$. The 1st, 2nd and 3rd terms of the geometric progression are the 1st, 3rd and 7th terms of an arithmetic progression. Find the value of r. [4]

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11 **(a)** There are 3 girls and 2 boys standing in a straight line. Find the number of possible orders in each of the following cases.

(i) No girls are next to each other. [2]

(ii) The 2 boys are not next to each other. [2]

(b) 12 people, including Anjie and Bubay, are divided into 3 groups of 4 people. Anjie and Bubay must not be in the same group.

Find the number of ways in which the 3 groups can be selected. [2]

12 A particle moves in a straight line. Its velocity, v ms^{-1}, at time t seconds is given by

$$v = \cos t - \sin t.$$

(a) Find the acceleration, a ms^{-2}, when $t = \frac{\pi}{3}$. [2]

The displacement of the particle from a fixed point O at time t is s metres. The particle passes through O when $t = 0$.

(b) Find the displacement at the time when the particle first changes direction after passing through O. [6]

(c) Find an expression for a in terms of s. [1]

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