



Cambridge O Level

CANDIDATE
NAME



CENTRE
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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.



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

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

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

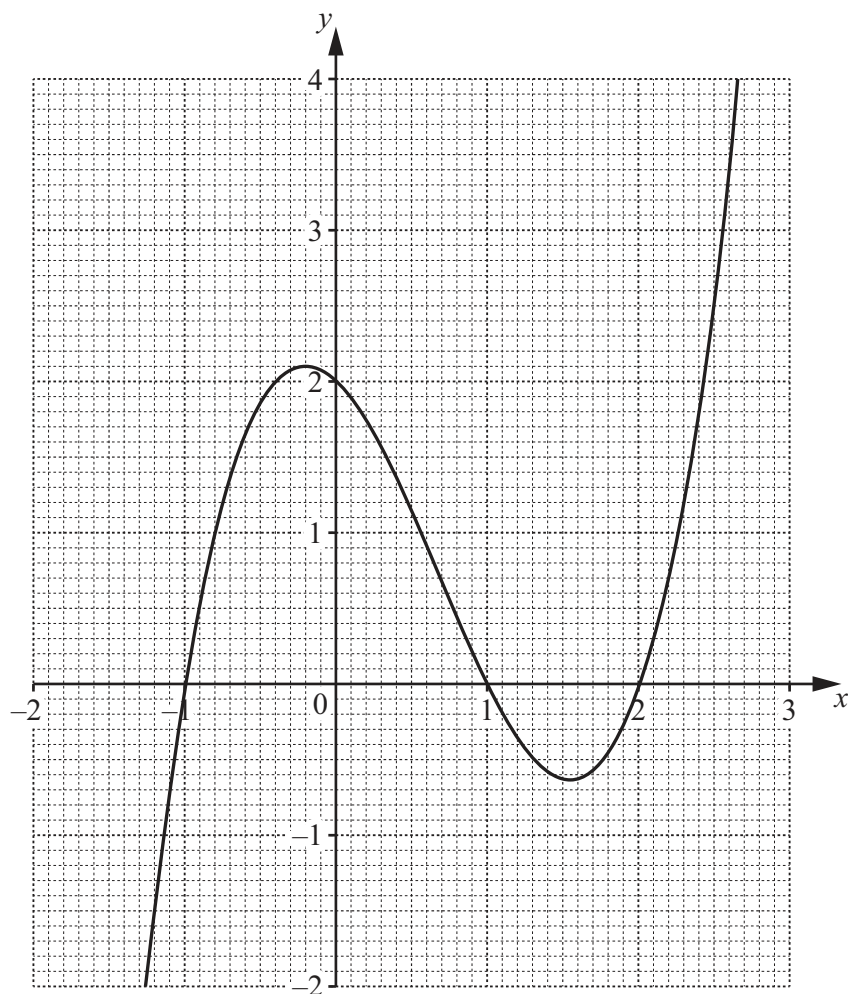
$$\begin{aligned}\sin^2 A + \cos^2 A &= 1 \\ \sec^2 A &= 1 + \tan^2 A \\ \operatorname{cosec}^2 A &= 1 + \cot^2 A\end{aligned}$$

Formulae for $\triangle ABC$

$$\begin{aligned}\frac{a}{\sin A} &= \frac{b}{\sin B} = \frac{c}{\sin C} \\ a^2 &= b^2 + c^2 - 2bc \cos A \\ \Delta &= \frac{1}{2}bc \sin A\end{aligned}$$



1



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]





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 $x \geq k$, 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]





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

[2]

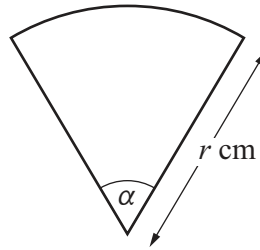
(b) Hence solve the equation $(2 \tan \theta + \sec \theta)(2 \tan \theta - \sec \theta) = 1$ for $0^\circ \leq \theta \leq 180^\circ$.

[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 cm^2 .

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

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

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





- 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]





6 (a) Find $\int \frac{1}{\sqrt{3x+2}} dx$.

[2]

(b) Find, in terms of a , $\int_{0.5}^a e^{(1-2x)} dx$.

[3]

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- 7 (a) In the expansion of $(x + x^2)^8$ 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]

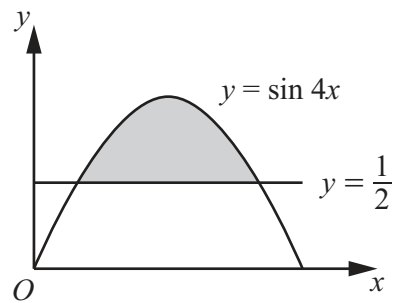




- 8 (a) Solve the equation $\sin 4x = \frac{1}{2}$ for $0 \leq x \leq \frac{\pi}{4}$, giving your answers in terms of π .

[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]



**9 DO NOT USE A CALCULATOR IN THIS QUESTION.**

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

[4]





- 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]





- 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, $v \text{ ms}^{-1}$, at time t seconds is given by

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

- (a) Find the acceleration, $a \text{ ms}^{-2}$, 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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