Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

ADDITIONAL MATHEMATICS **0606/12**

Paper 1 **February/March 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

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

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

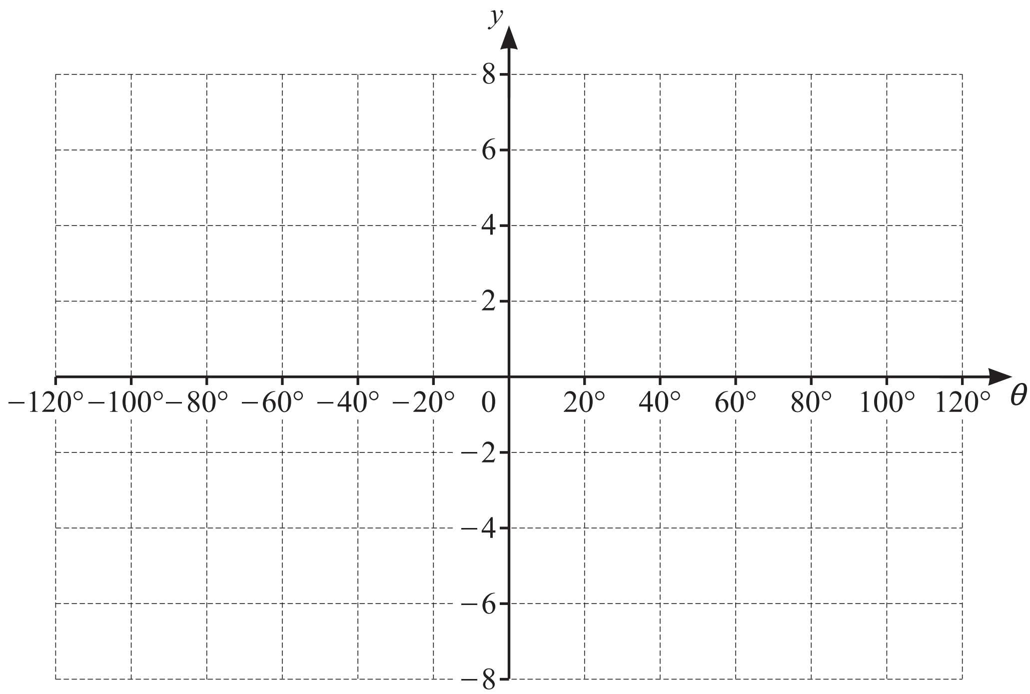
$$\Delta = \frac{1}{2}bc\sin A$$

1 Given that $y = 2 + 4\cos 3\theta$, for $-120° \leqslant \theta \leqslant 120°$,

(a) write down the amplitude of y [1]

(b) write down the period of y. [1]

(c) On the axes, sketch the graph of y. [3]



2 **(a)** Given that $\log_p a + \log_p 12 - \log_p 6 = 3\log_p 4$, find the value of a. [3]

(b) Find the exact solutions of the equation $4\log_3 x = 9\log_x 3$. [4]

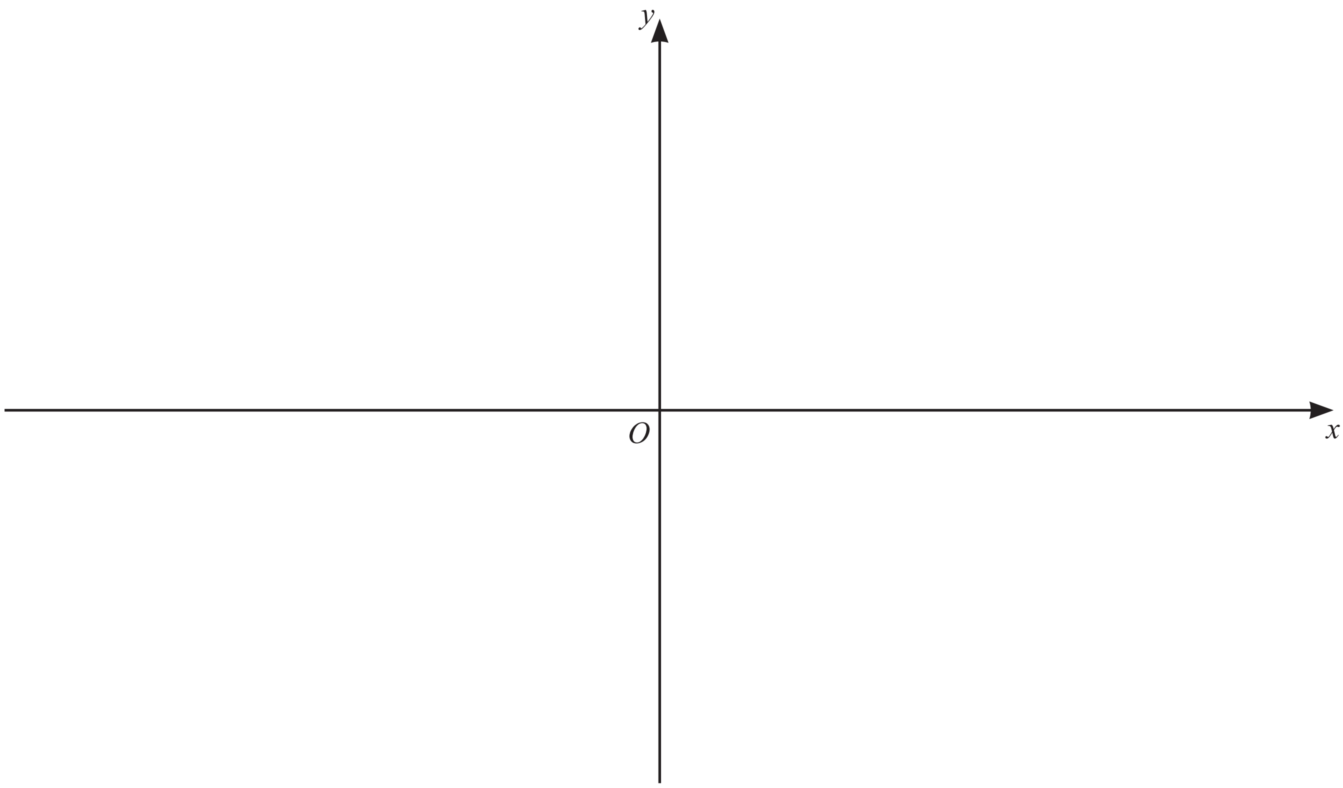
3 The curve C has equation $y = \ln(x^3 + 3)$. The normal to C at the point where $x = 1$ meets the line $y = x$ at the point P. Find the exact coordinates of P. [7]

4 A function f is such that $\mathrm{f}(x) = 2 + \mathrm{e}^{-3x}$, $x \in \mathbb{R}$.

(a) Write down the range of f. [1]

(b) Find an expression for f^{-1}. [2]

(c) On the axes, sketch the graphs of $y = \mathrm{f}(x)$ and $y = \mathrm{f}^{-1}(x)$, stating the coordinates of the points where the curves meet the coordinate axes. State the equations of any asymptotes. Label your curves. [4]



A function g is such that $g(x) = x^{\frac{3}{2}} + 4, \quad x \geqslant 0$.

(d) Find the exact solution of the equation $gf(x) = 12$. [4]

5 The polynomial p is such that $p(x) = 5x^3 + ax^2 + 39x + b$, where a and b are constants.

(a) Given that $x+3$ is a factor of both $p(x)$ and $p'(x)$, find the values of a and b. [5]

(b) Hence solve the equation $p(x) = 0$.

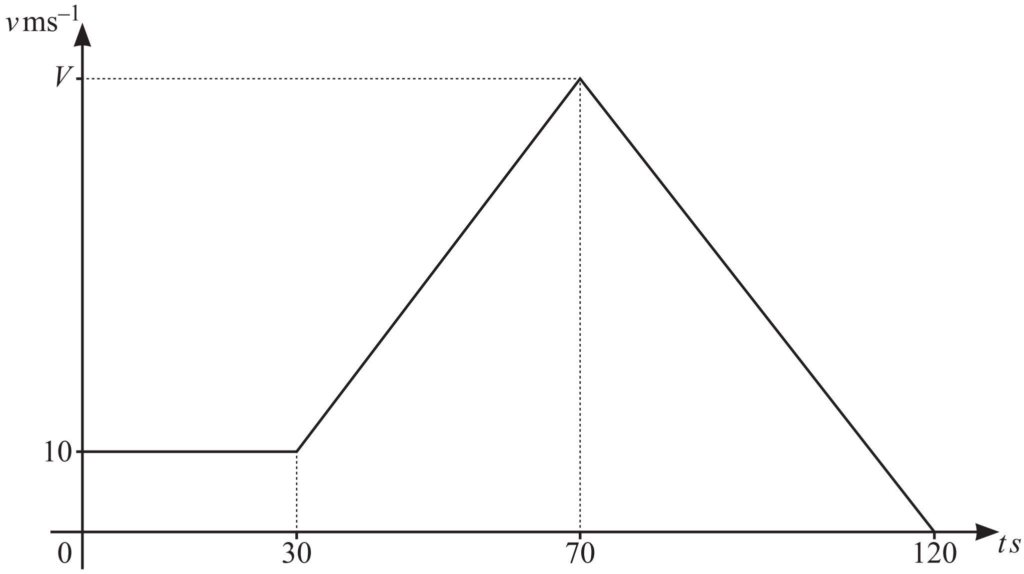
You must show your working. [3]

(c) Hence, using your values for a and b, solve the equation

$$5\,\mathrm{cosec}^3 2\theta + a\,\mathrm{cosec}^2 2\theta + 39\,\mathrm{cosec}\,2\theta + b = 0 \quad \text{for} \quad 0° \leqslant \theta \leqslant 360°.$$ [5]

6 In this question all distances are in metres and all times are in seconds.

(a)



(i) The diagram shows the velocity–time (v–t) graph of a particle travelling in a straight line. The particle travels a distance of 2750 m in 120 s. Find the velocity, V, of the particle when $t = 70$. [2]

(ii) Find the acceleration of the particle for $70 < t < 120$. [2]

(b) A different particle moves in a straight line such that its velocity, $v\,\text{ms}^{-1}$, t seconds after leaving a fixed point O, is given by $v = t\left(t^2+5\right)^{\frac{1}{2}}$.

(i) Find the exact acceleration of the particle when $t = 2$. [4]

(ii) Explain why the particle does not change direction for $t > 0$. [1]

7 **(a)** Find $\int_{2}^{4}(5x-2)^{-\frac{2}{3}}\,\mathrm{d}x$, giving your answer in exact form. [4]

(b) Find $\int_{0}^{\frac{1}{2}}\left(\frac{4}{2x+1}+\frac{8}{(2x+1)^2}\right)\mathrm{d}x$, giving your answer in the form $a+\ln b$, where a and b are integers. [5]

8 **(a)** A 5-digit number is to be formed using 5 different numbers selected from 1, 2, 3, 4, 5, 6, 7, 8 and 9. No digit may be used more than once in any 5-digit number.

(i) Find how many 5-digit numbers can be formed. [1]

(ii) Find how many of these 5-digit numbers are greater than 50 000 and even. [3]

(b) A team of 9 people is to be chosen from 6 doctors, 4 dentists and 2 nurses. Find how many possible teams include at least 2 doctors, at least 2 dentists and at least 2 nurses. [3]

9 **(a)** The first three terms of an arithmetic progression are $\lg\theta^2$, $\lg\theta^5$ and $\lg\theta^8$.

(i) Given that the sum to *n* terms of this progression is $4732\lg\theta$, find the value of *n*. [5]

(ii) This sum is equal to -14196. Find the exact value of θ. [1]

(b) The first three terms of a geometric progression are $\lg\phi^3$, $\lg\phi$ and $\lg\phi^{\frac{1}{3}}$.

(i) Determine whether this geometric progression has a sum to infinity. [2]

(ii) Find the *n*th term of this geometric progression, giving your answer in the form $3^A \lg\phi$, where A is a function of n. [3]

(iii) Find the value of ϕ, given that the 20th term is 3^{-18}. [1]

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