



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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0606/12

February/March 2024

2 hours

You must answer on the question paper.

No additional materials are needed.

- 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.

- 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 $\triangle ABC$

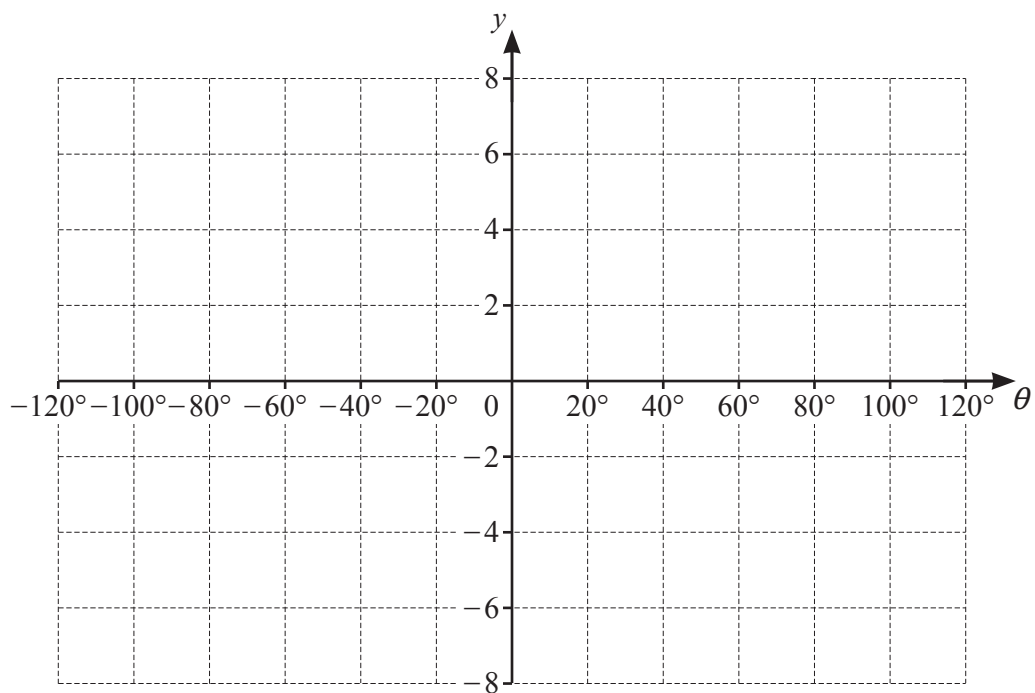
$$\begin{aligned}\frac{a}{\sin A} &= \frac{b}{\sin B} = \frac{c}{\sin C} \\ a^2 &= b^2 + c^2 - 2bc \cos A \\ \Delta &= \frac{1}{2}bc \sin A\end{aligned}$$

1 Given that $y = 2 + 4 \cos 3\theta$, for $-120^\circ \leq \theta \leq 120^\circ$,

(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]

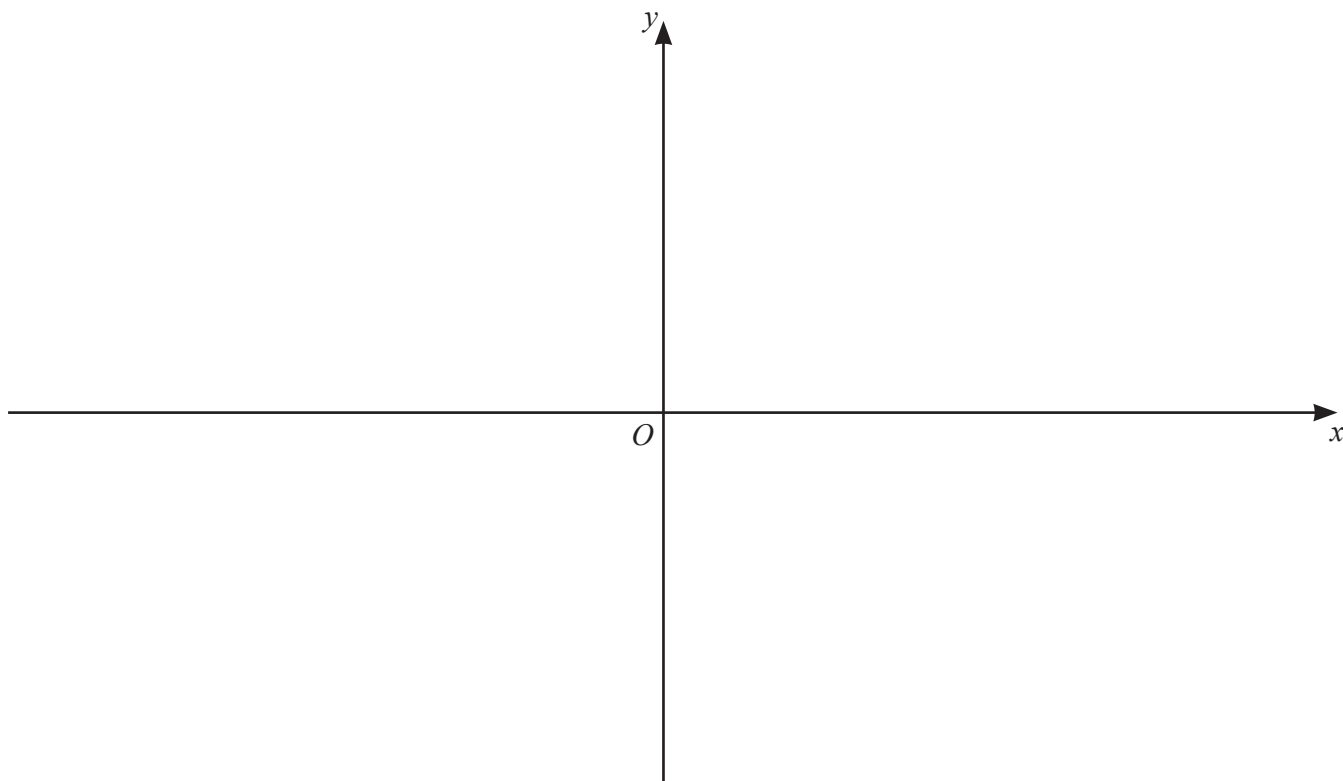
- 3 The curve C has equation $y = \ln(x^3 + 3)$. The normal to C at the point where $x = 1$ meets the line $y = x$ at the point P . Find the exact coordinates of P . [7]

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

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

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

(c) On the axes, sketch the graphs of $y = f(x)$ and $y = f^{-1}(x)$, 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 $g(x) = x^{\frac{3}{2}} + 4$, $x \geq 0$.

(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 $p(x) = 0$.

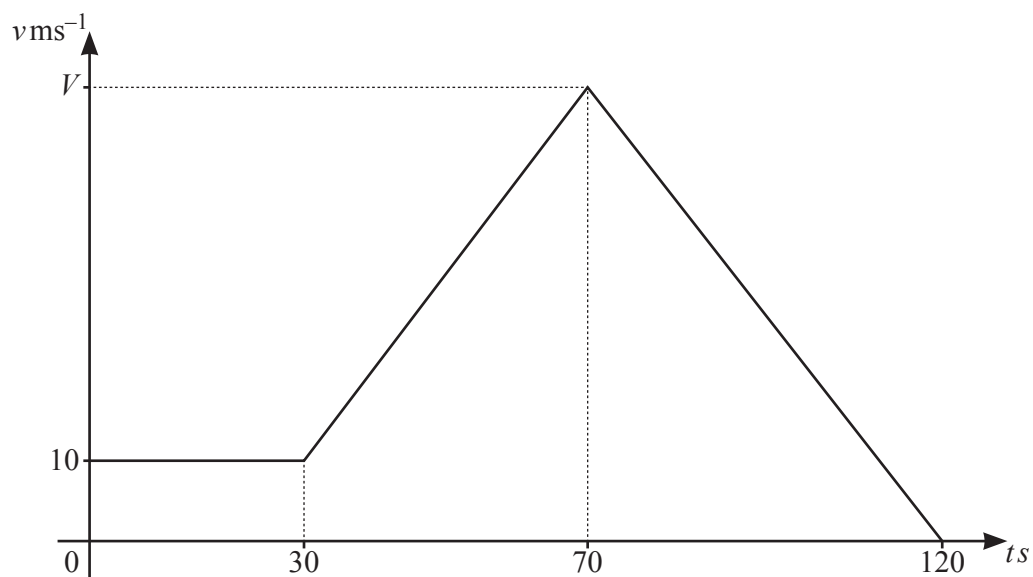
You must show your working. [3]

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

$$5 \operatorname{cosec}^3 2\theta + a \operatorname{cosec}^2 2\theta + 39 \operatorname{cosec} 2\theta + b = 0 \quad \text{for } 0^\circ \leq \theta \leq 360^\circ. \quad [5]$$

- 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 $v = t(t^2 + 5)^{\frac{1}{2}}$.
- (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 $\int_2^4 (5x-2)^{-\frac{2}{3}} dx$, giving your answer in exact form. [4]

(b) Find $\int_0^{\frac{1}{2}} \left(\frac{4}{2x+1} + \frac{8}{(2x+1)^2} \right) dx$, 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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