



## Cambridge IGCSE™

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## 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.

**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  $\triangle ABC$* 

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

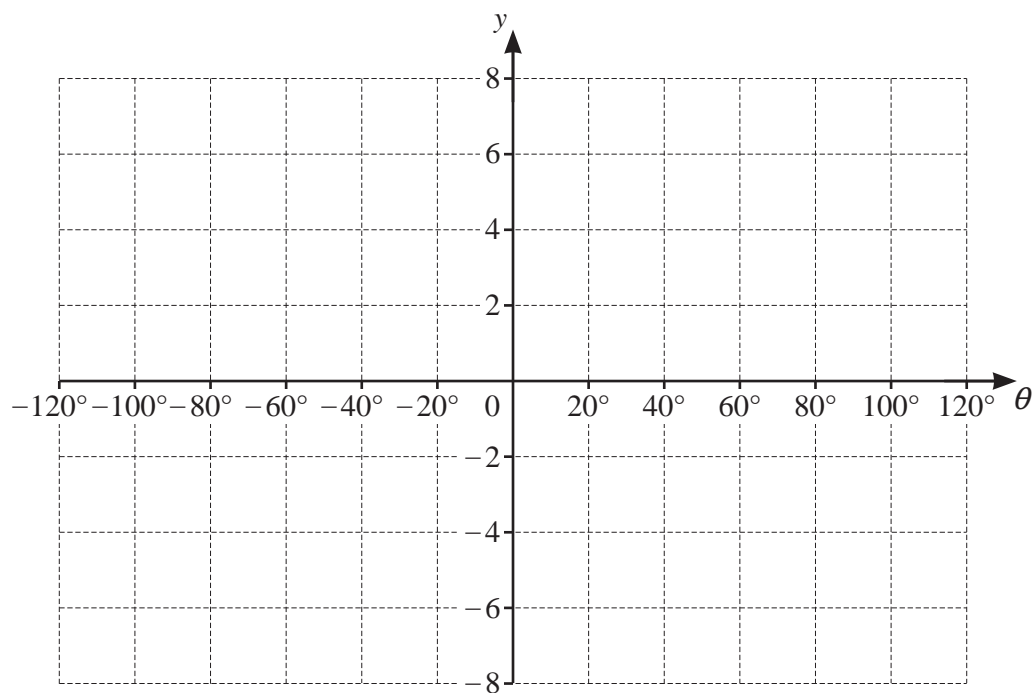
3

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]



**4**

- 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]

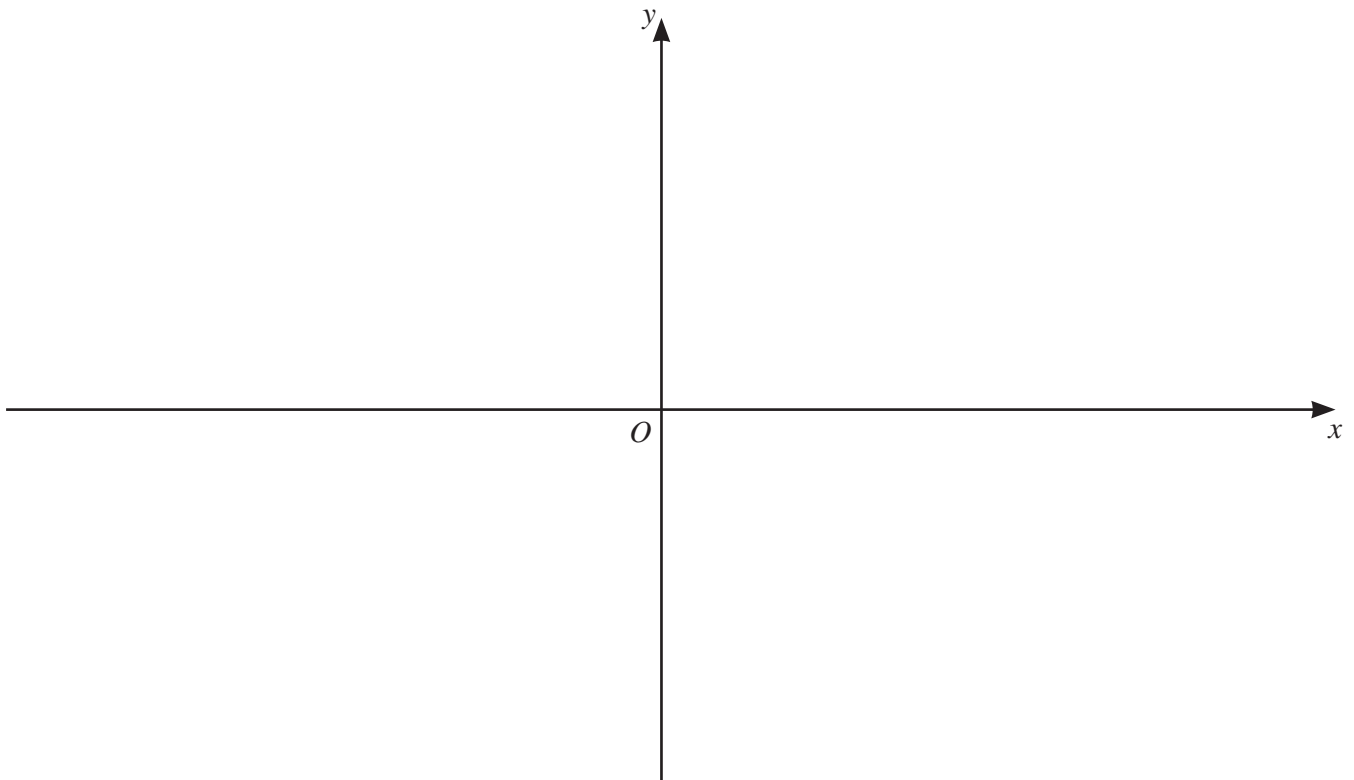
**6**

**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]



7

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]

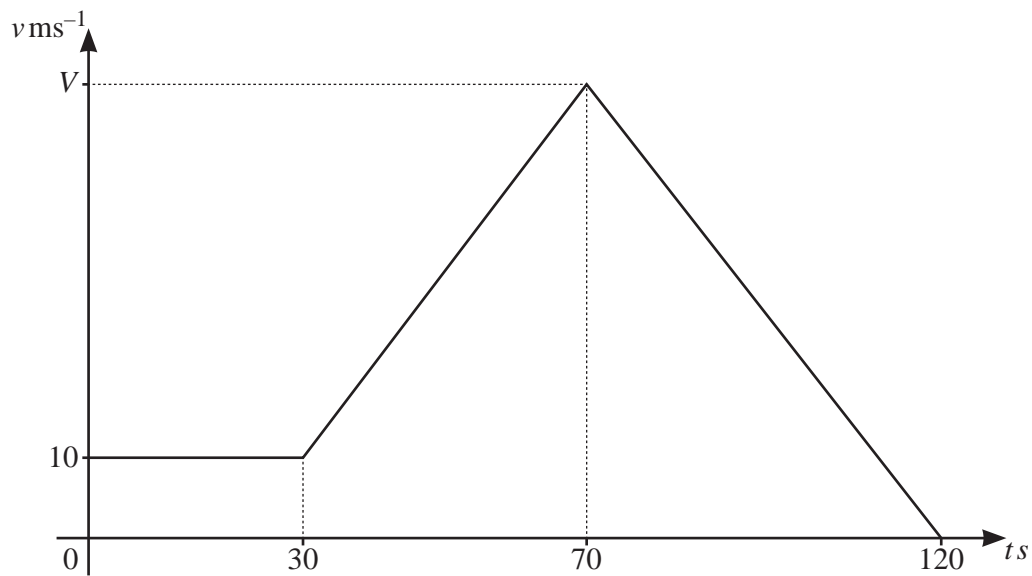


(c) Hence, using your values for  $a$  and  $b$ , solve the equation

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

- 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 2750m in 120s. 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]

## 13

- 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  $\theta$ . [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  $\phi$ , given that the 20th term is  $3^{-18}$ . [1]

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