



# Cambridge IGCSE™

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**ADDITIONAL MATHEMATICS**

**0606/11**

Paper 1

**May/June 2022**

**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  $\triangle ABC$* 

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

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

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

1 Find constants  $a$ ,  $b$  and  $c$  such that  $\frac{\sqrt{pq^{\frac{2}{3}}r^{-3}}}{(pq^{-1})^2 r^{-1}} = p^a q^b r^c$ . [3]

2 A particle moves in a straight line such that its displacement,  $s$  metres, from a fixed point, at time  $t$  seconds,  $t \geq 0$ , is given by  $s = (1 + 3t)^{-\frac{1}{2}}$ .

(a) Find the exact speed of the particle when  $t = 1$ . [3]

(b) Show that the acceleration of the particle will never be zero. [2]

3 A function  $f$  is such that  $f(x) = \ln(2x+1)$ , for  $x > -\frac{1}{2}$ .

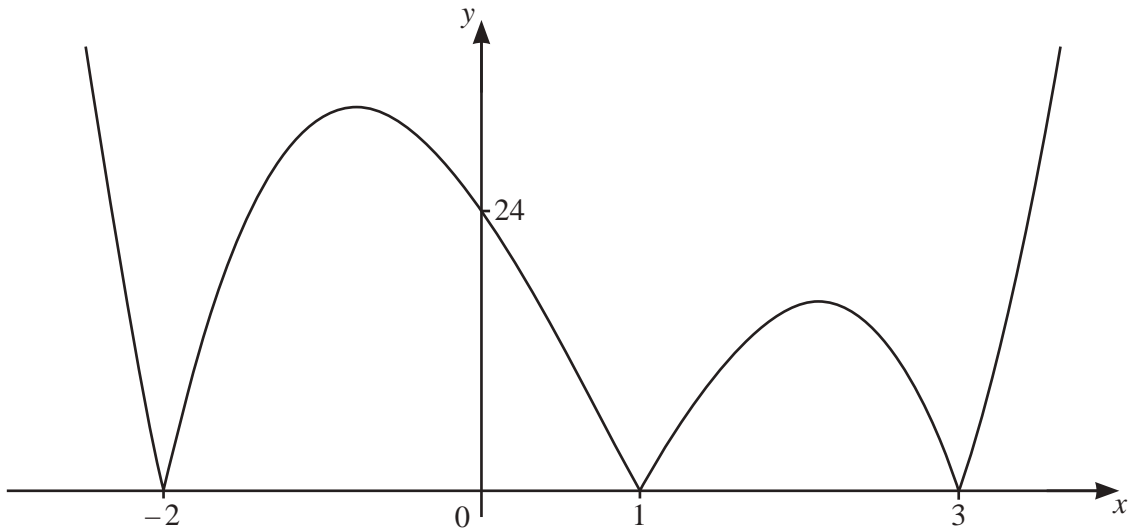
(a) Write down the range of  $f$ . [1]

A function  $g$  is such that  $g(x) = 5x-7$ , for  $x \in \mathbb{R}$ .

(b) Find the exact solution of the equation  $gf(x) = 13$ . [3]

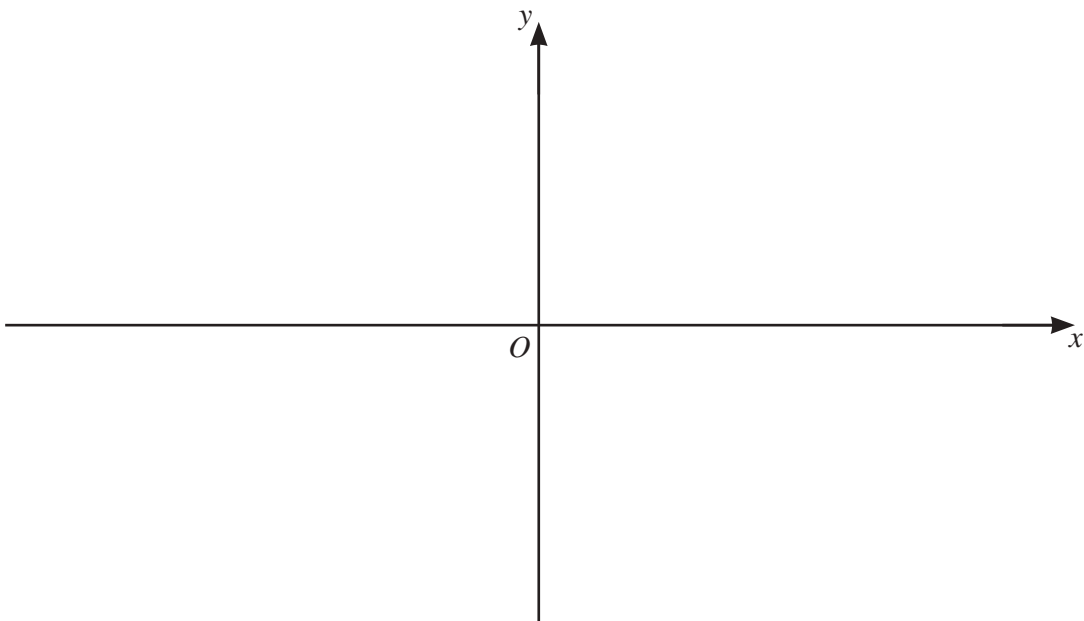
(c) Find the solution of the equation  $f'(x) = g^{-1}(x)$ . [6]

4 (a)



The diagram shows the graph of  $y = |f(x)|$ , where  $f(x)$  is a cubic. Find the possible expressions for  $f(x)$ . [3]

- (b) (i) On the axes below, sketch the graph of  $y = |2x + 1|$  and the graph of  $y = |4(x - 1)|$ , stating the coordinates of the points where the graphs meet the coordinate axes. [3]



- (ii) Find the exact solutions of the equation  $|2x + 1| = |4(x - 1)|$ . [4]

5 (a) Find the vector which is in the opposite direction to  $\begin{pmatrix} 15 \\ -8 \end{pmatrix}$  and has a magnitude of 8.5. [2]

(b) Find the values of  $a$  and  $b$  such that  $5\begin{pmatrix} 3a \\ b \end{pmatrix} + \begin{pmatrix} 2a+1 \\ 2 \end{pmatrix} = 6\begin{pmatrix} b+a \\ 2 \end{pmatrix}$ . [3]

6 (a) Write down the values of  $k$  for which the line  $y = k$  is a tangent to the curve  $y = 4 \sin\left(x + \frac{\pi}{4}\right) + 10$ . [2]



(b) (i) Show that  $\frac{1 + \tan \theta}{1 - \cos \theta} + \frac{1 - \tan \theta}{1 + \cos \theta} = \frac{2(1 + \sin \theta)}{\sin^2 \theta}$ . [4]

(ii) Hence solve the equation  $\frac{1 + \tan \theta}{1 - \cos \theta} + \frac{1 - \tan \theta}{1 + \cos \theta} = 3$ , for  $0^\circ \leq \theta \leq 360^\circ$ . [4]

- 7 (a) The first three terms of an arithmetic progression are  $\lg 3$ ,  $3\lg 3$ ,  $5\lg 3$ . Given that the sum to  $n$  terms of this progression can be written as  $256 \lg 81$ , find the value of  $n$ . [5]

(b) **DO NOT USE A CALCULATOR IN THIS PART OF THE QUESTION.**

The first three terms of a geometric progression are  $\ln 256$ ,  $\ln 16$ ,  $\ln 4$ . Find the sum to infinity of this progression, giving your answer in the form  $p \ln 2$ . [4]

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

- (a) Find the exact coordinates of the points of intersection of the curve  $y = x^2 + 2\sqrt{5}x - 20$  and the line  $y = 3\sqrt{5}x + 10$ . [4]

- (b) It is given that  $\tan \theta = \frac{\sqrt{3}-1}{2+\sqrt{3}}$ , for  $0 < \theta < \frac{\pi}{2}$ . Find  $\operatorname{cosec}^2 \theta$  in the form  $a + b\sqrt{3}$ , where  $a$  and  $b$  are constants. [5]

9 A circle, centre  $O$  and radius  $r$  cm, has a sector  $OAB$  of fixed area  $10\text{cm}^2$ . Angle  $AOB$  is  $\theta$  radians and the perimeter of the sector is  $P$  cm.

(a) Find an expression for  $P$  in terms of  $r$ . [3]

(b) Find the value of  $r$  for which  $P$  has a stationary value. [3]

(c) Determine the nature of this stationary value. [2]

(d) Find the value of  $\theta$  at this stationary value. [1]

- 10** The normal to the curve  $y = \tan\left(3x + \frac{\pi}{2}\right)$  at the point  $P$  with coordinates  $(p, -1)$ , where  $0 < p \leq \frac{\pi}{6}$ , meets the  $x$ -axis at the point  $A$  and the  $y$ -axis at the point  $B$ . Find the exact coordinates of the mid-point of  $AB$ . [10]

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