

# Cambridge International AS & A Level

CANDIDATE  
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## MATHEMATICS

9709/12

Paper 1 Pure Mathematics 1

February/March 2022

**1 hour 50 minutes**

You must answer on the question paper.

You will need: List of formulae (MF19)

## 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.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- 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 75.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

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- 1** A curve with equation  $y = f(x)$  is such that  $f'(x) = 2x^{-\frac{1}{3}} - x^{\frac{1}{3}}$ . It is given that  $f(8) = 5$ .

Find  $f(x)$ .

[4]

[illegible]

- 2** A curve has equation  $y = x^2 + 2cx + 4$  and a straight line has equation  $y = 4x + c$ , where  $c$  is a constant.
- Find the set of values of  $c$  for which the curve and line intersect at two distinct points. [5]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. In the bottom right corner, there is a small, partially visible circular logo with the word "AHEAD" written inside it. The rest of the page is empty.

3 Find the term independent of  $x$  in each of the following expansions.

(a)  $\left(3x + \frac{2}{x^2}\right)^6$  [3]

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(b)  $\left(3x + \frac{2}{x^2}\right)^6 (1 - x^3)$  [3]

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- 4 The first term of a geometric progression and the first term of an arithmetic progression are both equal to  $a$ .

The third term of the geometric progression is equal to the second term of the arithmetic progression.

The fifth term of the geometric progression is equal to the sixth term of the arithmetic progression.

Given that the terms are all positive and not all equal, find the sum of the first twenty terms of the arithmetic progression in terms of  $a$ . [6]

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- 5 (a) Express  $2x^2 - 8x + 14$  in the form  $2[(x - a)^2 + b]$ . [2]

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The functions  $f$  and  $g$  are defined by

$$f(x) = x^2 \quad \text{for } x \in \mathbb{R},$$

$$g(x) = 2x^2 - 8x + 14 \quad \text{for } x \in \mathbb{R}.$$

- (b) Describe fully a sequence of transformations that maps the graph of  $y = f(x)$  onto the graph of  $y = g(x)$ , making clear the order in which the transformations are applied. [4]

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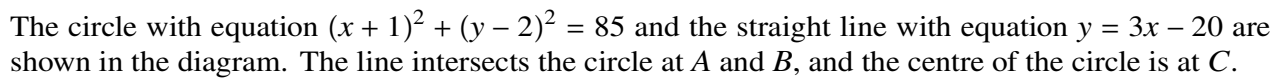
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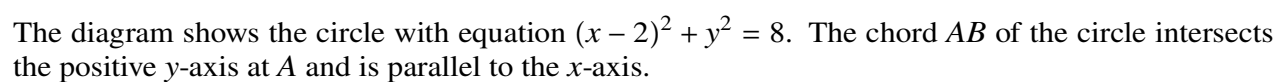
- [illegible]



7 (a) Show that  $\frac{\sin \theta + 2 \cos \theta}{\cos \theta - 2 \sin \theta} - \frac{\sin \theta - 2 \cos \theta}{\cos \theta + 2 \sin \theta} \equiv \frac{4}{5 \cos^2 \theta - 4}$ . [4]

[illegible]

Handwriting practice lines on a white background. The page contains 20 horizontal dotted lines for tracing and writing practice. A small circular logo is visible in the bottom right corner, featuring the text 'AHEAD' and a red and blue design.



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- This image shows a full page of blank handwriting practice paper. It features multiple sets of horizontal lines. Each set consists of a solid top line, a dashed midline, and a solid bottom line, providing a guide for letter height and placement. The paper is otherwise empty, with no text or markings other than the faint circular logo in the bottom right corner.

- (b)** Find the volume of revolution when the shaded segment, bounded by the circle and the chord  $AB$ , is rotated through  $360^\circ$  about the  $x$ -axis. [5]

Handwriting practice paper with horizontal lines and a circular logo in the bottom right corner.

**9** Functions  $f$ ,  $g$  and  $h$  are defined as follows:

$$f : x \mapsto x - 4x^{\frac{1}{2}} + 1 \quad \text{for } x \geq 0,$$

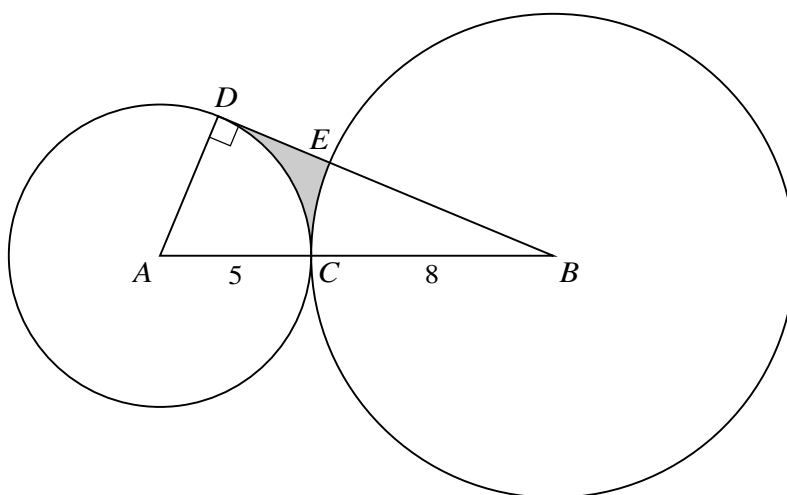
$g : x \mapsto mx^2 + n$  for  $x \geq -2$ , where  $m$  and  $n$  are constants,

$$h : x \mapsto x^{\frac{1}{2}} - 2 \quad \text{for } x \geq 0.$$

- (a) Solve the equation  $f(x) = 0$ , giving your solutions in the form  $x = a + b\sqrt{c}$ , where  $a$ ,  $b$  and  $c$  are integers. [4]

AHEAD

Blank lined paper with horizontal ruling lines and a dashed midline for handwriting practice. The page is designed for students to practice writing letters and words.



The diagram shows a circle with centre  $A$  of radius 5 cm and a circle with centre  $B$  of radius 8 cm. The circles touch at the point  $C$  so that  $ACB$  is a straight line. The tangent at the point  $D$  on the smaller circle intersects the larger circle at  $E$  and passes through  $B$ .

- (a) Find the perimeter of the shaded region.

[5]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. In the bottom right corner, there is a small, partially visible circular logo with the letters "HEA" inside it.

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**(b)** Find the area of the shaded region.

[3]

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- 11** It is given that a curve has equation  $y = k(3x - k)^{-1} + 3x$ , where  $k$  is a constant.

- (a) Find, in terms of  $k$ , the values of  $x$  at which there is a stationary point. [4]

AHEAD

The function  $f$  has a stationary value at  $x = a$  and is defined by

$$f(x) = 4(3x - 4)^{-1} + 3x \quad \text{for } x \geq \frac{3}{2}.$$

- (b) Find the value of  $a$  and determine the nature of the stationary value. [3]

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- (c) The function  $g$  is defined by  $g(x) = -(3x + 1)^{-1} + 3x$  for  $x \geq 0$ .

Determine, making your reasoning clear, whether  $g$  is an increasing function, a decreasing function or neither. [2]

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[illegible]

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