

Cambridge International AS & A Level

CANDIDATE
NAME

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CENTRE
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MATHEMATICS

9709/32

Paper 3 Pure Mathematics 3

October/November 2021

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 Find the value of x for which $3(2^{1-x}) = 7^x$. Give your answer in the form $\frac{\ln a}{\ln b}$, where a and b are integers. [4]

A series of horizontal dotted lines for writing.

AHEAD

- 2** Solve the inequality $|3x - a| > 2|x + 2a|$, where a is a positive constant. [4]

A series of horizontal dotted lines for writing practice.

A circular logo located at the bottom right corner of the page. The word "AHEAD" is written in a bold, sans-serif font, following the curve of the top half of the circle. The background of the circle appears to have a subtle pattern or texture.

- 3 (a)** Given the complex numbers $u = a + ib$ and $w = c + id$, where a, b, c and d are real, prove that $(u + w)^* = u^* + w^*$. [2]

[illegible]


- (b) Solve the equation $(z + 2 + i)^* + (2 + i)z = 0$, giving your answer in the form $x + iy$ where x and y are real. [4]

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. The logo has a blue border and contains the word "AHEAD" in white capital letters. Below the text, there is a red graphic element that appears to be part of a larger design.

4 Express $\frac{4x^2 - 13x + 13}{(2x - 1)(x - 3)}$ in partial fractions.

[5]

A series of horizontal dotted lines for writing.

A circular logo in the bottom right corner of the page. It features a grey arc at the top containing the words "GO AHEAD" in white capital letters. Below the arc is a solid red circle. The entire logo is partially cut off by the edge of the page.

- 5 (a) On a sketch of an Argand diagram, shade the region whose points represent complex numbers z satisfying the inequalities $|z - 3 - 2i| \leq 1$ and $\text{Im } z \geq 2$. [4]

- (b) Find the greatest value of $\arg z$ for points in the shaded region, giving your answer in degrees. [3]

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- 6 (a)** Using the expansions of $\sin(3x + 2x)$ and $\sin(3x - 2x)$, show that

$$\frac{1}{2}(\sin 5x + \sin x) \equiv \sin 3x \cos 2x. \quad [3]$$

[illegible]



[Turn over

and it is given that $y = 1$ when $x = 0$.

Solve the differential equation, obtaining an expression for y in terms of x . [7]

[illegible]

$$\cos^4 \theta + \sin^4 \theta \equiv 1 - \frac{1}{2} \sin^2 2\theta. \quad [3]$$

[illegible]

for $0^\circ < \theta < 180^\circ$.

[4]

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 dot.

9 The equation of a curve is $ye^{2x} - y^2e^x = 2$.

(a) Show that $\frac{dy}{dx} = \frac{2ye^x - y^2}{2y - e^x}$. [4]

A large area of dotted lines for writing.

GO AHEAD



Handwriting practice paper with 20 horizontal dotted lines for writing.

- 10 With respect to the origin O , the position vectors of the points A and B are given by $\overrightarrow{OA} = \begin{pmatrix} 1 \\ 2 \\ -1 \end{pmatrix}$ and $\overrightarrow{OB} = \begin{pmatrix} 0 \\ 3 \\ 1 \end{pmatrix}$.

- (a) Find a vector equation for the line l through A and B . [3]

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- (b) The point C lies on l and is such that $\overrightarrow{AC} = 3\overrightarrow{AB}$.

Find the position vector of C . [2]

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[illegible]

11 The equation of a curve is $y = \sqrt{\tan x}$, for $0 \leq x < \frac{1}{2}\pi$.

- (a) Express $\frac{dy}{dx}$ in terms of $\tan x$, and verify that $\frac{dy}{dx} = 1$ when $x = \frac{1}{4}\pi$. [4]

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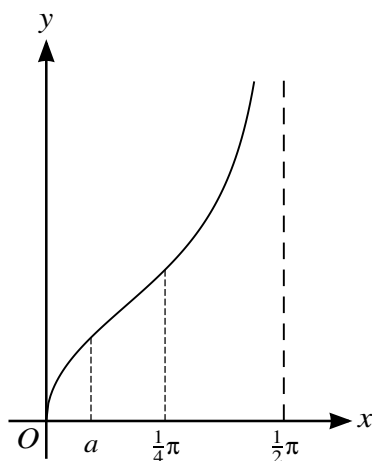
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The value of $\frac{dy}{dx}$ is also 1 at another point on the curve where $x = a$, as shown in the diagram.



- (b) Show that $t^3 + t^2 + 3t - 1 = 0$, where $t = \tan a$. [4]

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(c) Use the iterative formula

$$a_{n+1} = \tan^{-1} \left(\frac{1}{3} (1 - \tan^2 a_n - \tan^3 a_n) \right)$$

to determine a correct to 2 decimal places, giving the result of each iteration to 4 decimal places.
[3]

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[illegible]

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.