

Cambridge International AS & A Level

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MATHEMATICS

9709/32

Paper 3 Pure Mathematics 3

May/June 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** Solve the equation $\ln(e^{2x} + 3) = 2x + \ln 3$, giving your answer correct to 3 decimal places. [4]

AHEAD

2 Solve the equation $3 \cos 2\theta = 3 \cos \theta + 2$, for $0^\circ \leq \theta \leq 360^\circ$.

[5]

[illegible]

- 3** The polynomial $ax^3 + x^2 + bx + 3$ is denoted by $p(x)$. It is given that $p(x)$ is divisible by $(2x - 1)$ and that when $p(x)$ is divided by $(x + 2)$ the remainder is 5.

Find the values of a and b .

[5]

[illegible]

- 4** The equation of a curve is $y = \cos^3 x \sqrt{\sin x}$. It is given that the curve has one stationary point in the interval $0 < x < \frac{1}{2}\pi$.

Find the x -coordinate of this stationary point, giving your answer correct to 3 significant figures. [6]

[illegible]

- 5 (a) By sketching a suitable pair of graphs, show that the equation $\ln x = 3x - x^2$ has one real root. [2]

- (b) Verify by calculation that the root lies between 2 and 2.8. [2]

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- (c) Use the iterative formula $x_{n+1} = \sqrt{3x_n - \ln x_n}$ to determine the root correct to 2 decimal places. Give the result of each iteration to 4 decimal places. [3]

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6 The variables x and y satisfy the differential equation

$$\frac{dy}{dx} = xe^{y-x},$$

and $y = 0$ when $x = 0$.

(a) Solve the differential equation, obtaining an expression for y in terms of x .

[7]

This image shows a blank sheet of white paper with horizontal ruling lines. There are three types of lines: solid top and bottom lines, and a dashed midline. This pattern repeats down the page. In the bottom right corner, there is a small portion of a purple circular logo containing the word "AHEAD" in white capital letters.

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- 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 partial view of a circular graphic element. This element has a dark blue outer ring and a lighter blue inner section where the word "AHEAD" is written in white capital letters. A small red circle is also visible at the very edge of the bottom right corner.

7 The equation of a curve is $x^3 + 3x^2y - y^3 = 3$.

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

[illegible]

AHEAD

8 Let $f(x) = \frac{x^2 + 9x}{(3x - 1)(x^2 + 3)}$.

(a) Express $f(x)$ in partial fractions.

[5]

[illegible]

(b) Hence find $\int_1^3 f(x) \, dx$, giving your answer in a simplified exact form. [5]

[illegible]

9 The lines l and m have vector equations

$$\mathbf{r} = -\mathbf{i} + 3\mathbf{j} + 4\mathbf{k} + \lambda(2\mathbf{i} - \mathbf{j} - \mathbf{k}) \quad \text{and} \quad \mathbf{r} = 5\mathbf{i} + 4\mathbf{j} + 3\mathbf{k} + \mu(a\mathbf{i} + b\mathbf{j} + \mathbf{k})$$

respectively, where a and b are constants.

(a) Given that l and m intersect, show that $2b - a = 4$.

[4]

[illegible]

- (b) Given also that l and m are perpendicular, find the values of a and b . [4]

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- (c) When a and b have these values, find the position vector of the point of intersection of l and m . [2]

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- 10** The complex number $-1 + \sqrt{7}i$ is denoted by u . It is given that u is a root of the equation

$$2x^3 + 3x^2 + 14x + k = 0,$$

where k is a real constant.

- (a)** Find the value of k .

[3]

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- (b)** Find the other two roots of the equation.

[4]

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- (c) On an Argand diagram, sketch the locus of points representing complex numbers z satisfying the equation $|z - u| = 2$. [2]

- (d) Determine the greatest value of $\arg z$ for points on this locus, giving your answer in radians. [2]

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[illegible]

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