



Cambridge International AS & A Level

CANDIDATE
NAME

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MATHEMATICS

9709/31

Paper 3 Pure Mathematics 3

May/June 2026

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. Do **not** use correction fluid or tape.
- 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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- [5]

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- 3** The equation of a curve is $y = \frac{2x^2 + 7x}{3x^2 - 1}$.

Find an equation of the normal to the curve at the point where $x = 1$. Give your answer in the form $ax + by + c = 0$, where a , b and c are integers. [6]

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- 4 The square roots of $-71 - (20\sqrt{3})i$ can be expressed in the Cartesian form $x + iy$, where x and y are real and exact.

By first forming a quartic equation, find the square roots of $-71 - (20\sqrt{3})i$. Give your answer in exact Cartesian form. [5]

[5]





5 (a) Show that $(\cos x + \sin x)(\operatorname{cosec} x - \sec x) \equiv 2 \cot 2x$.

[4]

[illegible]



(b) Hence, solve the equation $(\cos x + \sin x)(\operatorname{cosec} x - \sec x) = 3$ for $0 \leq x \leq \pi$.

[3]

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6 A curve has the equation $y = e^{(x^2+4x)} \cos^2 x$, where $\cos x \neq 0$.

(a) Show that the x -coordinates of the stationary points of this curve satisfy the equation $\tan x = x + 2$.

[3]

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(b) By sketching a suitable pair of graphs, show that the equation $\tan x = x + 2$ has only one root in the interval $-\pi < x < \pi$.

[2]





(c) Show by calculation that this root lies between 1.2 and 1.3.

[2]

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(d) Use the iterative formula $x_{n+1} = \tan^{-1}(x_n + 2)$ to calculate this root correct to 3 decimal places. Give the result of each iteration to 5 decimal places.

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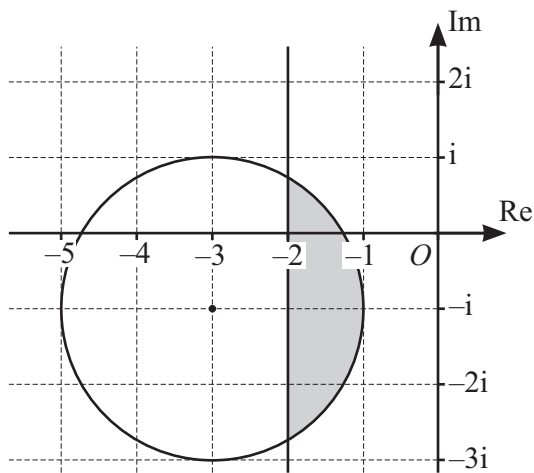
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The shaded region on the Argand diagram shows points representing the complex numbers, z , defined by two inequalities. The shaded region is bounded by the circle and the line parallel to the imaginary axis shown in the diagram and includes its boundaries.

- (a) Find two inequalities in terms of z that define the shaded region. [3]

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- (b) Calculate the greatest value of $|z|$ for points in the shaded region. [3]

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8 Find the exact value of $\int_0^1 3x^2 e^{3x} dx$.

[6]

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- 9 The points A and B have position vectors $\begin{pmatrix} 2 \\ -5 \\ 3 \end{pmatrix}$ and $\begin{pmatrix} -6 \\ 4 \\ 1 \end{pmatrix}$ respectively.

The line t passes through the points A and B .

- (a) Find a vector equation for t .

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The line s has equation $\mathbf{r} = \begin{pmatrix} 1 \\ 3 \\ 4 \end{pmatrix} + \mu \begin{pmatrix} -1 \\ 2 \\ -1 \end{pmatrix}$.

- (b) Determine whether s and t are parallel, intersect or are skew.

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- 10** The polynomial $ax^3 - 11x^2 + bx + 4$, where a and b are constants, is denoted by $p(x)$. It is given that $(x - 2)$ is a factor of $p(x)$, and that when $p'(x)$ is divided by $(x - 2)$ the remainder is 24.

(a) Find the value of a and the value of b .

[5]

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(b) (i) When a and b have these values, factorise $p(x)$ completely.

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(ii) Hence, solve the inequality $p(x) \geq 0$.

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- 11 (a) By differentiating $\frac{\cos 4x}{\sin 4x}$, show that if $y = \cot 4x$, then $\frac{dy}{dx} = -4 \operatorname{cosec}^2 4x$. [3]

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- (b) The variables x and y satisfy the differential equation

$$e^{(3x+2)} \frac{dy}{dx} = \sin^2 4y.$$

It is given that $y = \frac{1}{16}\pi$ when $x = -\frac{2}{3}$.

Solve the differential equation, and find the value of y in the range $-\frac{1}{8}\pi \leq y \leq 0$ when $x = 1$. [6]

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[illegible]



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