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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

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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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1 Solve the inequality $3|x+4| > |2x-1|$. [4]

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2 The variables x and y satisfy the equation $y^3 = Ae^{kx}$, where A and k are constants. The graph of $\ln y$ against x is a straight line passing through the points $(-1.32, 5.09)$ and $(0.25, 1.16)$.

Find the values of A and k. [5]

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

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

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

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5 **(a)** Show that $(\cos x + \sin x)(\operatorname{cosec} x - \sec x) \equiv 2\cot 2x$. [4]

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

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(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. [3]

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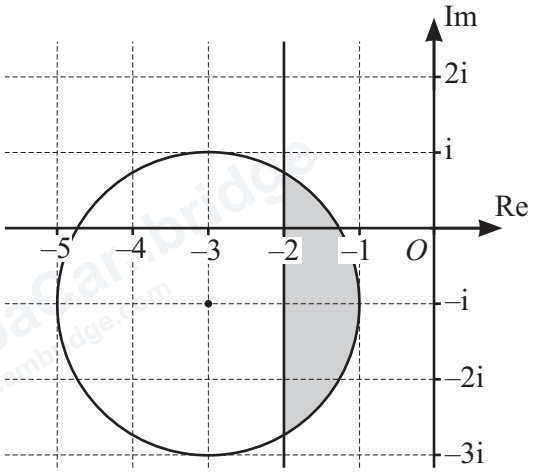

The shaded region on the Argand diagram shows points representing the complex numbers, z, defined by two inequalities. The shaded region is bounded by the circle and the line parallel to the imaginary axis shown in the diagram and includes its boundaries.

(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. [2]

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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. [5]

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10 The polynomial $ax^3 - 11x^2 + bx + 4$, where a and b are constants, is denoted by $\mathrm{p}(x)$. It is given that $(x - 2)$ is a factor of $\mathrm{p}(x)$, and that when $\mathrm{p}'(x)$ 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. [3]

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(ii) Hence, solve the inequality $p(x) \geqslant 0$. [2]

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

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

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

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 $-\frac{1}{8}\pi \leqslant y \leqslant 0$ when $x = 1$. [6]

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