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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 5 3 5 8 2 4 7 1 7 1 *

MATHEMATICS **9709/33**

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 equation $\ln 5 + \ln(3x-2) = 2\ln(x-4)$. Give your answer in a simplified exact form. [4]

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2 Find the set of values of x satisfying the inequality $|3^{2x-1} - 4| > 2$. Give your answers correct to 3 significant figures. [4]

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3 On an Argand diagram, shade the region which represents the complex numbers, z, satisfying the inequalities $|z-2+\mathrm{i}| \leqslant 3$ and $|z| \geqslant |z-2+2\mathrm{i}|$. [5]

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4 Solve the equation $\cos(2\theta - 45°) + \sin(2\theta - 45°) + 1 = 0$ for $-180° \leqslant \theta \leqslant 180°$. [6]

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5 **(a)** The parametric equations of a curve are

$$x = \tan 2t, \qquad y = \frac{1}{\sin 2t}.$$

Show that $\frac{\mathrm{d}y}{\mathrm{d}x}$ can be written as $\frac{A\cos 2t}{\tan^2 2t}$, where A is a constant to be found. [5]

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(b) Find an exact equation of the tangent to the curve at the point where $t = \frac{1}{8}\pi$. [4]

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6 Use the substitution $u = \sqrt{x}$ to find the exact value of $\int_{\frac{1}{16}\pi^2}^{\frac{1}{4}\pi^2} \frac{\cos\left(3\sqrt{x}\right)}{\sqrt{x}}\,\mathrm{d}x$. [6]

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7 The square roots of $3-(20\sqrt{7})\mathrm{i}$ 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 $3-(20\sqrt{7})\mathrm{i}$. Give your answer in exact Cartesian form. [5]

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8 **(a)** By sketching a suitable pair of graphs, show that the equation $x^3 = 4 - 2x$ has exactly one real root. [1]

(b) Show that, if a sequence of real values given by the iterative formula

$$x_{n+1} = \frac{3x_n^3 + 4}{4x_n^2 + 2}$$

converges, then it converges to the root of the equation in **8(a)**. [2]

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(c) Show by calculation that this root lies between 1 and 2. [2]

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(d) Use the iterative formula given in **8(b)** to calculate this root correct to 2 decimal places. Give the result of each iteration to 5 decimal places. [3]

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9 Let $f(x) = \dfrac{36-4x-3x^2}{(3x+1)(x^2+4)}$.

(a) Express $f(x)$ in partial fractions. [5]

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(b) Hence, obtain the expansion of f(x) in ascending powers of x, up to and including the term in x^3. [4]

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(c) State the set of values of x for which the expansion is valid. [1]

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10 The variables x and y satisfy the differential equation

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

for $y > -3$. It is given that $y = -2$ when $x = 0$.

Solve the differential equation and obtain an expression for y in terms of x. [8]

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11 The points A and B have position vectors $\begin{pmatrix} 4 \\ -1 \\ 2 \end{pmatrix}$ and $\begin{pmatrix} -1 \\ -3 \\ 5 \end{pmatrix}$ 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 $\mathbf{r} = \begin{pmatrix} 2 \\ 1 \\ 5 \end{pmatrix} + \mu \begin{pmatrix} -3 \\ -4 \\ 5 \end{pmatrix}$.

(b) Find the acute angle between s and t. [3]

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(c) Find the length of the perpendicular from A to s. [5]

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