



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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9709/32

February/March 2024

1 hour 50 minutes

You will need: List of formulae (MF19)

- 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.

- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [].

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[Turn over

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- 1 Find the quotient and remainder when $x^4 - 3x^3 + 9x^2 - 12x + 27$ is divided by $x^2 + 5$. [3]

This image shows a full page of white paper with horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

- 2 (a)** Find the coefficient of x^2 in the expansion of $(2x-5)\sqrt{4-x}$. [4]

This image shows a full page of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for handwriting practice or general writing. There are no margins, text, or other markings on the page.

- (b)** State the set of values of x for which the expansion in part **(a)** is valid. [1]

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3 It is given that $z = -\sqrt{3} + i$.

(a) Express z^2 in the form $re^{i\theta}$, where $r > 0$ and $-\pi < \theta \leq \pi$. [3]

[illegible]

(b) The complex number ω is such that $z^2\omega$ is real and $\left|\frac{z^2}{\omega}\right| = 12$.

Find the two possible values of ω , giving your answers in the form $Re^{i\alpha}$, where $R > 0$ and $-\pi < \alpha \leq \pi$. [3]

This image shows a full page of white paper with horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

4 The positive numbers p and q are such that

$$\ln\left(\frac{p}{q}\right) = a \quad \text{and} \quad \ln(q^2 p) = b.$$

Express $\ln(p^7q)$ in terms of a and b .

[4]

[illegible]

- 5 (a)** On a sketch of an Argand diagram, shade the region whose points represent complex numbers z satisfying the inequalities $|z - 4 - 2i| \leq 3$ and $|z| \geq |10 - z|$. [4]

- (b) Find the greatest value of $\arg z$ for points in this region. [2]

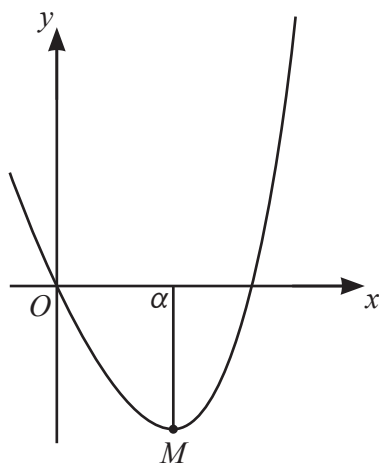
[illegible]

6 The equation of a curve is $2y^2 + 3xy + x = x^2$.

(a) Show that $\frac{dy}{dx} = \frac{2x-3y-1}{4y+3x}$. [4]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dashed lines, providing a guide for letter height and placement. The lines are evenly spaced across the entire page, leaving ample room for writing practice. There is no text or other markings on the page.

(b) Hence show that the curve does **not** have a tangent that is parallel to the x -axis. [3]



(a) Show that α satisfies the equation $\alpha = \frac{1}{2} \ln\left(\frac{5}{1+2\alpha}\right)$. [3]

This image shows a full page of a document template designed for handwritten notes or essays. It features approximately 20 evenly spaced, horizontal grey lines across the entire width of the page. The lines are thin and light, providing a guide for writing without being distracting. There are no margins, headers, footers, or other markings present on the page.

This image shows a blank sheet of white paper with ten horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and extend across the width of the page. There is no handwriting or other markings on the paper.

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- This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

- 8 (a)** Express $3 \sin x + 2\sqrt{2} \cos\left(x + \frac{1}{4}\pi\right)$ in the form $R \sin(x + \alpha)$, where $R > 0$ and $0 < \alpha < \frac{1}{2}\pi$. State the exact value of R and give α correct to 3 decimal places. [4]

[illegible]

for $-4\pi < \theta < 4\pi$.

[5]

[illegible]

- 9 Relative to the origin O , the position vectors of the points A , B and C are given by

$$\overrightarrow{OA} = 5\mathbf{i} - 2\mathbf{j} + \mathbf{k}, \quad \overrightarrow{OB} = 8\mathbf{i} + 2\mathbf{j} - 6\mathbf{k} \quad \text{and} \quad \overrightarrow{OC} = 3\mathbf{i} + 4\mathbf{j} - 7\mathbf{k}.$$

- (a) Show that $OABC$ is a rectangle.

[4]

[illegible]

[illegible]

10 Let $f(x) = \frac{36a^2}{(2a+x)(2a-x)(5a-2x)}$, where a is a positive constant.

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

[5]

[illegible]

- (b) Hence find the exact value of $\int_{-a}^a f(x)dx$, giving your answer in the form $p \ln q + r \ln s$ where p and r are integers and q and s are prime numbers. [5]

[illegible]

- 11** The variables y and θ satisfy the differential equation

$$(1+y)(1+\cos 2\theta)\frac{dy}{d\theta} = e^{3y}.$$

It is given that $y = 0$ when $\theta = \frac{1}{4}\pi$.

Solve the differential equation and find the exact value of $\tan \theta$ when $y = 1$. [9]

This image shows a single page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

[illegible]

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