



CANDIDATE
NAME

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 [].

This document has **20** pages. Any blank pages are indicated.

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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]

[illegible]

- 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 a handwriting practice worksheet. It consists of multiple sets of three horizontal dashed lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

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

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]

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- (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]

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- 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]

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- 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]

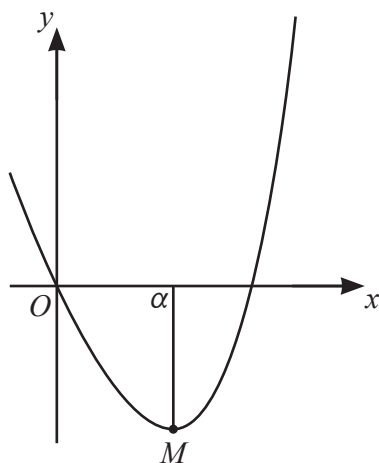
6 The equation of a curve is $2y^2 + 3xy + x = x^2$.

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

[illegible]

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

[illegible]



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

[illegible]

- (b) Verify by calculation that α lies between 0.4 and 0.5 .

[2]

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- (c) Use an iterative formula based on the equation in part (a) to determine α correct to 2 decimal places. Give the result of each iteration to 4 decimal places.

[3]

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- 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]

- 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]

[Turn over

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]

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[illegible]

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