



CANDIDATE
NAME

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CENTRE
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CANDIDATE
NUMBER

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9709/23

October/November 2021

1 hour 15 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 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Any blank pages are indicated.

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- 1** Find the exact value of $\int_{-1}^2 (4e^{2x} - 2e^{-x}) \, dx$.

[4]

[illegible]

- 2 (a) Sketch, on the same diagram, the graphs of $y = 3x$ and $y = |x - 3|$. [2]

- (b) Find the coordinates of the point where the two graphs intersect. [3]

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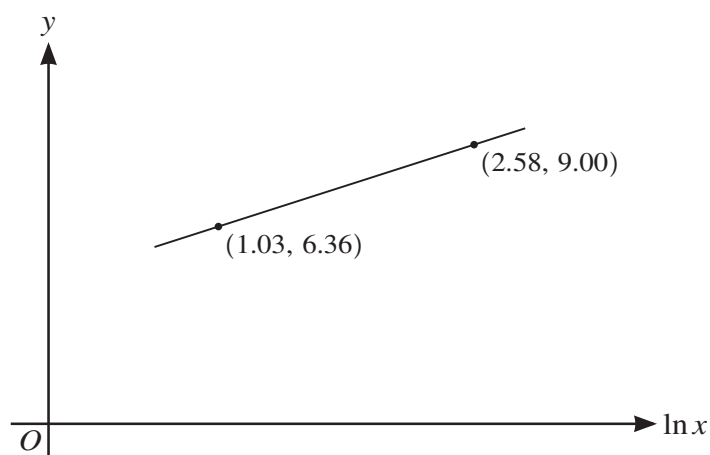
- (c) Deduce the solution of the inequality $3x < |x - 3|$. [1]

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The variables x and y satisfy the equation $a^y = kx$, where a and k are constants. The graph of y against $\ln x$ is a straight line passing through the points $(1.03, 6.36)$ and $(2.58, 9.00)$, as shown in the diagram.

Find the values of a and k , giving each value correct to 2 significant figures. [5]

[illegible]

- 4** The curve with equation $y = xe^{2x} + 5e^{-x}$ has a minimum point M .

- (a) Show that the x -coordinate of M satisfies the equation $x = \frac{1}{3} \ln 5 - \frac{1}{3} \ln(1 + 2x)$. [5]

[illegible]

- (b) Use an iterative formula, based on the equation in part (a), to find the x -coordinate of M correct to 3 significant figures. Use an initial value of 0.35 and give the result of each iteration to 5 significant figures. [3]

[illegible]



The curve crosses the y -axis at the point A and the x -axis at the point B .

- [illegible]

(b) Find the gradient of the curve at A .

[2]

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(c) Find the gradient of the curve at B .

[2]

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- 6 The polynomials $f(x)$ and $g(x)$ are defined by

$$f(x) = 4x^3 + ax^2 + 8x + 15 \quad \text{and} \quad g(x) = x^2 + bx + 18,$$

where a and b are constants.

- (a) Given that $(x + 3)$ is a factor of $f(x)$, find the value of a . [2]

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- (b) Given that the remainder is 40 when $g(x)$ is divided by $(x - 2)$, find the value of b . [2]

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- (c) When a and b have these values, factorise $f(x) - g(x)$ completely. [3]

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- (d) Hence solve the equation $f(\operatorname{cosec} \theta) - g(\operatorname{cosec} \theta) = 0$ for $0 < \theta < 2\pi$. [3]

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- 7 (a) By first expanding $\cos(2\theta + \theta)$, show that $\cos 3\theta \equiv 4\cos^3 \theta - 3\cos \theta$. [3]

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- (b) Find the exact value of $2\cos^3\left(\frac{5}{18}\pi\right) - \frac{3}{2}\cos\left(\frac{5}{18}\pi\right)$. [2]

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(c) Find $\int (12 \cos^3 x - 4 \cos^3 3x) dx$.

[4]

[illegible]

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.

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