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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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7359878114

MATHEMATICS **9709/23**

Paper 2 Pure Mathematics 2 **October/November 2021**

1 hour 15 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 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.

INFORMATION

- 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 $\int_{-1}^{2} \left(4e^{2x} - 2e^{-x}\right) dx$. [4]

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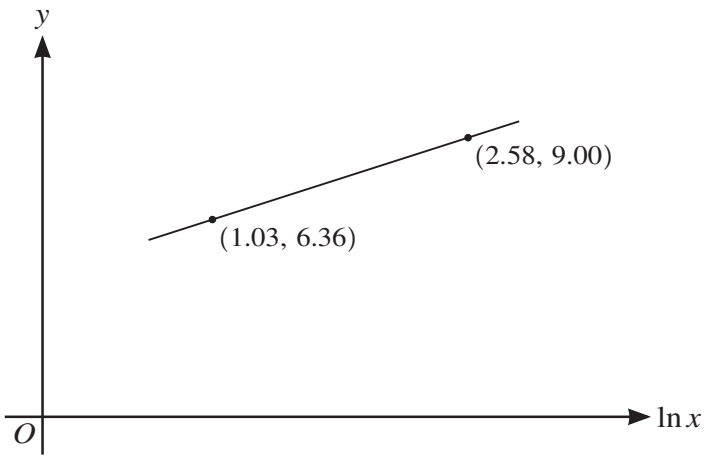
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The variables x and y satisfy the equation $a^y = kx$, where a and k are constants. The graph of y against $\ln x$ is a straight line passing through the points (1.03, 6.36) and (2.58, 9.00), as shown in the diagram.

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

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

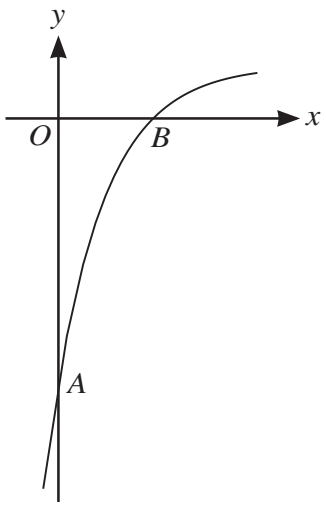
(a) Show that the x-coordinate of M satisfies the equation $x = \frac{1}{3}\ln 5 - \frac{1}{3}\ln(1 + 2x)$. [5]

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(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]

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The diagram shows the curve with parametric equations

$$x = \ln(2t + 3), \qquad y = \frac{2t - 3}{2t + 3}.$$

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

(a) Show that $\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{6}{2t + 3}$. [4]

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(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

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

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 $f(\text{cosec } \theta) - g(\text{cosec } \theta) = 0$ 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]

(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 $\int (12\cos^3 x - 4\cos^3 3x)\,\mathrm{d}x$. [4]

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Additional Page

If you use the following lined page to complete the answer(s) to any question(s), the question number(s) must be clearly shown.

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