



Cambridge International AS & A Level

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MATHEMATICS

9709/22

Paper 2 Pure Mathematics 2

October/November 2023

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.

1 When the polynomial

$$ax^3 + 4ax^2 - 7x - 5$$

is divided by $(x + 2)$, the remainder is 33.

Find the value of the constant a .

[2]

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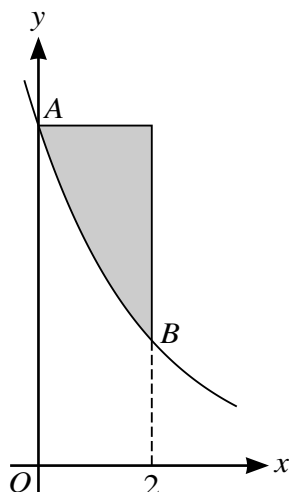
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The diagram shows the curve with equation $y = 6e^{-\frac{1}{2}x}$. The points on the curve with x -coordinates 0 and 2 are denoted by A and B respectively. The shaded region is enclosed by the curve, the line through A parallel to the x -axis and the line through B parallel to the y -axis.

(a) Find the exact gradient of the curve at B . [2]

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- 4 (a) Sketch, on the same diagram, the graphs of $y = |3 - x|$ and $y = 9 - 2x$. [2]

- (b) Solve the inequality $|3 - x| > 9 - 2x$. [3]

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- (c) Use logarithms to solve the inequality $2^{3x-10} < 500$. Give your answer in the form $x < a$, where the value of a is given correct to 3 significant figures. [3]

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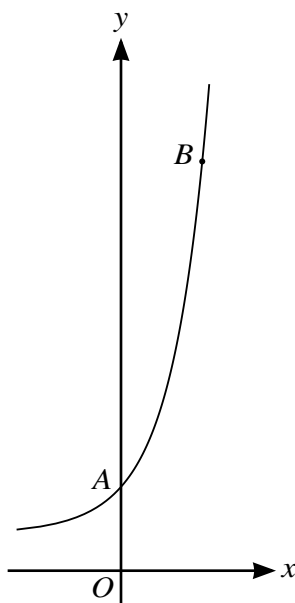
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- (d) List the integers that satisfy both of the inequalities $|3 - x| > 9 - 2x$ and $2^{3x-10} < 500$. [1]

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The diagram shows the curve with parametric equations

$$x = 3 \ln(2t - 3), \quad y = 4t \ln t.$$

The curve crosses the y-axis at the point A . At the point B , the gradient of the curve is 12.

(a) Find the exact gradient of the curve at A . [5]

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(b) Show that the value of the parameter t at B satisfies the equation

$$t = \frac{9}{1 + \ln t} + \frac{3}{2}. \quad [2]$$

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(c) Use an iterative formula, based on the equation in (b), to find the value of t at B , giving your answer correct to 3 significant figures. Use an initial value of 5 and give the result of each iteration to 5 significant figures. [3]

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7 (a) Prove that $\sin 2x(\cot x + 3 \tan x) \equiv 4 - 2 \cos 2x$. [4]

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(b) Hence find the exact value of $\cot \frac{1}{12}\pi + 3 \tan \frac{1}{12}\pi$. [2]

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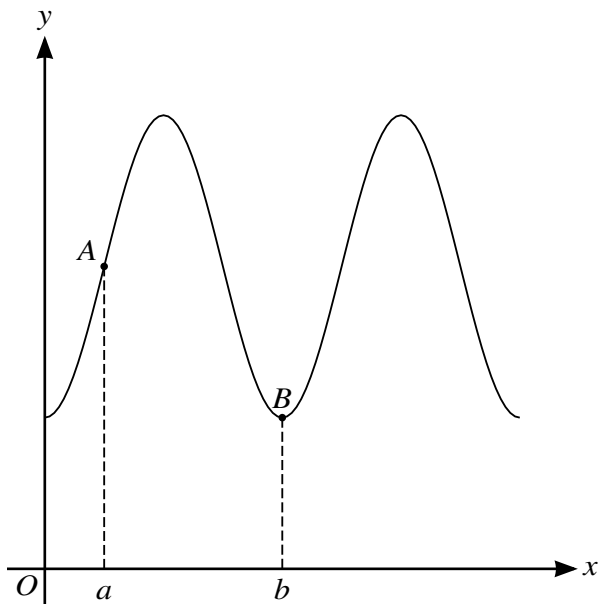
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(c)



The diagram shows the curve with equation $y = 4 - 2 \cos 2x$, for $0 < x < 2\pi$. At the point A , the gradient of the curve is 4. The point B is a minimum point. The x -coordinates of A and B are a and b respectively.

Show that $\int_a^b (4 - 2 \cos 2x) \, dx = 3\pi + 1$. [5]

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