



# Cambridge International AS & A Level

CANDIDATE  
NAME

CENTRE  
NUMBER

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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

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

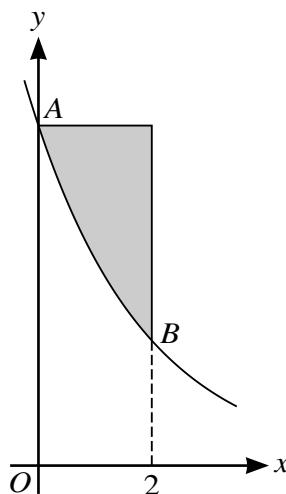
is divided by  $(x + 2)$ , the remainder is 33.

Find the value of the constant  $a$ .

[2]

2 Solve the equation  $\sec \theta \cos(\theta - 60^\circ) = 4$  for  $-180^\circ < \theta < 180^\circ$ . [5]

3



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]

(b) Find the exact area of the shaded region. [3]



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

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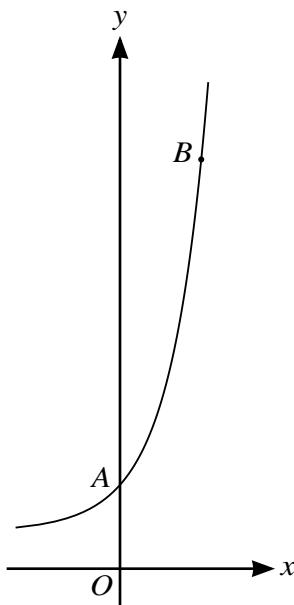
5 (a) Find the quotient when  $6x^3 - 5x^2 - 24x - 4$  is divided by  $(2x + 1)$ , and show that the remainder is 6. [3]

(b) Hence find

$$\int_2^7 \frac{6x^3 - 5x^2 - 24x - 4}{2x + 1} dx,$$

giving your answer in the form  $a + \ln b$ , where  $a$  and  $b$  are integers.

[5]



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]

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

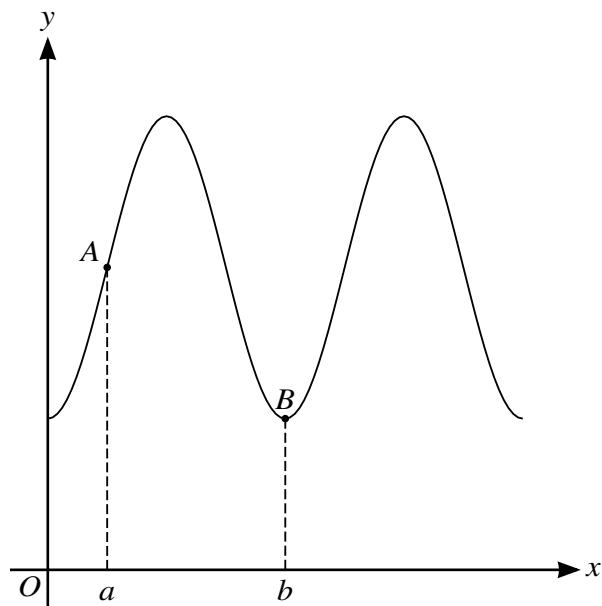
$$t = \frac{9}{1 + \ln t} + \frac{3}{2}. \quad [2]$$

(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]

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

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

(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]

## **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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