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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

5120588436

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.

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1 When the polynomial

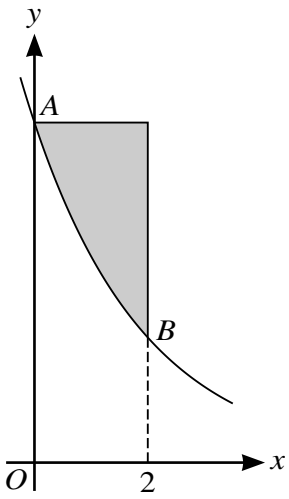
$$ax^3 + 4ax^2 - 7x - 5$$

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

Find the value of the constant a. [2]

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

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

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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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(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]

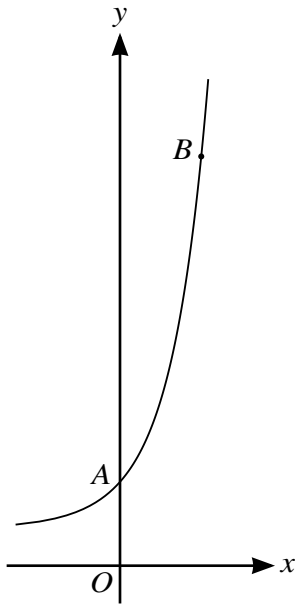
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(b) Hence find

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

giving your answer in the form $a + \ln b$, where a and b are integers. [5]

6



The diagram shows the curve with parametric equations

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

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

$$t = \frac{9}{1 + \ln t} + \frac{3}{2}.$$ [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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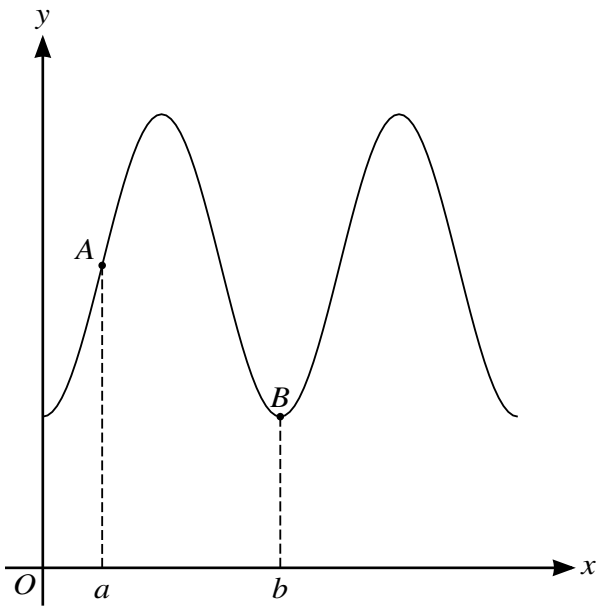
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7 **(a)** Prove that $\sin 2x(\cot x + 3\tan x) \equiv 4 - 2\cos 2x$. [4]

(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 $\int_a^b (4 - 2\cos 2x)\,\mathrm{d}x = 3\pi + 1$. [5]

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Additional Page

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