Cambridge International AS & A Level

CANDIDATE
NAME

CENTRE
NUMBER

CANDIDATE
NUMBER

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 $\sec\theta\cos(\theta - 60°) = 4$ for $-180° < \theta < 180°$. [5]
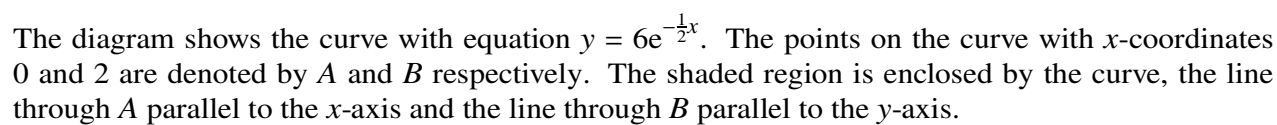
3

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]

....

....

....

....

....

....

....

....

....

....

....

....

....

....

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

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

6

BLANK PAGE

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]

....

....

....

....

....

(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]

....

....

....

....

....

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

....

....

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]

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

6

The diagram shows the curve with parametric equations

$$x = 3\ln(2t - 3), \qquad y = 4t\ln t.$$
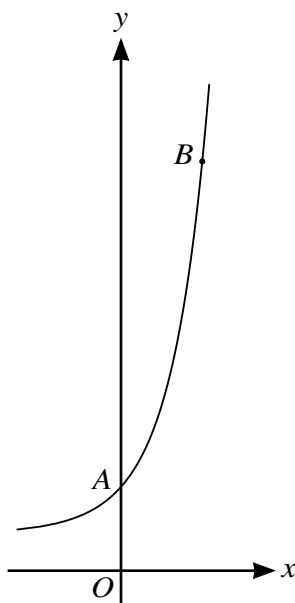
The curve crosses the y-axis at the point A. At the point B, the gradient of the curve is 12.

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

....

....

....

....

....

....

....

....

....

....

....

....

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

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

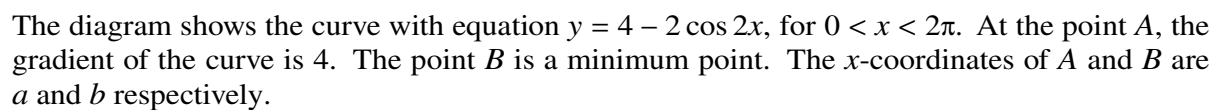..

....

....

....

....

....

....

(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 $\displaystyle\int_{a}^{b} (4 - 2\cos 2x)\,\mathrm{d}x = 3\pi + 1$. [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.

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

BLANK PAGE

BLANK PAGE