Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2702778238

MATHEMATICS **9709/22**

Paper 2 Pure Mathematics 2 **February/March 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 **(a)** Sketch, on the same diagram, the graphs of $y = |3x - 5|$ and $y = x + 2$. [2]

(b) Solve the equation $|3x - 5| = x + 2$. [3]

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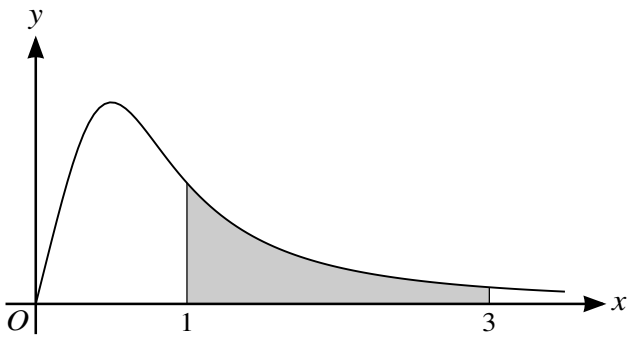
2 Solve the equation $\sec^2\theta \cot\theta = 8$ for $0 < \theta < \pi$. [5]

3 The parametric equations of a curve are

$$x = e^{2t} \cos 4t, \qquad y = 3 \sin 2t.$$

Find the gradient of the curve at the point for which $t = 0$. [5]

4



The diagram shows part of the curve with equation $y = \dfrac{5x}{4x^3 + 1}$. The shaded region is bounded by the curve and the lines $x = 1$, $x = 3$ and $y = 0$.

(a) Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ and hence find the x-coordinate of the maximum point. [4]

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(b) Use the trapezium rule with two intervals to find an approximation to the area of the shaded region. Give your answer correct to 2 significant figures. [3]

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(c) State, with a reason, whether your answer to part **(b)** is an over-estimate or under-estimate of the exact area of the shaded region. [1]

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5 **(a)** Given that $2\ln(x+1) + \ln x = \ln(x+9)$, show that $x = \sqrt{\dfrac{9}{x+2}}$. [3]

(b) It is given that the equation $x = \sqrt{\dfrac{9}{x+2}}$ has a single root.

Show by calculation that this root lies between 1.5 and 2.0. [2]

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(c) Use an iterative formula, based on the equation in part **(b)**, to find the root correct to 3 significant figures. Give the result of each iteration to 5 significant figures. [3]

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6 The polynomial $\mathrm{p}(x)$ is defined by

$$\mathrm{p}(x) = x^3 + ax + b,$$

where a and b are constants. It is given that $(x + 2)$ is a factor of $\mathrm{p}(x)$ and that the remainder is 5 when $\mathrm{p}(x)$ is divided by $(x - 3)$.

(a) Find the values of a and b. [5]

(b) Hence find the exact root of the equation $p\left(e^{2y}\right) = 0$. [5]

7 **(a)** Express $5\sqrt{3}\cos x + 5\sin x$ in the form $R\cos(x - \alpha)$, where $R > 0$ and $0 < \alpha < \frac{1}{2}\pi$. [3]

(b) As x varies, find the least possible value of

$$4 + 5\sqrt{3}\cos x + 5\sin x,$$

and determine the corresponding value of x where $-\pi < x < \pi$. [3]

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(c) Find $\int \frac{1}{(5\sqrt{3}\cos 3\theta + 5\sin 3\theta)^2}\,\mathrm{d}\theta$. [3]

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Additional Page

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