

Cambridge International AS & A Level

CANDIDATE
NAME

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CENTRE
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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]

[illegible]

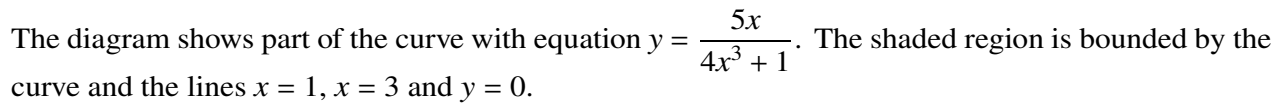
3 The parametric equations of a curve are

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

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

[5]

[illegible]



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- This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

- (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]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

- (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]

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

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

- (b) It is given that the equation $x = \sqrt{\frac{9}{x+2}}$ 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 $p(x)$ is defined by

$$p(x) = x^3 + ax + b,$$

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

- (a) Find the values of a and b .

[5]

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(b) Hence find the exact root of the equation $p(e^{2y}) = 0$.

[5]

This image shows a full page of a worksheet designed for handwriting practice. It features approximately 20 evenly spaced horizontal dotted lines across the entire width of the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

- 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]

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

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