



Cambridge International AS & A Level

| CANDIDATE NAME | | | | | |
|-------------------|--|--|---------------------|--|--|
| CENTRE NUMBER | | | CANDIDATE NUMBER | | |

MATHEMATICS

9709/23 May/June 2024

1 hour 15 minutes

Paper 2 Pure Mathematics 2

You will need: List of formulae (MF19)

You must answer on the question paper.

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
- 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.

| | * 0019655440902 * |
|---|--|
| | |
| 1 | Solve the inequality $ 5x+7 > 2x-3 $ |

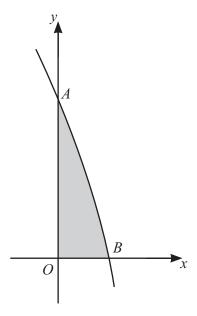
| | .,, | |
|------|-----|--|
| | | |
| | .,, | |
| | .,, | |

| Solve the inequality $ 5x+7 > 2x-3 $. | [4] |
|--|-----|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

© UCLES 2024

| • | 19655440903 * | |
|---|---------------|--|
| | | |

| Use logarithms to solve the equation $6^{2x-1} = 5e^{3x+2}$. Give your answer correct to 4 significant figures. [4] |
|--|
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |



The diagram shows the curve with equation $y = 8e^{-x} - e^{2x}$. The curve crosses the y-axis at the point A and the x-axis at the point B. The shaded region is bounded by the curve and the two axes.

|) | Find the gradient of the curve at A. | [3] |
|---|--------------------------------------|-------|
| | | ••••• |
| | | ••••• |
| | | ••••• |
| | | ••••• |
| | | ••••• |
| | | |
| | | •••• |
| | | |
| | | |
| | | |
| | | |
| | | ••••• |
| | | ••••• |
| | | ••••• |
| | | |

* 0019655440905 * **(b)** Show that the x-coordinate of B is $\ln 2$ and hence find the area of the shaded region.

| Show that the x-coordinate of B is $\ln 2$ and hence find the area of the shaded region. | [5] |
|--|------|
| | •••• |
| | •••• |
| | •••• |
| | |
| | |
| | |
| | •••• |
| | •••• |
| | •••• |
| | •••• |
| | •••• |
| | •••• |
| | •••• |
| | •••• |
| | |
| | |
| | •••• |
| | •••• |
| | •••• |
| | •••• |
| | •••• |
| | •••• |
| | •••• |
| | |
| | |
| | |
| | •••• |
| | •••• |
| | •••• |
| | |

A curve is defined by the parametric equations

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

for values of t such that $0 < t < \frac{1}{2}\pi$.

| Find the equation of the normal to the curve at the point for which $t = \frac{1}{6}\pi$. Give your answer in the form $ax + by + c = 0$ where a , b and c are integers. |
|---|
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |

| * 0019655440907 * | |
|-------------------|-----|
| | •• |
| | •• |
| | |
| | |
| | |
| | •• |
| | ••• |
| | ••• |
| | |
| | |
| | ••• |
| | ••• |
| | ••• |
| | |
| | |
| | •• |
| | ••• |
| | |
| | |
| | |
| | •• |
| | ••• |
| | |
| | |
| | |
| | •• |
| | •• |
| | |
| | |
| | |
| | •• |
| | ••• |
| | ••• |
| | |

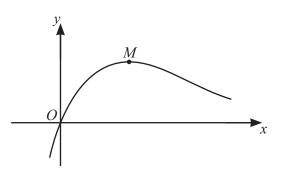
- 5 The polynomial p(x) is defined by $p(x) = 9x^3 + 18x^2 + 5x + 4$.
 - (a) Find the quotient when p(x) is divided by (3x+2), and show that the remainder is 6. [3]

DO NOT WRITE IN THIS MARGIN

| * 00196554 | |
|------------|--|
| | |

(b)

| Find the value of $\int_0^2 \frac{p(x)}{3x+2} dx$, giving your answer in the form $a + \ln b$ where a and b are integers. [5] |
|--|
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |



The diagram shows the curve with equation $y = \frac{\ln(2x+1)}{x+3}$. The curve has a maximum point M.

| | | | x+3 | * | |
|-----|-------------------------------|-------------------------------------|-----|---|--------|
| (a) | Find an expression for | $\frac{\mathrm{d}y}{\mathrm{d}x}$. | | | [2] |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | •••••• |
| | | | | | •••••• |
| | | | | | |
| | | | | | |
| | | | | | |
| (b) | Show that the <i>x</i> -coord | inate of M satisfies the e | | | [2] |
| | | | | | |
| | | | | | |

| | |
|------|------|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

(d)

DO NOT WRITE IN THIS MARGIN

| 0013033441011 | |
|---------------|--|
| | |

(c)

| Show by calculation that the x-coordi | nate of M lies between 2.5 and 3.0. | [2] |
|---|---|------------------|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | ••••• |
| | | |
| | | |
| | | |
| | | |
| Use an iterative formula based on the | equation in part (h) to find the r coordinate of | M correct to |
| Use an iterative formula based on the 4 significant figures. Give the result of | e equation in part (b) to find the <i>x</i> -coordinate of of each iteration to 6 significant figures. | M correct to [3] |
| Use an iterative formula based on the 4 significant figures. Give the result of | e equation in part (b) to find the <i>x</i> -coordinate of of each iteration to 6 significant figures. | |
| Use an iterative formula based on the 4 significant figures. Give the result o | e equation in part (b) to find the <i>x</i> -coordinate of of each iteration to 6 significant figures. | |
| Use an iterative formula based on the 4 significant figures. Give the result o | e equation in part (b) to find the <i>x</i> -coordinate of of each iteration to 6 significant figures. | |
| Use an iterative formula based on the 4 significant figures. Give the result o | e equation in part (b) to find the <i>x</i> -coordinate of of each iteration to 6 significant figures. | |
| Use an iterative formula based on the 4 significant figures. Give the result o | e equation in part (b) to find the <i>x</i> -coordinate of of each iteration to 6 significant figures. | |
| Use an iterative formula based on the 4 significant figures. Give the result o | e equation in part (b) to find the <i>x</i> -coordinate of of each iteration to 6 significant figures. | |
| Use an iterative formula based on the 4 significant figures. Give the result o | e equation in part (b) to find the <i>x</i> -coordinate of of each iteration to 6 significant figures. | |
| Use an iterative formula based on the 4 significant figures. Give the result o | e equation in part (b) to find the <i>x</i> -coordinate of of each iteration to 6 significant figures. | |
| Use an iterative formula based on the 4 significant figures. Give the result o | e equation in part (b) to find the <i>x</i> -coordinate of of each iteration to 6 significant figures. | |
| Use an iterative formula based on the 4 significant figures. Give the result o | e equation in part (b) to find the <i>x</i> -coordinate of of each iteration to 6 significant figures. | |
| Use an iterative formula based on the 4 significant figures. Give the result o | e equation in part (b) to find the <i>x</i> -coordinate of of each iteration to 6 significant figures. | |
| Use an iterative formula based on the 4 significant figures. Give the result o | e equation in part (b) to find the x-coordinate of of each iteration to 6 significant figures. | |
| Use an iterative formula based on the 4 significant figures. Give the result o | e equation in part (b) to find the x-coordinate of of each iteration to 6 significant figures. | |
| Use an iterative formula based on the 4 significant figures. Give the result o | e equation in part (b) to find the x-coordinate of of each iteration to 6 significant figures. | |
| Use an iterative formula based on the 4 significant figures. Give the result o | e equation in part (b) to find the x-coordinate of of each iteration to 6 significant figures. | |

| | Prove that $2 \sin \theta \csc 2\theta \equiv \sec \theta$. | |
|-----|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | , |
| | | |
| | | |
| | | |
| (b) | Solve the equation $\tan^2 \theta + 7 \sin \theta \csc 2\theta = 8$ for $-\pi < \theta < \pi$. [5] |] |
| | | |
| | | |
| | | , |
| | | |
| | | |
| | | |
| | | |

| | 13 | |
|-----|--|----|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| (c) | Find $\int 8\sin^2\frac{1}{2}x\csc^2x dx$. | [3 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Additional page

| If you use the following page to complete the answer to any question, the question number must be clearly shown. |
|--|
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| |

* 0019655441015 *

15

BLANK PAGE

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.

