GradeMax

Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

* 3 8 3 3 7 7 7 1 3 3 *

MATHEMATICS **9709/21**

Paper 2 Pure Mathematics 2 **October/November 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.

© UCLES 2021

[Turn over

GradeMax

BLANK PAGE

GradeMax

1 Find the exact value of $\int_{-1}^{2} \left(4e^{2x} - 2e^{-x}\right) dx$. [4]

GradeMax

2 **(a)** Sketch, on the same diagram, the graphs of $y = 3x$ and $y = |x - 3|$. [2]

(b) Find the coordinates of the point where the two graphs intersect. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) Deduce the solution of the inequality $3x < |x - 3|$. [1]

.....

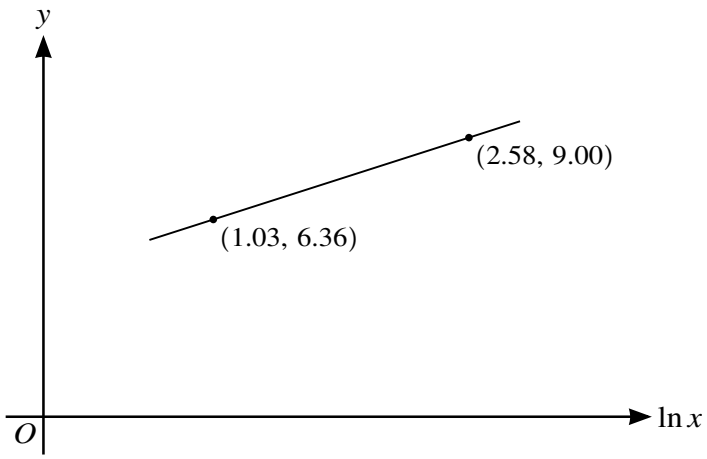
.....

.....

.....

© UCLES 2021

3



The variables x and y satisfy the equation $a^y = kx$, where a and k are constants. The graph of y against $\ln x$ is a straight line passing through the points (1.03, 6.36) and (2.58, 9.00), as shown in the diagram.

Find the values of a and k, giving each value correct to 2 significant figures. [5]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

© UCLES 2021

GradeMax

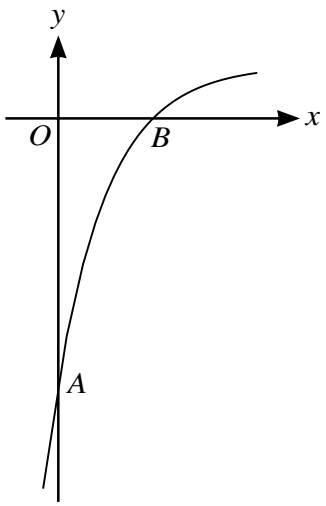
4 The curve with equation $y = xe^{2x} + 5e^{-x}$ has a minimum point M.

(a) Show that the x-coordinate of M satisfies the equation $x = \frac{1}{3}\ln 5 - \frac{1}{3}\ln(1 + 2x)$. [5]

GradeMax

(b) Use an iterative formula, based on the equation in part **(a)**, to find the x-coordinate of M correct to 3 significant figures. Use an initial value of 0.35 and give the result of each iteration to 5 significant figures. [3]

5



The diagram shows the curve with parametric equations

$$x = \ln(2t + 3), \qquad y = \frac{2t - 3}{2t + 3}.$$

The curve crosses the y-axis at the point A and the x-axis at the point B.

(a) Show that $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{6}{2t + 3}$. [4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Find the gradient of the curve at A. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) Find the gradient of the curve at B. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

6 The polynomials $f(x)$ and $g(x)$ are defined by

$$f(x) = 4x^3 + ax^2 + 8x + 15 \qquad \text{and} \qquad g(x) = x^2 + bx + 18,$$

where a and b are constants.

(a) Given that $(x + 3)$ is a factor of $f(x)$, find the value of a. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Given that the remainder is 40 when $g(x)$ is divided by $(x - 2)$, find the value of b. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

© UCLES 2021

GradeMax

(c) When a and b have these values, factorise $f(x) - g(x)$ completely. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(d) Hence solve the equation $f(\text{cosec}\,\theta) - g(\text{cosec}\,\theta) = 0$ for $0 < \theta < 2\pi$. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

© UCLES 2021

[Turn over

7 **(a)** By first expanding $\cos(2\theta + \theta)$, show that $\cos 3\theta \equiv 4\cos^3\theta - 3\cos\theta$. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Find the exact value of $2\cos^3\left(\frac{5}{18}\pi\right) - \frac{3}{2}\cos\left(\frac{5}{18}\pi\right)$. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

© UCLES 2021

GradeMax

(c) Find $\int (12\cos^3 x - 4\cos^3 3x)\,\mathrm{d}x$. [4]

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.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

© UCLES 2021

BLANK PAGE

GradeMax

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 the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.