GradeMax

Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

8149304845

MATHEMATICS **9709/21**

Paper 2 Pure Mathematics 2 **May/June 2022**

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

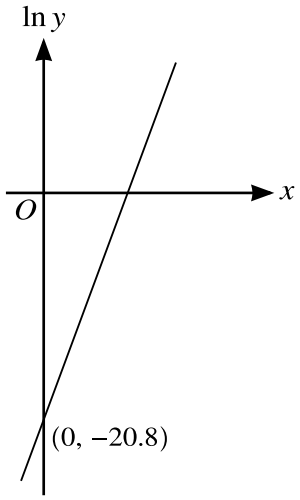
- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages.

© UCLES 2022

[Turn over

1



The variables x and y satisfy the equation $y = 4^{2x-a}$, where a is an integer. As shown in the diagram, the graph of $\ln y$ against x is a straight line passing through the point $(0, -20.8)$, where the second coordinate is given correct to 3 significant figures.

(a) Show that the gradient of the straight line is $\ln 16$. [2]

.....

.....

.....

.....

.....

.....

.....

(b) Determine the value of a. [2]

.....

.....

.....

.....

.....

.....

.....

© UCLES 2022

GradeMax

2 **(a)** Express the equation $7\tan\theta + 4\cot\theta - 13\sec\theta = 0$ in terms of $\sin\theta$ only. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Hence solve the equation $7\tan\theta + 4\cot\theta - 13\sec\theta = 0$ for $0° < \theta < 360°$. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

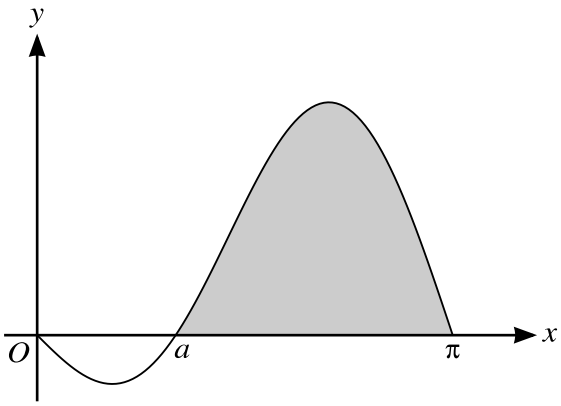
.....

.....

© UCLES 2022

[Turn over

3



The diagram shows the curve with equation $y = 3\sin x - 3\sin 2x$ for $0 \leqslant x \leqslant \pi$. The curve meets the x-axis at the origin and at the points with x-coordinates a and π.

(a) Find the exact value of a. [3]

.....

.....

.....

.....

.....

.....

.....

(b) Find the area of the shaded region. [4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

© UCLES 2022

GradeMax

4 A curve has equation $x^2y + 2y^3 = 48$.

Find the equation of the normal to the curve at the point (4, 2), giving your answer in the form $ax + by + c = 0$ where a, b and c are integers. [7]

5 **(a)** By sketching the graphs of

$$y = |5 - 2x| \qquad \text{and} \qquad y = 3\ln x$$

on the same diagram, show that the equation $|5 - 2x| = 3\ln x$ has exactly two roots. [3]

(b) Show that the value of the larger root satisfies the equation $x = 2.5 + 1.5\ln x$. [1]

.....

.....

.....

.....

.....

.....

.....

© UCLES 2022

GradeMax

(c) Show by calculation that the value of the larger root lies between 4.5 and 5.0. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

© UCLES 2022

[Turn over

GradeMax

6 A curve has equation $y = \dfrac{9e^{2x} + 16}{e^x - 1}$.

(a) Show that the x-coordinate of any stationary point on the curve satisfies the equation

$$e^x(3e^x - 8)(3e^x + 2) = 0.$$ [4]

© UCLES 2022

GradeMax

(b) Hence show that the curve has only one stationary point and find its exact coordinates. [4]

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

$$\mathrm{p}(x) = 2x^3 + 5x^2 + ax + 2a,$$

where a is an integer.

(a) Find, in terms of x and a, the quotient when $\mathrm{p}(x)$ is divided by $(x + 2)$, and show that the remainder is 4. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) It is given that $\displaystyle\int_{-1}^{1} \frac{\mathrm{p}(x)}{x+2}\,\mathrm{d}x = \frac{22}{3} + \ln b$, where b is an integer.

Find the values of a and b. [6]

.....

.....

.....

.....

.....

.....

.....

© UCLES 2022

11

GradeMax

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.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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.

© UCLES 2022