



# Cambridge International AS & A Level

CANDIDATE  
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**MATHEMATICS**

**9709/22**

Paper 2 Pure Mathematics 2

**February/March 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.

1 Solve the equation  $|5x - 2| = |4x + 9|$ .

[3]

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2 A curve has equation  $y = 7 + 4 \ln(2x + 5)$ .

Find the equation of the tangent to the curve at the point  $(-2, 7)$ , giving your answer in the form  $y = mx + c$ . [5]

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3 The variables  $x$  and  $y$  satisfy the equation  $y = 3^{2a} a^x$ , where  $a$  is a constant. The graph of  $\ln y$  against  $x$  is a straight line with gradient 0.239.

(a) Find the value of  $a$  correct to 3 significant figures. [3]

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(b) Hence find the value of  $x$  when  $y = 36$ . Give your answer correct to 3 significant figures. [2]

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4 (a) Show that  $\sin 2\theta \cot \theta - \cos 2\theta \equiv 1$ . [3]

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(b) Hence find the exact value of  $\sin \frac{1}{6}\pi \cot \frac{1}{12}\pi$ . [2]

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(c) Find the smallest positive value of  $\theta$  (in radians) satisfying the equation  
 $\sin 2\theta \cot \theta - 3 \cos 2\theta = 1$ . [2]

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5 (a) Given that  $y = \tan^2 x$ , show that  $\frac{dy}{dx} = 2 \tan x + 2 \tan^3 x$ . [2]

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(b) Find the exact value of  $\int_{\frac{1}{4}\pi}^{\frac{1}{3}\pi} (\tan x + \tan^2 x + \tan^3 x) dx$ . [6]

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A series of 25 horizontal dotted lines for writing.

6 The polynomial  $p(x)$  is defined by

$$p(x) = 4x^3 + 16x^2 + 9x - 15.$$

(a) Find the quotient when  $p(x)$  is divided by  $(2x + 3)$ , and show that the remainder is  $-6$ . [3]

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(b) Find  $\int \frac{p(x)}{2x + 3} dx$ . [2]

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(c) Factorise  $p(x) + 6$  completely and hence solve the equation

$$p(\operatorname{cosec} 2\theta) + 6 = 0$$

for  $0^\circ < \theta < 135^\circ$ .

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7 A curve has equation  $e^{2x}y - e^y = 100$ .

(a) Show that  $\frac{dy}{dx} = \frac{2e^{2x}y}{e^y - e^{2x}}$ . [3]

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(b) Show that the curve has no stationary points. [2]

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It is required to find the  $x$ -coordinate of  $P$ , the point on the curve at which the tangent is parallel to the  $y$ -axis.

(c) Show that the  $x$ -coordinate of  $P$  satisfies the equation

$$x = \ln 10 - \frac{1}{2} \ln(2x - 1). \quad [4]$$

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(d) Use an iterative formula, based on the equation in part (c), to find the  $x$ -coordinate of  $P$  correct to 3 significant figures. Use an initial value of 2 and give the result of each iteration to 5 significant figures. [3]

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