

# Cambridge International AS & A Level

CANDIDATE  
NAME

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**MATHEMATICS****9709/21**

Paper 2 Pure Mathematics 2

**May/June 2021****1 hour 15 minutes**

You must answer on the question paper.

You will need: List of formulae (MF19)

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**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 [ ].

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This document has **16** pages. Any blank pages are indicated.

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1 Solve the inequality  $|3x - 7| < |4x + 5|$ .

[4]

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2 By first expanding  $\sin(\theta + 30^\circ)$ , solve the equation  $\sin(\theta + 30^\circ) \operatorname{cosec} \theta = 2$  for  $0^\circ < \theta < 360^\circ$ . [6]

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- 3 (a) Show that  $(\sec x + \cos x)^2$  can be expressed as  $\sec^2 x + a + b \cos 2x$ , where  $a$  and  $b$  are constants to be determined. [2]

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- (b) Hence find the exact value of  $\int_0^{\frac{1}{4}\pi} (\sec x + \cos x)^2 dx$ . [4]

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4 A curve has parametric equations

$$x = \ln(2t + 6) - \ln t, \quad y = t \ln t.$$

(a) Find the value of  $t$  at the point  $P$  on the curve for which  $x = \ln 4$ . [3]

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(b) Find the exact gradient of the curve at  $P$ .

[5]

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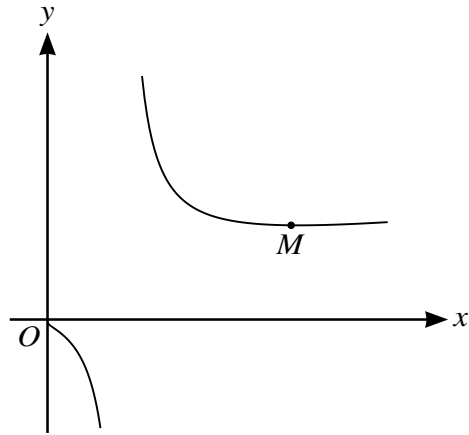
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The diagram shows the curve with equation  $y = \frac{3x + 2}{\ln x}$ . The curve has a minimum point  $M$ .

- (a) Find an expression for  $\frac{dy}{dx}$  and show that the  $x$ -coordinate of  $M$  satisfies the equation  $x = \frac{3x + 2}{3 \ln x}$ . [3]

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- (b) Use the equation in part (a) to show by calculation that the  $x$ -coordinate of  $M$  lies between 3 and 4. [2]

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- (c) Use an iterative formula, based on the equation in part (a), to find the  $x$ -coordinate of  $M$  correct to 5 significant figures. Give the result of each iteration to 7 significant figures. [3]

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- 6 (a) Use the trapezium rule with three intervals to find an approximation to  $\int_1^4 \frac{6}{1+\sqrt{x}} dx$ . Give your answer correct to 5 significant figures. [3]

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- (b) Find the exact value of  $\int_1^4 2e^{\frac{1}{2}x-2} dx$ . [3]

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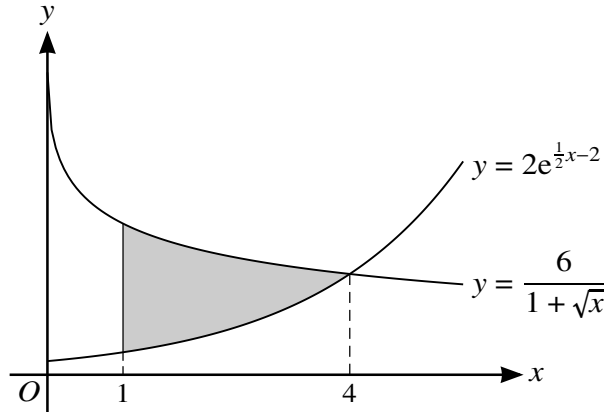
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(c)



The diagram shows the curves  $y = \frac{6}{1 + \sqrt{x}}$  and  $y = 2e^{\frac{1}{2}x-2}$  which meet at a point with  $x$ -coordinate 4. The shaded region is bounded by the two curves and the line  $x = 1$ .

Use your answers to parts (a) and (b) to find an approximation to the area of the shaded region. Give your answer correct to 3 significant figures. [2]

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(d) State, with a reason, whether your answer to part (c) is an over-estimate or under-estimate of the exact area of the shaded region. [1]

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

$$p(x) = ax^3 - 11x^2 - 19x - a,$$

where  $a$  is a constant. It is given that  $(x - 3)$  is a factor of  $p(x)$ .

(a) Find the value of  $a$ .

[2]

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(b) When  $a$  has this value, factorise  $p(x)$  completely.

[3]

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**Additional Page**

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