

Cambridge  
International  
**A Level**

**Cambridge Assessment International Education**  
Cambridge International Advanced Level

CANDIDATE  
NAME

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CENTRE  
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**MATHEMATICS**

**9709/33**

Paper 3 Pure Mathematics 3 (P3)

**October/November 2019**

**1 hour 45 minutes**

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

**READ THESE INSTRUCTIONS FIRST**

Write your centre number, candidate number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

**DO NOT WRITE IN ANY BARCODES.**

Answer **all** the questions in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number(s) must be clearly shown.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

The use of an electronic calculator is expected, where appropriate.

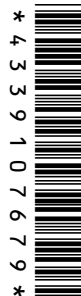
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 75.

This document consists of **19** printed pages and **1** blank page.



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- 2 The polynomial  $6x^3 + ax^2 + bx - 2$ , where  $a$  and  $b$  are constants, is denoted by  $p(x)$ . It is given that  $(2x + 1)$  is a factor of  $p(x)$  and that when  $p(x)$  is divided by  $(x + 2)$  the remainder is  $-24$ . Find the values of  $a$  and  $b$ . [5]

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(ii) Hence solve the equation  $\tan 3x = 3 \cot x$  for  $0^\circ < x < 90^\circ$ . [3]

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- 5 (i) By sketching a suitable pair of graphs, show that the equation  $\ln(x + 2) = 4e^{-x}$  has exactly one real root. [2]

- (ii) Show by calculation that this root lies between  $x = 1$  and  $x = 1.5$ . [2]

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- (iii) Use the iterative formula  $x_{n+1} = \ln\left(\frac{4}{\ln(x_n + 2)}\right)$  to determine the root correct to 2 decimal places. Give the result of each iteration to 4 decimal places. [3]

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**6 Throughout this question the use of a calculator is not permitted.**

The complex number with modulus 1 and argument  $\frac{1}{3}\pi$  is denoted by  $w$ .

- (i) Express  $w$  in the form  $x + iy$ , where  $x$  and  $y$  are real and exact. [1]

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The complex number  $1 + 2i$  is denoted by  $u$ . The complex number  $v$  is such that  $|v| = 2|u|$  and  $\arg v = \arg u + \frac{1}{3}\pi$ .

- (ii) Sketch an Argand diagram showing the points representing  $u$  and  $v$ . [2]

(iii) Explain why  $v$  can be expressed as  $2uw$ . Hence find  $v$ , giving your answer in the form  $a + ib$ , where  $a$  and  $b$  are real and exact. [4]

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- 7 The plane  $m$  has equation  $x + 4y - 8z = 2$ . The plane  $n$  is parallel to  $m$  and passes through the point  $P$  with coordinates  $(5, 2, -2)$ .

(i) Find the equation of  $n$ , giving your answer in the form  $ax + by + cz = d$ . [2]

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(ii) Calculate the perpendicular distance between  $m$  and  $n$ . [3]

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(iii) The line  $l$  lies in the plane  $n$ , passes through the point  $P$  and is perpendicular to  $OP$ , where  $O$  is the origin. Find a vector equation for  $l$ . [4]

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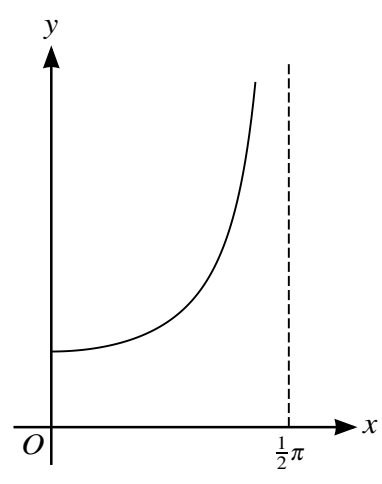
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The diagram shows the graph of  $y = \sec x$  for  $0 \leq x < \frac{1}{2}\pi$ .

- (i) Use the trapezium rule with 2 intervals to estimate the value of  $\int_0^{1.2} \sec x \, dx$ , giving your answer correct to 2 decimal places. [3]

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- (ii) Explain, with reference to the diagram, whether the trapezium rule gives an overestimate or an underestimate of the true value of the integral in part (i). [1]

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9 The variables  $x$  and  $t$  satisfy the differential equation  $5\frac{dx}{dt} = (20 - x)(40 - x)$ . It is given that  $x = 10$  when  $t = 0$ .

(i) Using partial fractions, solve the differential equation, obtaining an expression for  $x$  in terms of  $t$ . [9]

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**(ii)** State what happens to the value of  $x$  when  $t$  becomes large. [1]

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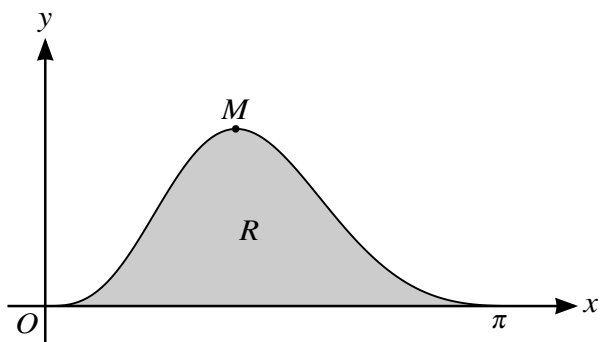
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The diagram shows the graph of  $y = e^{\cos x} \sin^3 x$  for  $0 \leq x \leq \pi$ , and its maximum point  $M$ . The shaded region  $R$  is bounded by the curve and the  $x$ -axis.

- (i) Find the  $x$ -coordinate of  $M$ . Show all necessary working and give your answer correct to 2 decimal places. [5]

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**Additional Page**

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