

CANDIDATE
NAME

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CENTRE
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MATHEMATICS

9709/33

Paper 3 Pure Mathematics 3 **(P3)**

May/June 2017

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.

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.



1 Prove the identity $\frac{\cot x - \tan x}{\cot x + \tan x} \equiv \cos 2x$.

[3]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dashed lines, providing a guide for letter height and placement. The lines are evenly spaced across the entire page, leaving ample room for writing practice. There is no text or other markings on the page.

- 2** Expand $(3 + 2x)^{-3}$ in ascending powers of x up to and including the term in x^2 , simplifying the coefficients. [4]

[illegible]

- 3 Using the substitution $u = e^x$, solve the equation $4e^{-x} = 3e^x + 4$. Give your answer correct to 3 significant figures. [4]

[illegible]

4

[4]

[illegible]

- 5** A curve has equation $y = \frac{2}{3} \ln(1 + 3 \cos^2 x)$ for $0 \leq x \leq \frac{1}{2}\pi$.

(i) Express $\frac{dy}{dx}$ in terms of $\tan x$.

[4]

This image shows a full page of white paper with horizontal dashed lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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6 The equation $\cot x = 1 - x$ has one root in the interval $0 < x < \pi$, denoted by α .

(i) Show by calculation that α is greater than 2.5.

[2]

[illegible]

(ii) Show that, if a sequence of values in the interval $0 < x < \pi$ given by the iterative formula $x_{n+1} = \pi + \tan^{-1}\left(\frac{1}{1-x_n}\right)$ converges, then it converges to α . [2]

[illegible]

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- (iii) Use this iterative formula to determine α correct to 3 decimal places. Give the result of each iteration to 5 decimal places. [3]

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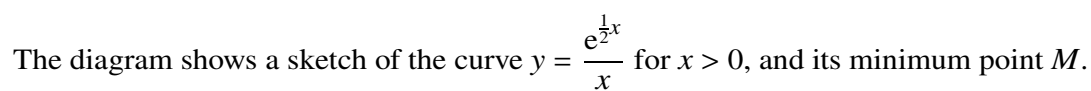
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- [4]

[illegible]

- (ii) Use the trapezium rule with two intervals to estimate the value of

$$\int_1^3 \frac{e^{\frac{1}{2}x}}{x} dx,$$

giving your answer correct to 2 decimal places.

[3]

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- (iii) The estimate found in part (ii) is denoted by E . Explain, without further calculation, whether another estimate found using the trapezium rule with four intervals would be greater than E or less than E . [1]

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- 8 In a certain chemical reaction, a compound A is formed from a compound B . The masses of A and B at time t after the start of the reaction are x and y respectively and the sum of the masses is equal to 50 throughout the reaction. At any time the rate of increase of the mass of A is proportional to the mass of B at that time.

- (i) Explain why $\frac{dx}{dt} = k(50 - x)$, where k is a constant. [1]

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It is given that $x = 0$ when $t = 0$, and $x = 25$ when $t = 10$.

- (ii) Solve the differential equation in part (i) and express x in terms of t . [8]

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9 Let $f(x) = \frac{3x^2 - 4}{x^2(3x + 2)}$.

(i) Express $f(x)$ in partial fractions.

[5]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dotted lines, providing a guide for letter height and placement. The lines are evenly spaced across the entire page, leaving ample room for writing practice. There is no text or other markings on the page.

(ii) Hence show that $\int_1^2 f(x) \, dx = \ln\left(\frac{25}{8}\right) - 1$. [5]

[illegible]

- 10** The points A and B have position vectors given by $\overrightarrow{OA} = \mathbf{i} - 2\mathbf{j} + 2\mathbf{k}$ and $\overrightarrow{OB} = 3\mathbf{i} + \mathbf{j} + \mathbf{k}$. The line l has equation $\mathbf{r} = 2\mathbf{i} + \mathbf{j} + m\mathbf{k} + \mu(\mathbf{i} - 2\mathbf{j} - 4\mathbf{k})$, where m is a constant.

(i) Given that the line l intersects the line passing through A and B , find the value of m . [5]

[illegible]

- (ii) Find the equation of the plane which is parallel to $\mathbf{i} - 2\mathbf{j} - 4\mathbf{k}$ and contains the points A and B .
Give your answer in the form $ax + by + cz = d$. [5]

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for writing. The lines are evenly spaced across the entire page, providing a guide for letter height and placement. There is no text or other markings on the page.

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

- (a) The complex numbers z and w satisfy the equations

$$z + (1 + i)w = i \quad \text{and} \quad (1 - i)z + iw = 1.$$

Solve the equations for z and w , giving your answers in the form $x + iy$, where x and y are real.

[6]

This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

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