

CANDIDATE  
NAME

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CENTRE  
NUMBER

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**MATHEMATICS**

**9709/32**

Paper 3 Pure Mathematics 3 (P3)

**February/March 2018**

**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 **20** printed pages.











4 The variables  $x$  and  $y$  satisfy the equation  $y^n = Ax^3$ , where  $n$  and  $A$  are constants. It is given that  $y = 2.58$  when  $x = 1.20$ , and  $y = 9.49$  when  $x = 2.51$ .

(i) Explain why the graph of  $\ln y$  against  $\ln x$  is a straight line. [2]

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(ii) Find the values of  $n$  and  $A$ , giving your answers correct to 2 decimal places. [4]

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6 The variables  $x$  and  $\theta$  satisfy the differential equation

$$x \cos^2 \theta \frac{dx}{d\theta} = 2 \tan \theta + 1,$$

for  $0 \leq \theta < \frac{1}{2}\pi$  and  $x > 0$ . It is given that  $x = 1$  when  $\theta = \frac{1}{4}\pi$ .

(i) Show that  $\frac{d}{d\theta}(\tan^2 \theta) = \frac{2 \tan \theta}{\cos^2 \theta}$ . [1]

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(ii) Solve the differential equation and calculate the value of  $x$  when  $\theta = \frac{1}{3}\pi$ , giving your answer correct to 3 significant figures. [7]

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7 (i) By sketching suitable graphs, show that the equation  $e^{2x} = 6 + e^{-x}$  has exactly one real root. [2]

(ii) Verify by calculation that this root lies between 0.5 and 1. [2]

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(iii) Show that if a sequence of values given by the iterative formula

$$x_{n+1} = \frac{1}{3} \ln(1 + 6e^{x_n})$$

converges, then it converges to the root of the equation in part (i). [2]

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(iv) Use this iterative formula to calculate the root correct to 3 decimal places. Give the result of each iteration to 5 decimal places. [3]

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9 The complex number  $1 + 2i$  is denoted by  $u$ .

(i) It is given that  $u$  is a root of the equation  $2x^3 - x^2 + 4x + k = 0$ , where  $k$  is a constant.

(a) Showing all working and without using a calculator, find the value of  $k$ . [3]

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(b) Showing all working and without using a calculator, find the other two roots of this equation. [4]

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- (ii) On an Argand diagram sketch the locus of points representing complex numbers  $z$  satisfying the equation  $|z - u| = 1$ . Determine the least value of  $\arg z$  for points on this locus. Give your answer in radians correct to 2 decimal places. [4]

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10 The line  $l$  has equation  $\mathbf{r} = 4\mathbf{i} + 3\mathbf{j} - \mathbf{k} + \mu(\mathbf{i} + 2\mathbf{j} - 2\mathbf{k})$ . The plane  $p$  has equation  $2x - 3y - z = 4$ .

(i) Find the position vector of the point of intersection of  $l$  and  $p$ . [3]

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(ii) Find the acute angle between  $l$  and  $p$ . [3]

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