



**Cambridge International Examinations**  
Cambridge International Advanced Level

CANDIDATE  
NAME

--

CENTRE  
NUMBER

--	--	--	--	--

CANDIDATE  
NUMBER

--	--	--	--

## MATHEMATICS

9709/32

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** Solve the equation  $\ln(x^2 + 1) = 1 + 2 \ln x$ , giving your answer correct to 3 significant figures. [3]

[illegible]

**2** Solve the inequality  $|x - 3| < 3x - 4$ .

[4]

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.

- 3** (i) Express the equation  $\cot \theta - 2 \tan \theta = \sin 2\theta$  in the form  $a \cos^4 \theta + b \cos^2 \theta + c = 0$ , where  $a$ ,  $b$  and  $c$  are constants to be determined. [3]

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.

(ii) Hence solve the equation  $\cot \theta - 2 \tan \theta = \sin 2\theta$  for  $90^\circ < \theta < 180^\circ$ . [2]

[illegible]

**4** The parametric equations of a curve are

$$x = t^2 + 1, \quad y = 4t + \ln(2t - 1).$$

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

[3]

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.

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.

## 8

- 5 In a certain chemical process a substance  $A$  reacts with and reduces a substance  $B$ . The masses of  $A$  and  $B$  at time  $t$  after the start of the process are  $x$  and  $y$  respectively. It is given that  $\frac{dy}{dt} = -0.2xy$  and  $x = \frac{10}{(1+t)^2}$ . At the beginning of the process  $y = 100$ .

(i) Form a differential equation in  $y$  and  $t$ , and solve this differential equation. [6]

[illegible]



.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (ii) Find the exact value approached by the mass of  $B$  as  $t$  becomes large. State what happens to the mass of  $A$  as  $t$  becomes large. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(i) It is given that  $u$  is a root of the equation  $x^3 + ax^2 - 3x + b = 0$ , where the constants  $a$  and  $b$  are real. Find the values of  $a$  and  $b$ . [4]

[illegible]

**11**

- (ii) On a sketch of an Argand diagram, shade the region whose points represent complex numbers  $z$  satisfying both the inequalities  $|z - u| < 1$  and  $|z| < |z + i|$ . [4]

## 12

- 7 (i) Prove that if  $y = \frac{1}{\cos \theta}$  then  $\frac{dy}{d\theta} = \sec \theta \tan \theta$ . [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (ii) Prove the identity  $\frac{1 + \sin \theta}{1 - \sin \theta} \equiv 2 \sec^2 \theta + 2 \sec \theta \tan \theta - 1$ . [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(iii) Hence find the exact value of  $\int_0^{\frac{1}{4}\pi} \frac{1 + \sin \theta}{1 - \sin \theta} d\theta$ . [4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[5]

[illegible]

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.

- 9 Relative to the origin  $O$ , the point  $A$  has position vector given by  $\overrightarrow{OA} = \mathbf{i} + 2\mathbf{j} + 4\mathbf{k}$ . The line  $l$  has equation  $\mathbf{r} = 9\mathbf{i} - \mathbf{j} + 8\mathbf{k} + \mu(3\mathbf{i} - \mathbf{j} + 2\mathbf{k})$ .
- (i) Find the position vector of the foot of the perpendicular from  $A$  to  $l$ . Hence find the position vector of the reflection of  $A$  in  $l$ . [5]

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.



- (ii) Find the equation of the plane through the origin which contains  $l$ . Give your answer in the form  $ax + by + cz = d$ . [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (iii) Find the exact value of the perpendicular distance of  $A$  from this plane. [3]

.....

.....

.....

.....

.....

.....

.....

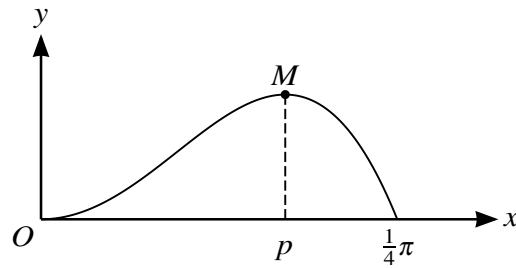
.....

.....

.....

.....

10



The diagram shows the curve  $y = x^2 \cos 2x$  for  $0 \leq x \leq \frac{1}{4}\pi$ . The curve has a maximum point at  $M$  where  $x = p$ .

- (i) Show that  $p$  satisfies the equation  $p = \frac{1}{2} \tan^{-1} \left( \frac{1}{p} \right)$ . [3]

.....

.....

.....

.....

.....

.....

.....

.....

- (ii) Use the iterative formula  $p_{n+1} = \frac{1}{2} \tan^{-1} \left( \frac{1}{p_n} \right)$  to determine the value of  $p$  correct to 2 decimal places. Give the result of each iteration to 4 decimal places. [3]

.....

.....

.....

.....

.....

.....

.....

.....

[illegible]

**BLANK PAGE**

---

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at [www.cie.org.uk](http://www.cie.org.uk) after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.