

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS  
AS GCE**

**4725/01**

**MATHEMATICS**

**Further Pure Mathematics 1**

**QUESTION PAPER**

**MONDAY 10 JUNE 2013: Morning**

**DURATION: 1 hour 30 minutes  
plus your additional time allowance**

**MODIFIED ENLARGED**

**Candidates answer on the Printed Answer Book or any suitable paper provided by the centre. The Printed Answer Book may be enlarged by the centre.**

**OCR SUPPLIED MATERIALS:**

**Printed Answer Book 4725/01  
List of Formulae (MF1)**

**OTHER MATERIALS REQUIRED:**

**Scientific or graphical calculator**

**READ INSTRUCTIONS OVERLEAF**

## **INSTRUCTIONS TO CANDIDATES**

- **Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book or on the paper provided by the centre. Please write clearly and in capital letters.**
- **If you use the Printed Answer Book, write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).**
- **Use black ink. HB pencil may be used for graphs and diagrams only.**
- **Read each question carefully. Make sure you know what you have to do before starting your answer.**
- **Answer ALL the questions.**
- **You are permitted to use a scientific or graphical calculator in this paper.**
- **Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.**

## **INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question on the Question Paper.
- **YOU ARE REMINDED OF THE NEED FOR CLEAR PRESENTATION IN YOUR ANSWERS.**
- The total number of marks for this paper is 72.
- Any blank pages are indicated.

## **INSTRUCTION TO EXAMS OFFICER/INVIGILATOR**

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**1 The complex number  $3 + ai$ , where  $a$  is real, is denoted by  $z$ . Given that  $\arg z = \frac{1}{6}\pi$ , find the value of  $a$  and hence find  $|z|$  and  $z^* - 3$ . [6]**

**2 The matrices  $A$ ,  $B$  and  $C$  are given by**

$$A = \begin{pmatrix} 5 & 1 \end{pmatrix}, B = \begin{pmatrix} 2 & -5 \end{pmatrix} \text{ and } C = \begin{pmatrix} 3 \\ 2 \end{pmatrix}.$$

**(i) Find  $3A - 4B$ . [2]**

**(ii) Find  $CB$ . Determine whether  $CB$  is singular or non-singular, giving a reason for your answer. [5]**

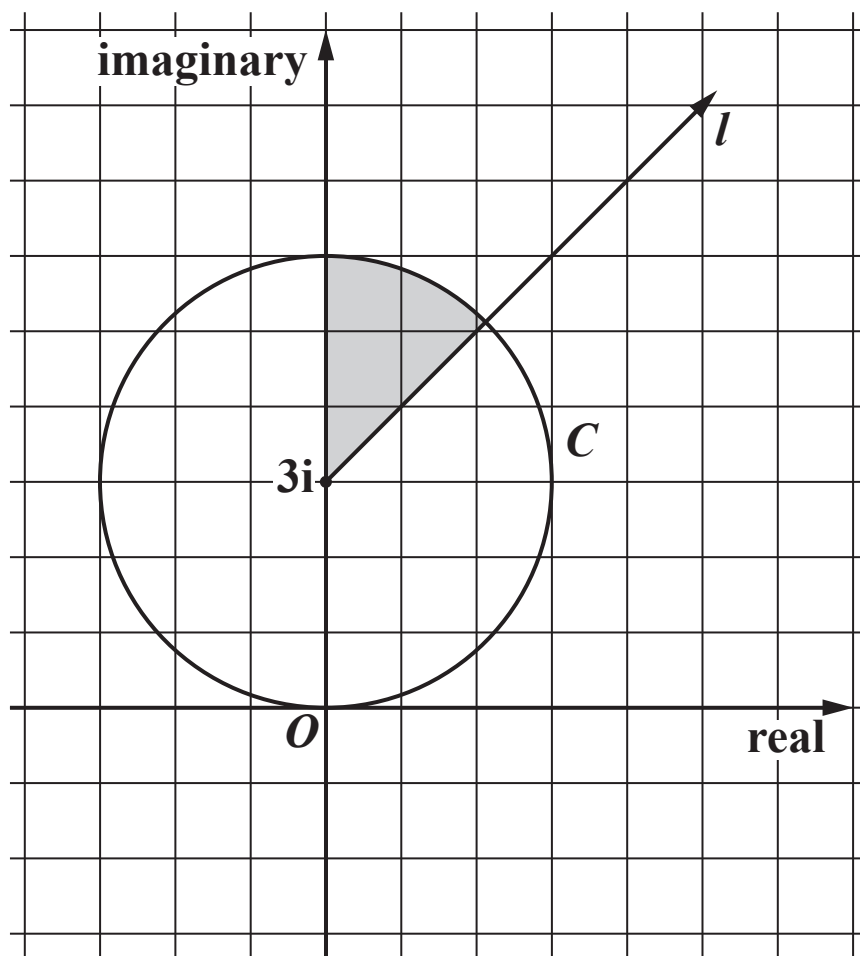
**3 Use an algebraic method to find the square roots of  $11 + (12\sqrt{5})i$ . Give your answers in the form  $x + iy$ , where  $x$  and  $y$  are exact real numbers. [6]**

**4 The matrix  $M$  is given by  $M = \begin{pmatrix} 2 & 2 \\ 0 & 1 \end{pmatrix}$ . Prove by induction that, for  $n \geq 1$ ,**

$$M^n = \begin{pmatrix} 2^n & 2^{n+1} - 2 \\ 0 & 1 \end{pmatrix}. \quad [6]$$

**5 Find  $\sum_{r=1}^n (4r^3 - 3r^2 + r)$ , giving your answer in a fully factorised form. [6]**

**6 Look at the following diagram.**



**The Argand diagram above shows a half-line  $l$  and a circle  $C$ . The circle has centre  $3i$  and passes through the origin.**

- (i) Write down, in complex number form, the equations of  $l$  and  $C$ . [4]**
- (ii) Write down inequalities that define the region shaded in the diagram. [The shaded region includes the boundaries.] [3]**

- 7 (i) Find the matrix that represents a rotation through  $90^\circ$  clockwise about the origin. [2]
- (ii) Find the matrix that represents a reflection in the  $x$ -axis. [2]
- (iii) Hence find the matrix that represents a rotation through  $90^\circ$  clockwise about the origin, followed by a reflection in the  $x$ -axis. [2]
- (iv) Describe a SINGLE transformation that is represented by your answer to part (iii). [2]

- 8 The cubic equation  $kx^3 + 6x^2 + x - 3 = 0$ , where  $k$  is a non-zero constant, has roots  $\alpha$ ,  $\beta$  and  $\gamma$ .

Find the value of  $(\alpha + 1)(\beta + 1) + (\beta + 1)(\gamma + 1) + (\gamma + 1)(\alpha + 1)$  in terms of  $k$ . [6]

- 9 (i) Show that  $\frac{1}{3r-1} - \frac{1}{3r+2} \equiv \frac{3}{(3r-1)(3r+2)}$ . [2]
- (ii) Hence show that  $\sum_{r=1}^{2n} \frac{1}{(3r-1)(3r+2)} = \frac{n}{2(3n+1)}$ . [6]

**10** The matrix **A** is given by  $\mathbf{A} = \begin{pmatrix} a & 2 & 1 \\ 1 & 3 & 2 \\ 4 & 1 & 1 \end{pmatrix}$ .

**(i)** Find the value of  $a$  for which **A** is singular. [5]

**(ii)** Given that **A** is non-singular, find  $\mathbf{A}^{-1}$  and hence solve the equations

$$\begin{aligned} ax + 2y + z &= 1, \\ x + 3y + 2z &= 2, \\ 4x + y + z &= 3. \end{aligned} \quad [7]$$

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