

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS  
AS GCE  
4755/01  
MATHEMATICS (MEI)  
Further Concepts for Advanced  
Mathematics (FP1)  
QUESTION PAPER  
FRIDAY 19 MAY 2017: Morning  
DURATION: 1 hour 30 minutes  
plus your additional time allowance  
MODIFIED ENLARGED 24pt**

**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:**

**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.**

**Final answers should be given to a degree of accuracy appropriate to the context.**

## **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 advised that an answer may receive NO MARKS unless you show sufficient detail of the working to indicate that a correct method is being used.**

**The total number of marks for this paper is 72.**

**Any blank pages are indicated.**

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

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## SECTION A (36 marks)

1 The matrices  $A$  and  $B$  are given by  $A = \begin{pmatrix} 4 & -3 \\ 2 & 1 \end{pmatrix}$ ,  $B = \begin{pmatrix} a & 4 \\ 7 & a+3 \end{pmatrix}$

and  $I$  is the  $2 \times 2$  identity matrix. Find

- (i)  $2A - B + 3I$ , giving your answer in terms of  $a$ , [3]
- (ii) the value of  $a$  for which  $AB = \begin{pmatrix} 3 & -11 \\ 19 & 17 \end{pmatrix}$ , [2]
- (iii) the values of  $a$  for which  $B$  is singular. [3]

2 The complex number  $2 - 3j$  is denoted by  $z$ .

(i) Find  $|z|$  and  $\arg z$ . [2]

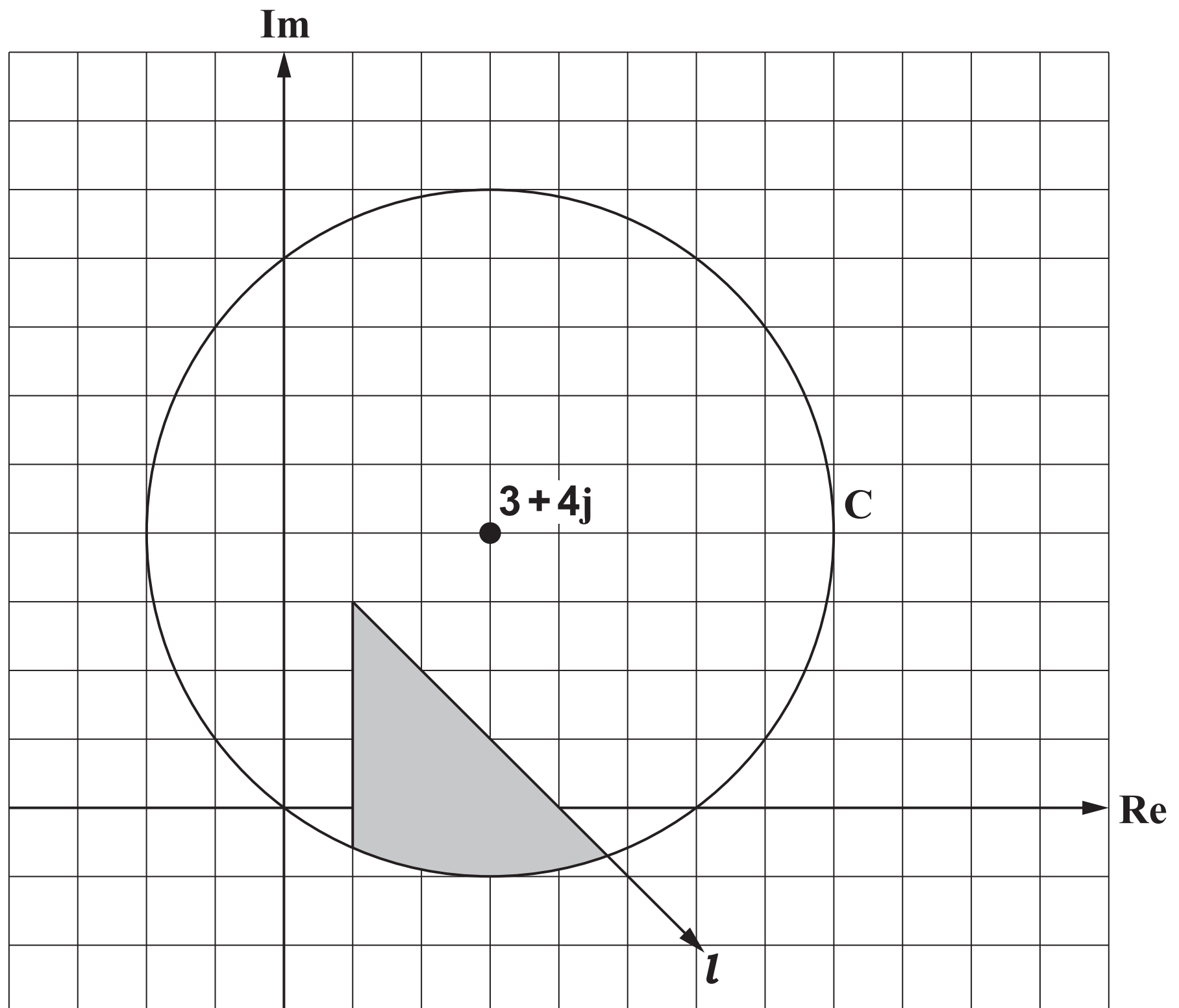
(ii) You are given that  $2az + 3z^* = 5 - bj$ , where  $a$  and  $b$  are real. Find the values of  $a$  and  $b$ . [4]

3 (i) Using the standard summation formulae, find an expression for  $\sum_{r=1}^n (1 - 2r)^2$  in terms of  $n$ . Give your answer in a fully factorised form. [6]

(ii) Hence evaluate  $\sum_{r=25}^{75} (1 - 2r)^2$ . [2]

- 4 The Argand diagram in Fig. 4 below shows a half-line  $l$  and a circle  $C$ . The circle has centre  $3 + 4j$ .

FIG. 4



- (i) Write down, in complex number form, the equations of  $l$  and  $C$ . [4]
- (ii) Write down inequalities that define the shaded region indicated in Fig. 4, together with its boundaries. [3]
- 5 Prove by induction that  $\sum_{r=1}^n \frac{r}{2^r} = 2 - \left(\frac{1}{2}\right)^n (2 + n)$ . [7]

## SECTION B (36 marks)

6 A curve has equation  $y = \frac{ax^2 - 12}{4x^2 + bx - 6}$ , where  $a$  and  $b$  are constants.

(i) Find the coordinates of the point where the curve crosses the  $y$ -axis. [1]

(ii) You are given that the curve has a vertical asymptote at  $x = 2$ . Find the value of  $b$  and the equation of the other vertical asymptote. [3]

(iii) You are given that the curve crosses the  $x$ -axis when  $x = \pm\sqrt{6}$ . Find the value of  $a$  and the equation of the horizontal asymptote. [2]

(iv) Sketch the curve. [3]

(v) Find the set of values for which  $y \geq 0$ . [3]

7 (a) The roots of the cubic equation  $2x^3 - x^2 + 4x + 2 = 0$  are  $\alpha$ ,  $\beta$  and  $\gamma$ . Find the cubic equation whose roots are  $3\alpha$ ,  $3\beta$  and  $3\gamma$ , expressing your answer in a form with integer coefficients. [5]

(b) A second cubic equation  $x^3 + px^2 + qx + r = 0$ , where  $p$ ,  $q$  and  $r$  are real, has roots that may be written as  $a - \lambda$ ,  $a$  and  $a + \lambda$ .

(i) By considering the sum of the roots show that  $2p^3 - 9pq + 27r = 0$ . [4]

(ii) Given that  $p = -6$  and  $q = 37$  find the roots of this second cubic equation. [4]

- 8 (i) The matrix  $P$  is given by  $P = \begin{pmatrix} \frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & \frac{1}{2} \end{pmatrix}$ . Describe fully the geometrical transformation represented by  $P$ . [2]

The matrix  $R$  is given by  $R = \begin{pmatrix} 2 - 3\sqrt{3} & 3 + 2\sqrt{3} \\ 1 + \sqrt{3} & -1 + \sqrt{3} \end{pmatrix}$ .

- (ii) Show that the multiplication of  $P$  and  $R$  is not commutative. [2]
- (iii) The transformation represented by  $R$  is equivalent to the transformation represented by  $P$  followed by another transformation represented by the matrix  $Q$ . Find  $Q$ . [5]
- (iv) The transformation represented by  $Q$  is applied to a figure of area 4 square units. Find the area of the transformed figure. [2]

**END OF QUESTION PAPER**

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