



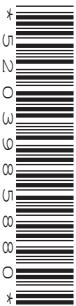
Oxford Cambridge and RSA

**Friday 19 May 2017 – Morning**

**AS GCE MATHEMATICS (MEI)**

**4755/01 Further Concepts for Advanced Mathematics (FP1)**

**QUESTION PAPER**



Candidates answer on the Printed Answer Book.

**OCR supplied materials:**

- Printed Answer Book 4755/01
- MEI Examination Formulae and Tables (MF2)

**Other materials required:**

- Scientific or graphical calculator

**Duration: 1 hour 30 minutes**

**INSTRUCTIONS TO CANDIDATES**

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found inside the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book.** 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.
- Do **not** write in the bar codes.
- 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**

This information is the same on the Printed Answer Book and the Question Paper.

- 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**.
- The Printed Answer Book consists of **16** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

**INSTRUCTION TO EXAMS OFFICER/INVIGILATOR**

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## Section A (36 marks)

- 1 The matrices  $\mathbf{A}$  and  $\mathbf{B}$  are given by  $\mathbf{A} = \begin{pmatrix} 4 & -3 \\ 2 & 1 \end{pmatrix}$ ,  $\mathbf{B} = \begin{pmatrix} a & 4 \\ 7 & a+3 \end{pmatrix}$  and  $\mathbf{I}$  is the  $2 \times 2$  identity matrix. Find
- (i)  $2\mathbf{A} - \mathbf{B} + 3\mathbf{I}$ , giving your answer in terms of  $a$ , [3]
  - (ii) the value of  $a$  for which  $\mathbf{AB} = \begin{pmatrix} 3 & -11 \\ 19 & 17 \end{pmatrix}$ , [2]
  - (iii) the values of  $a$  for which  $\mathbf{B}$  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 shows a half-line  $l$  and a circle  $C$ . The circle has centre  $3+4j$ .

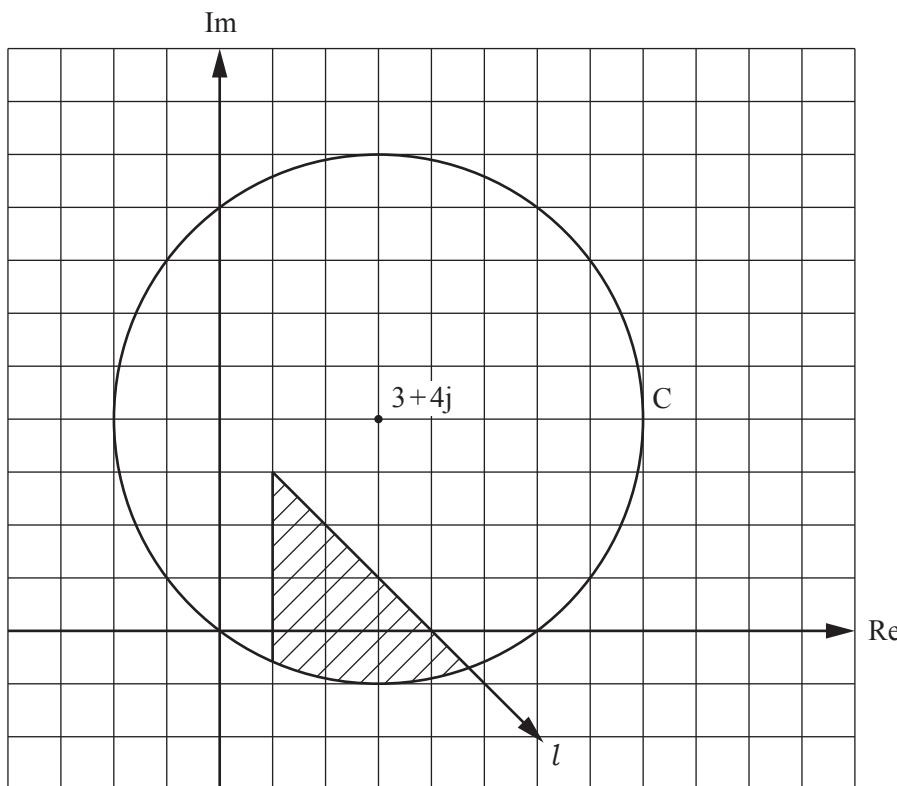


Fig. 4

- (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.
- Find the coordinates of the point where the curve crosses the  $y$ -axis. [1]
  - 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]
  - 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]
  - Sketch the curve. [3]
  - 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  $a + \lambda$ .
- By considering the sum of the roots show that  $2p^3 - 9pq + 27r = 0$ . [4]
  - Given that  $p = -6$  and  $q = 37$  find the roots of this second cubic equation. [4]
- 8 (i) The matrix  $\mathbf{P}$  is given by  $\mathbf{P} = \begin{pmatrix} \frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & \frac{1}{2} \end{pmatrix}$ . Describe fully the geometrical transformation represented by  $\mathbf{P}$ . [2]
- The matrix  $\mathbf{R}$  is given by  $\mathbf{R} = \begin{pmatrix} 2 - 3\sqrt{3} & 3 + 2\sqrt{3} \\ 1 + \sqrt{3} & -1 + \sqrt{3} \end{pmatrix}$ .
- Show that the multiplication of  $\mathbf{P}$  and  $\mathbf{R}$  is not commutative. [2]
  - The transformation represented by  $\mathbf{R}$  is equivalent to the transformation represented by  $\mathbf{P}$  followed by another transformation represented by the matrix  $\mathbf{Q}$ . Find  $\mathbf{Q}$ . [5]
  - The transformation represented by  $\mathbf{Q}$  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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