



**Friday 16 May 2014 – Afternoon**

**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**

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

## Section A (36 marks)

1 Use standard series formulae to find  $\sum_{r=1}^n r(r-2)$ , factorising your answer as far as possible. [5]

2 Fig. 2 shows the unit square, OABC, and its image, OA'B'C', after undergoing a transformation.

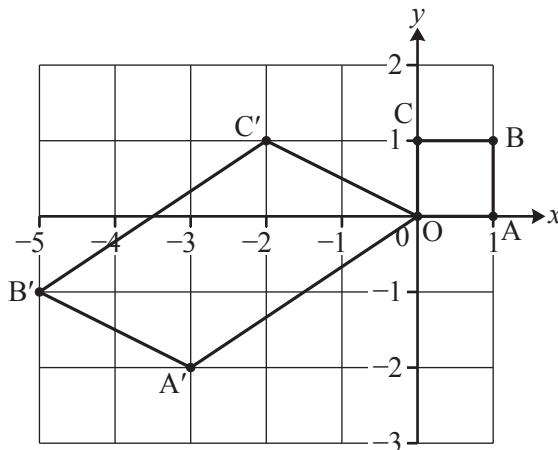


Fig. 2

(i) Write down the matrix  $T$  representing this transformation. [2]

The quadrilateral OA'B'C' is reflected in the  $x$ -axis to give a new quadrilateral, OA''B''C''.

(ii) Write down the matrix representing reflection in the  $x$ -axis. [1]

(iii) Find the single matrix that will transform OABC onto OA''B''C''. [2]

3 You are given that  $z = 2 + 3j$  is a root of the quartic equation  $z^4 - 5z^3 + 15z^2 - 5z - 26 = 0$ . Find the other roots. [7]

4 Use the identity  $\frac{1}{2r+3} - \frac{1}{2r+5} \equiv \frac{2}{(2r+3)(2r+5)}$  and the method of differences to find  $\sum_{r=1}^n \frac{1}{(2r+3)(2r+5)}$ , expressing your answer as a single fraction. [5]

5 The roots of the cubic equation  $3x^3 - 9x^2 + x - 1 = 0$  are  $\alpha, \beta$  and  $\gamma$ . Find the cubic equation whose roots are  $3\alpha - 1, 3\beta - 1$  and  $3\gamma - 1$ , expressing your answer in a form with integer coefficients. [7]

6 Prove by induction that  $\frac{1}{1 \times 3} + \frac{1}{3 \times 5} + \frac{1}{5 \times 7} + \dots + \frac{1}{(2n-1)(2n+1)} = \frac{n}{2n+1}$ . [7]

## Section B (36 marks)

7 A curve has equation  $y = \frac{x^2 - 5}{(x+3)(x-2)(ax-1)}$ , where  $a$  is a constant.

(i) Find the coordinates of the points where the curve crosses the  $x$ -axis and the  $y$ -axis. [2]

(ii) You are given that the curve has a vertical asymptote at  $x = \frac{1}{2}$ . Write down the value of  $a$  and the equations of the other asymptotes. [3]

(iii) Sketch the curve. [4]

(iv) Find the set of values of  $x$  for which  $y > 0$ . [3]

8 You are given the complex number  $w = 2 + 2\sqrt{3}j$ .

(i) Express  $w$  in modulus-argument form. [3]

(ii) Indicate on an Argand diagram the set of points,  $z$ , which satisfy both of the following inequalities.

$$-\frac{\pi}{2} \leq \arg z \leq \frac{\pi}{3} \text{ and } |z| \leq 4$$

Mark  $w$  on your Argand diagram and find the greatest value of  $|z - w|$ . [9]

9 You are given that  $\mathbf{A} = \begin{pmatrix} 1 & 3 & -1 \\ -1 & \alpha & -1 \\ -2 & -1 & 3 \end{pmatrix}$ ,  $\mathbf{B} = \begin{pmatrix} 3\alpha - 1 & -8 & \alpha - 3 \\ 5 & 1 & 2 \\ 2\alpha + 1 & -5 & \alpha + 3 \end{pmatrix}$  and  $\mathbf{AB} = \begin{pmatrix} \gamma & 0 & 0 \\ \beta & \gamma & 0 \\ 0 & 0 & \gamma \end{pmatrix}$ .

(i) Show that  $\beta = 0$ . [2]

(ii) Find  $\gamma$  in terms of  $\alpha$ . [2]

(iii) Write down  $\mathbf{A}^{-1}$  for the case when  $\alpha = 2$ . State the value of  $\alpha$  for which  $\mathbf{A}^{-1}$  does not exist. [3]

(iv) Use your answer to part (iii) to solve the following simultaneous equations.

$$\begin{aligned} x + 3y - z &= 25 \\ -x + 2y - z &= 11 \\ -2x - y + 3z &= -23 \end{aligned}$$

[5]

END OF QUESTION PAPER

**THERE ARE NO QUESTIONS PRINTED ON THIS PAGE.**



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