

**ADVANCED SUBSIDIARY GCE  
MATHEMATICS (MEI)**

Further Concepts for Advanced Mathematics (FP1)

**4755**

Candidates answer on the Answer Booklet

**OCR Supplied Materials:**

- 8 page Answer Booklet
- MEI Examination Formulae and Tables (MF2)

**Other Materials Required:**

- Scientific or graphical calculator

**Thursday 27 May 2010  
Morning**

**Duration:** 1 hour 30 minutes



**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that 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 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.
- 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**.
- This document consists of **4** pages. Any blank pages are indicated.

## Section A (36 marks)

1 Find the values of  $A$ ,  $B$  and  $C$  in the identity  $4x^2 - 16x + C \equiv A(x + B)^2 + 2$ . [4]

2 You are given that  $\mathbf{M} = \begin{pmatrix} 2 & -5 \\ 3 & 7 \end{pmatrix}$ .

$\mathbf{M} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 9 \\ -1 \end{pmatrix}$  represents two simultaneous equations.

(i) Write down these two equations. [2]

(ii) Find  $\mathbf{M}^{-1}$  and use it to solve the equations. [4]

3 The cubic equation  $2z^3 - z^2 + 4z + k = 0$ , where  $k$  is real, has a root  $z = 1 + 2j$ .

Write down the other complex root. Hence find the real root and the value of  $k$ . [6]

4 The roots of the cubic equation  $x^3 - 2x^2 - 8x + 11 = 0$  are  $\alpha$ ,  $\beta$  and  $\gamma$ .

Find the cubic equation with roots  $\alpha + 1$ ,  $\beta + 1$  and  $\gamma + 1$ . [6]

5 Use the result  $\frac{1}{5r-1} - \frac{1}{5r+4} \equiv \frac{5}{(5r-1)(5r+4)}$  and the method of differences to find

$$\sum_{r=1}^n \frac{1}{(5r-1)(5r+4)},$$

simplifying your answer. [6]

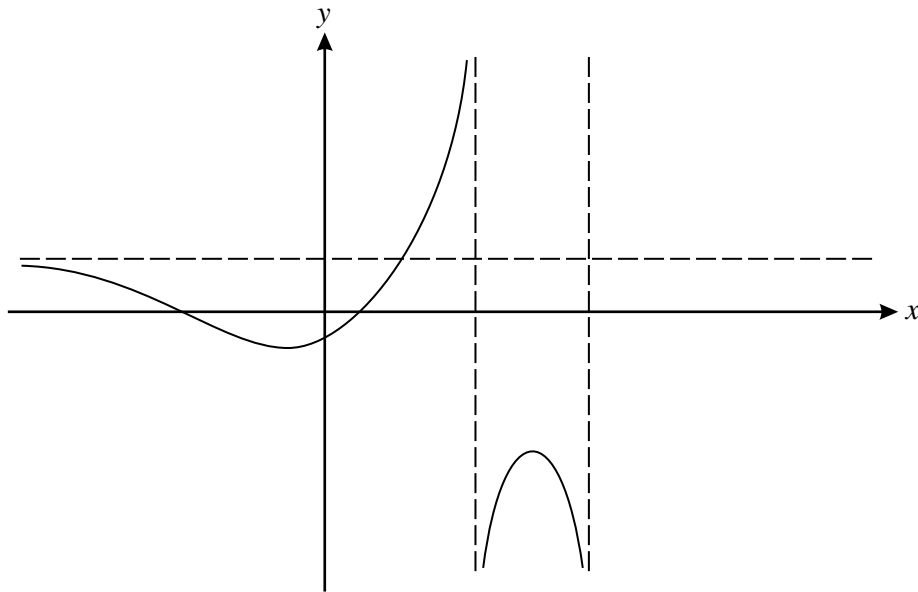
6 A sequence is defined by  $u_1 = 2$  and  $u_{n+1} = \frac{u_n}{1 + u_n}$ .

(i) Calculate  $u_3$ . [2]

(ii) Prove by induction that  $u_n = \frac{2}{2n-1}$ . [6]

## Section B (36 marks)

- 7 Fig. 7 shows an incomplete sketch of  $y = \frac{(2x - 1)(x + 3)}{(x - 3)(x - 2)}$ .



Not to  
scale

Fig. 7

- (i) Find the coordinates of the points where the curve cuts the axes. [2]
- (ii) Write down the equations of the three asymptotes. [3]
- (iii) Determine whether the curve approaches the horizontal asymptote from above or below for large positive values of  $x$ , justifying your answer. Copy and complete the sketch. [3]
- (iv) Solve the inequality  $\frac{(2x - 1)(x + 3)}{(x - 3)(x - 2)} < 2$ . [4]
- 8 Two complex numbers,  $\alpha$  and  $\beta$ , are given by  $\alpha = \sqrt{3} + j$  and  $\beta = 3j$ .
- (i) Find the modulus and argument of  $\alpha$  and  $\beta$ . [3]
- (ii) Find  $\alpha\beta$  and  $\frac{\beta}{\alpha}$ , giving your answers in the form  $a + bj$ , showing your working. [5]
- (iii) Plot  $\alpha$ ,  $\beta$ ,  $\alpha\beta$  and  $\frac{\beta}{\alpha}$  on a single Argand diagram. [2]

[Question 9 is printed overleaf.]

9 The matrices  $\mathbf{P} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$  and  $\mathbf{Q} = \begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$  represent transformations P and Q respectively.

(i) Describe fully the transformations P and Q. [4]

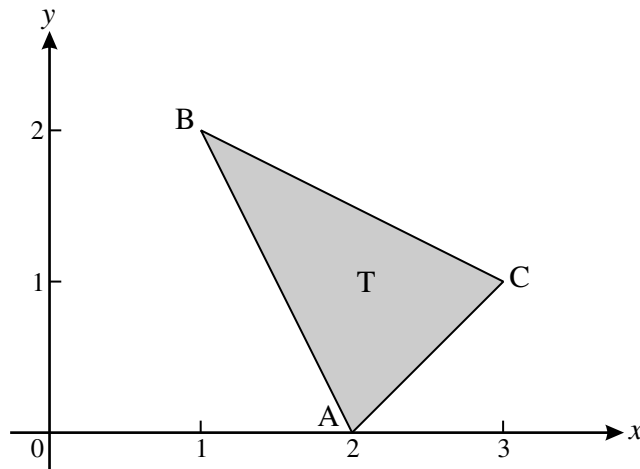


Fig. 9

Fig. 9 shows triangle T with vertices A (2, 0), B (1, 2) and C (3, 1).

Triangle T is transformed first by transformation P, then by transformation Q.

(ii) Find the single matrix that represents this composite transformation. [2]

(iii) This composite transformation maps triangle T onto triangle T', with vertices A', B' and C'. Calculate the coordinates of A', B' and C'. [2]

T' is reflected in the line  $y = -x$  to give a new triangle, T''.

(iv) Find the matrix  $\mathbf{R}$  that represents reflection in the line  $y = -x$ . [2]

(v) A single transformation maps T'' onto the original triangle, T. Find the matrix representing this transformation. [4]

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