

**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
- Graph paper
- MEI Examination Formulae and Tables (MF2)

**Other Materials Required:**

None

**Friday 22 May 2009**

**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 (i) Find the inverse of the matrix  $\mathbf{M} = \begin{pmatrix} 4 & -1 \\ 3 & 2 \end{pmatrix}$ . [2]

(ii) Use this inverse to solve the simultaneous equations

$$\begin{aligned} 4x - y &= 49, \\ 3x + 2y &= 100, \end{aligned}$$

showing your working clearly. [3]

2 Show that  $z = 3$  is a root of the cubic equation  $z^3 + z^2 - 7z - 15 = 0$  and find the other roots. [5]

3 (i) Sketch the graph of  $y = \frac{2}{x+4}$ . [2]

(ii) Solve the inequality

$$\frac{2}{x+4} \leq x+3,$$

showing your working clearly. [5]

4 The roots of the cubic equation  $2x^3 + x^2 + px + q = 0$  are  $2w$ ,  $-6w$  and  $3w$ . Find the values of the roots and the values of  $p$  and  $q$ . [6]

5 (i) Show that  $\frac{1}{5r-2} - \frac{1}{5r+3} \equiv \frac{5}{(5r-2)(5r+3)}$  for all integers  $r$ . [2]

(ii) Hence use the method of differences to show that  $\sum_{r=1}^n \frac{1}{(5r-2)(5r+3)} = \frac{n}{3(5n+3)}$ . [4]

6 Prove by induction that  $3 + 10 + 17 + \dots + (7n-4) = \frac{1}{2}n(7n-1)$  for all positive integers  $n$ . [7]

## Section B (36 marks)

- 7 A curve has equation  $y = \frac{(x+2)(3x-5)}{(2x+1)(x-1)}$ .
- (i) Write down the coordinates of the points where the curve crosses the axes. [3]
- (ii) Write down the equations of the three asymptotes. [3]
- (iii) Determine whether the curve approaches the horizontal asymptote from above or below for
- (A) large positive values of  $x$ ,
- (B) large negative values of  $x$ . [3]
- (iv) Sketch the curve. [3]
- 8 Fig. 8 shows an Argand diagram.

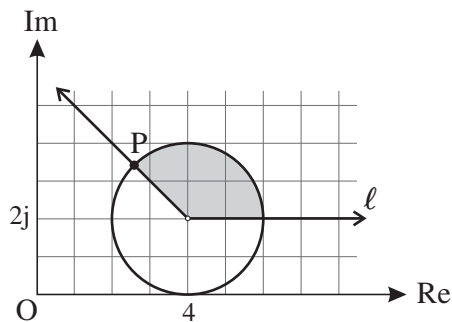


Fig. 8

- (i) Write down the equation of the locus represented by the perimeter of the circle in the Argand diagram. [3]
- (ii) Write down the equation of the locus represented by the half-line  $\ell$  in the Argand diagram. [3]
- (iii) Express the complex number represented by the point P in the form  $a + bj$ , giving the exact values of  $a$  and  $b$ . [3]
- (iv) Use inequalities to describe the set of points that fall within the shaded region (excluding its boundaries) in the Argand diagram. [3]

[Question 9 is printed overleaf.]

9 You are given that  $\mathbf{M} = \begin{pmatrix} 3 & 0 \\ 0 & 2 \end{pmatrix}$ ,  $\mathbf{N} = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$  and  $\mathbf{Q} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ .

- (i) The matrix products  $\mathbf{Q}(\mathbf{MN})$  and  $(\mathbf{QM})\mathbf{N}$  are identical. What property of matrix multiplication does this illustrate?

Find  $\mathbf{QMN}$ .

[4]

$\mathbf{M}$ ,  $\mathbf{N}$  and  $\mathbf{Q}$  represent the transformations  $M$ ,  $N$  and  $Q$  respectively.

- (ii) Describe the transformations  $M$ ,  $N$  and  $Q$ .

[4]

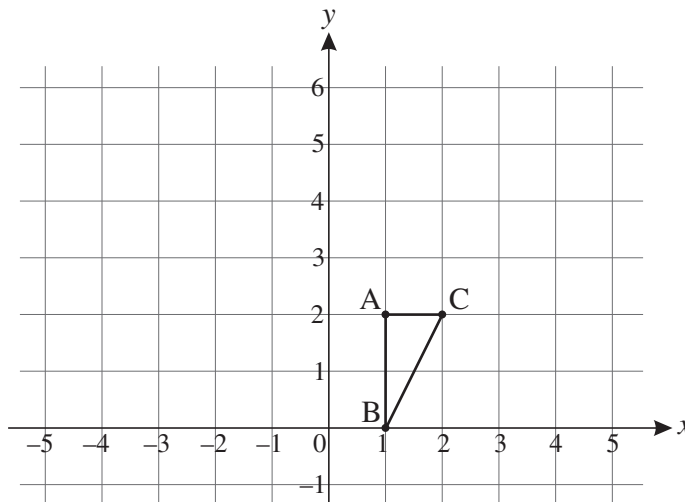


Fig. 9

- (iii) The points  $A$ ,  $B$  and  $C$  in the triangle in Fig. 9 are mapped to the points  $A'$ ,  $B'$  and  $C'$  respectively by the composite transformation  $N$  followed by  $M$  followed by  $Q$ . Draw a diagram showing the image of the triangle after this composite transformation, labelling the image of each point clearly.

[4]

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