OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI) 4755

Further Concepts for Advanced Mathematics (FP1)

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

4755

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

$$4x - y = 49,$$
$$3x + 2y = 100,$$

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 $y = \dfrac{2}{x+4}$. **[2]**

(ii) Solve the inequality

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

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 $\dfrac{1}{5r-2} - \dfrac{1}{5r+3} \equiv \dfrac{5}{(5r-2)(5r+3)}$ for all integers r. **[2]**

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

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

Section B (36 marks)

7 A curve has equation $y = \dfrac{(x+2)(3x-5)}{(2x+1)(x-1)}$.

(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.

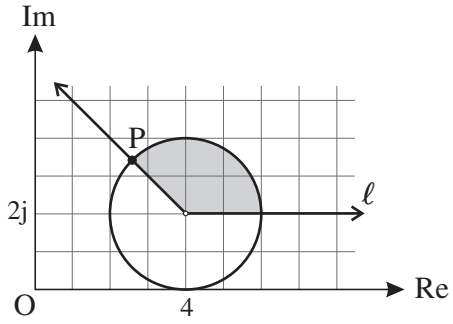

Fig. 8

(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 ℓ in the Argand diagram. **[3]**

(iii) Express the complex number represented by the point P in the form $a + b\mathrm{j}$, 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 **Q**(**MN**) and (**QM**)**N** are identical. What property of matrix multiplication does this illustrate?

Find **QMN**. **[4]**

M, **N** and **Q** represent the transformations M, N and Q respectively.

(ii) Describe the transformations M, N and Q. **[4]**

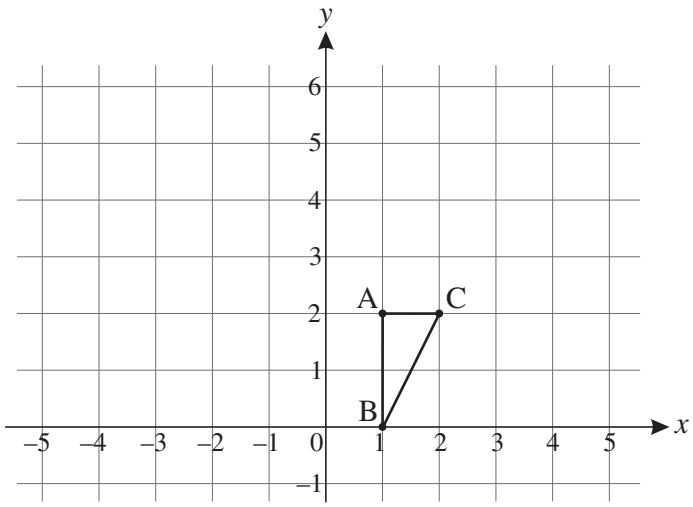

Fig. 9

(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]**