

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.

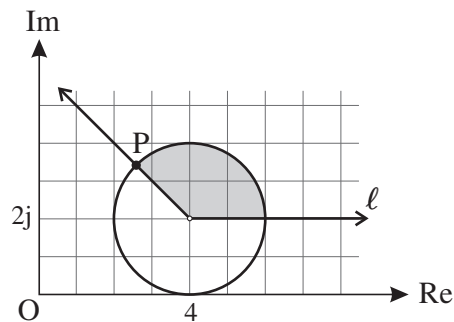


Fig. 8

(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 ℓ 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]

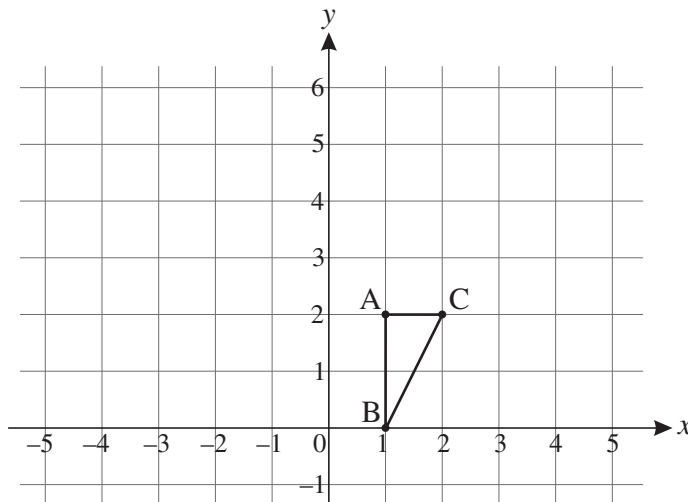


Fig. 9

- (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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