



**ADVANCED SUBSIDIARY GCE
MATHEMATICS (MEI)**

4755

Further Concepts for Advanced Mathematics (FP1)

QUESTION PAPER

Candidates answer on the printed answer book.

OCR supplied materials:

- Printed answer book 4755
- MEI Examination Formulae and Tables (MF2)

Other materials required:

- Scientific or graphical calculator

**Wednesday 19 January 2011
Afternoon**

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 in the centre of 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. 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 destroyed.

Section A (36 marks)

- 1 Find the values of P , Q , R and S in the identity $3x^3 + 18x^2 + Px + 31 \equiv Q(x + R)^3 + S$. [5]
- 2 You are given that $\mathbf{M} = \begin{pmatrix} 4 & 0 \\ -1 & 3 \end{pmatrix}$.
- (i) The transformation associated with \mathbf{M} is applied to a figure of area 3 square units. Find the area of the transformed figure. [2]
- (ii) Find \mathbf{M}^{-1} and $\det \mathbf{M}^{-1}$. [3]
- (iii) Explain the significance of $\det \mathbf{M} \times \det \mathbf{M}^{-1}$ in terms of transformations. [2]
- 3 The roots of the cubic equation $x^3 - 4x^2 + 8x + 3 = 0$ are α , β and γ .
Find a cubic equation whose roots are $2\alpha - 1$, $2\beta - 1$ and $2\gamma - 1$. [7]
- 4 Represent on an Argand diagram the region defined by $2 < |z - (3 + 2j)| \leq 3$. [6]
- 5 Use standard series formulae to show that $\sum_{r=1}^n r^2(3 - 4r) = \frac{1}{2}n(n + 1)(1 - 2n^2)$. [5]
- 6 A sequence is defined by $u_1 = 5$ and $u_{n+1} = u_n + 2^{n+1}$. Prove by induction that $u_n = 2^{n+1} + 1$. [6]

Section B (36 marks)

- 7 Fig. 7 shows part of the curve with equation $y = \frac{x+5}{(2x-5)(3x+8)}$.

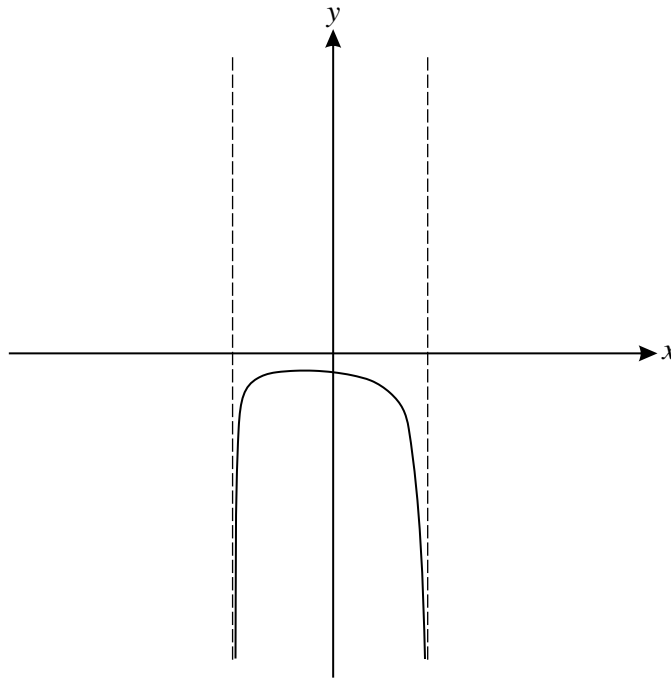


Fig. 7

- (i) Write down the coordinates of the two points where the curve crosses the axes. [2]
- (ii) Write down the equations of the two vertical asymptotes and the one horizontal asymptote. [3]
- (iii) Determine how the curve approaches the horizontal asymptote for large positive and large negative values of x . [3]
- (iv) On the copy of Fig. 7, sketch the rest of the curve. [2]
- (v) Solve the inequality $\frac{x+5}{(2x-5)(3x+8)} < 0$. [2]
- 8 The function $f(z) = z^4 - z^3 + az^2 + bz + c$ has real coefficients. The equation $f(z) = 0$ has roots α , β , γ and δ where $\alpha = 1$ and $\beta = 1 + j$.
- (i) Write down the other complex root and explain why the equation must have a second real root. [2]
- (ii) Write down the value of $\alpha + \beta + \gamma + \delta$ and find the second real root. [3]
- (iii) Find the values of a , b and c . [5]
- (iv) Write down $f(-z)$ and the roots of $f(-z) = 0$. [2]

9 You are given that $\mathbf{A} = \begin{pmatrix} -2 & 1 & -5 \\ 3 & a & 1 \\ 1 & -1 & 2 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 2a+1 & 3 & 1+5a \\ -5 & 1 & -13 \\ -3-a & -1 & -2a-3 \end{pmatrix}$.

(i) Show that $\mathbf{AB} = (8+a)\mathbf{I}$. [3]

(ii) State the value of a for which \mathbf{A}^{-1} does not exist. Write down \mathbf{A}^{-1} in terms of a , when \mathbf{A}^{-1} exists. [3]

(iii) Use \mathbf{A}^{-1} to solve the following simultaneous equations. [5]

$$-2x + y - 5z = -55$$

$$3x + 4y + z = -9$$

$$x - y + 2z = 26$$

(iv) What can you say about the solutions of the following simultaneous equations? [1]

$$-2x + y - 5z = p$$

$$3x - 8y + z = q$$

$$x - y + 2z = r$$

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