

Monday 13 May 2013 – Afternoon

AS GCE MATHEMATICS (MEI)

4755/01 Further Concepts for Advanced Mathematics (FP1)

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:

- Printed Answer Book 4755/01
- MEI Examination Formulae and Tables (MF2)

Other materials required:

- Scientific or graphical calculator

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. HB 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 recycled. Please contact OCR Copyright should you wish to re-use this document.

Section A (36 marks)

1 Find the values of A , B , C and D in the identity $2x(x^2 - 5) \equiv (x - 2)(Ax^2 + Bx + C) + D$. [5]

2 You are given that $z = \frac{3}{2}$ is a root of the cubic equation $2z^3 + 9z^2 + 2z - 30 = 0$. Find the other two roots. [6]

3 You are given that $\mathbf{N} = \begin{pmatrix} -9 & -2 & -4 \\ 3 & 2 & 2 \\ 5 & 1 & 2 \end{pmatrix}$ and $\mathbf{N}^{-1} = \begin{pmatrix} 1 & 0 & 2 \\ 2 & 1 & 3 \\ -\frac{7}{2} & p & -6 \end{pmatrix}$.

(i) Find the value of p . [2]

(ii) Solve the equation $\mathbf{N} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} -39 \\ 5 \\ 22 \end{pmatrix}$. [4]

4 The complex number z_1 is $3 - 2j$ and the complex number z_2 has modulus 5 and argument $\frac{\pi}{4}$.

(i) Express z_2 in the form $a + bj$, giving a and b in exact form. [2]

(ii) Represent z_1 , z_2 , $z_1 + z_2$ and $z_1 - z_2$ on a single Argand diagram. [4]

5 You are given that $\frac{4}{(4n - 3)(4n + 1)} \equiv \frac{1}{4n - 3} - \frac{1}{4n + 1}$. Use the method of differences to show that

$$\sum_{r=1}^n \frac{1}{(4r - 3)(4r + 1)} = \frac{n}{4n + 1}. \quad [6]$$

6 The cubic equation $x^3 - 5x^2 + 3x - 6 = 0$ has roots α , β and γ . Find a cubic equation with roots $\frac{\alpha}{3} + 1$, $\frac{\beta}{3} + 1$ and $\frac{\gamma}{3} + 1$, simplifying your answer as far as possible. [7]

Section B (36 marks)

- 7 Fig. 7 shows an incomplete sketch of $y = \frac{cx^2}{(bx-1)(x+a)}$ where a , b and c are integers. The asymptotes of the curve are also shown.

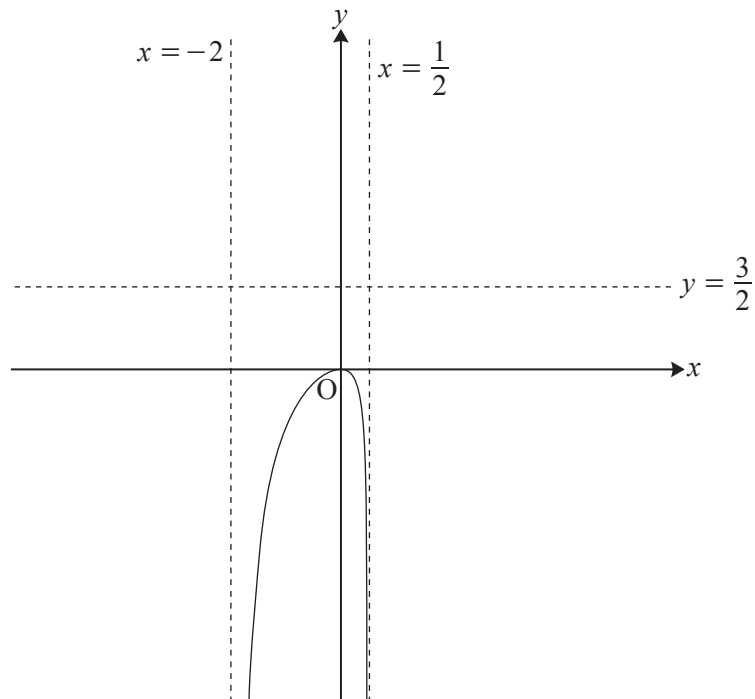


Fig. 7

- (i) Determine the values of a , b and c . [4]

Use these values of a , b and c throughout the rest of the question.

- (ii) Determine how the curve approaches the horizontal asymptote for large positive values of x , and for large negative values of x , justifying your answer. On the copy of Fig. 7, sketch the rest of the curve. [4]

- (iii) Find the x coordinates of the points on the curve where $y = 1$. Write down the solution to the inequality $\frac{cx^2}{(bx-1)(x+a)} < 1$. [4]

- 8 (i) Use standard series formulae to show that

$$\sum_{r=1}^n [r(r-1) - 1] = \frac{1}{3}n(n+2)(n-2). \quad (*) \quad [5]$$

- (ii) Prove (*) by mathematical induction. [7]

- 9 (i) Describe fully the transformation Q , represented by the matrix \mathbf{Q} , where $\mathbf{Q} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$. [2]

The transformation M is represented by the matrix \mathbf{M} , where $\mathbf{M} = \begin{pmatrix} 0 & -1 \\ 0 & 1 \end{pmatrix}$.

- (ii) M maps all points on the line $y = 2$ onto a single point, P . Find the coordinates of P . [2]
- (iii) M maps all points on the plane onto a single line, l . Find the equation of l . [2]
- (iv) M maps all points on the line n onto the point $(-6, 6)$. Find the equation of n . [2]
- (v) Show that \mathbf{M} is singular. Relate this to the transformation it represents. [2]
- (vi) R is the composite transformation M followed by Q . R maps all points on the plane onto the line q . Find the equation of q . [2]

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