

**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  $\alpha$ ,  $\beta$  and  $\gamma$ . 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.

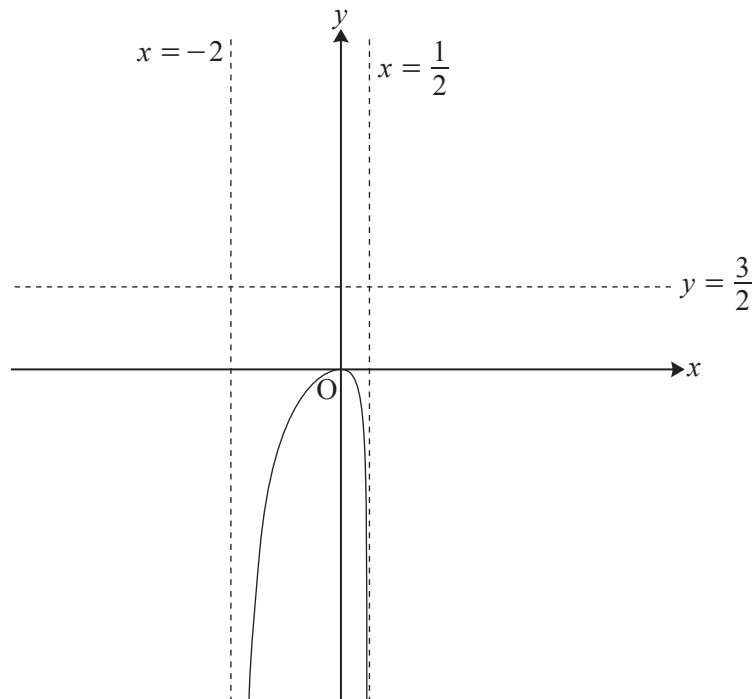


Fig. 7

- (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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