



## 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

**Friday 20 May 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 (i) Write down the matrix for a rotation of  $90^\circ$  anticlockwise about the origin. [1]
- (ii) Write down the matrix for a reflection in the line  $y = x$ . [1]
- (iii) Find the matrix for the composite transformation of rotation of  $90^\circ$  anticlockwise about the origin, followed by a reflection in the line  $y = x$ . [2]
- (iv) What single transformation is equivalent to this composite transformation? [1]
- 2 You are given that  $z = 3 - 2j$  and  $w = -4 + j$ .
- (i) Express  $\frac{z + w}{w}$  in the form  $a + bj$ . [3]
- (ii) Express  $w$  in modulus-argument form. [3]
- (iii) Show  $w$  on an Argand diagram, indicating its modulus and argument. [2]
- 3 The equation  $x^3 + px^2 + qx + 3 = 0$  has roots  $\alpha$ ,  $\beta$  and  $\gamma$ , where
- $$\alpha + \beta + \gamma = 4$$
- $$\alpha^2 + \beta^2 + \gamma^2 = 6.$$
- Find  $p$  and  $q$ . [5]
- 4 Solve the inequality  $\frac{5x}{x^2 + 4} < x$ . [6]
- 5 Given that  $\frac{3}{(3r-1)(3r+2)} \equiv \frac{1}{3r-1} - \frac{1}{3r+2}$ , find  $\sum_{r=1}^{20} \frac{1}{(3r-1)(3r+2)}$ , giving your answer as an exact fraction. [5]
- 6 Prove by induction that  $1 + 8 + 27 + \dots + n^3 = \frac{1}{4}n^2(n+1)^2$ . [7]

**Section B** (36 marks)

7 A curve has equation  $y = \frac{(x+9)(3x-8)}{x^2-4}$ .

(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 A polynomial  $P(z)$  has real coefficients. Two of the roots of  $P(z) = 0$  are  $2 - j$  and  $-1 + 2j$ .

(i) Explain why  $P(z)$  cannot be a cubic. [1]

You are given that  $P(z)$  is a quartic.

(ii) Write down the other roots of  $P(z) = 0$  and hence find  $P(z)$  in the form  $z^4 + az^3 + bz^2 + cz + d$ . [8]

(iii) Show the roots of  $P(z) = 0$  on an Argand diagram and give, in terms of  $z$ , the equation of the circle they lie on. [2]

9 The simultaneous equations

$$2x - y = 1$$

$$3x + ky = b$$

are represented by the matrix equation  $\mathbf{M} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1 \\ b \end{pmatrix}$ .

(i) Write down the matrix  $\mathbf{M}$ . [2]

(ii) State the value of  $k$  for which  $\mathbf{M}^{-1}$  does not exist and find  $\mathbf{M}^{-1}$  in terms of  $k$  when  $\mathbf{M}^{-1}$  exists.

Use  $\mathbf{M}^{-1}$  to solve the simultaneous equations when  $k = 5$  and  $b = 21$ . [7]

(iii) What can you say about the solutions of the equations when  $k = -\frac{3}{2}$ ? [1]

(iv) The two equations can be interpreted as representing two lines in the  $x$ - $y$  plane. Describe the relationship between these two lines

(A) when  $k = 5$  and  $b = 21$ ,

(B) when  $k = -\frac{3}{2}$  and  $b = 1$ ,

(C) when  $k = -\frac{3}{2}$  and  $b = \frac{3}{2}$ . [3]

**THERE ARE NO QUESTIONS PRINTED ON THIS PAGE**



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