



ADVANCED SUBSIDIARY GCE MATHEMATICS (MEI)

Further Concepts for Advanced Mathematics (FP1)

4755

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° 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° 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 α, β and γ , where

$$\begin{aligned}\alpha + \beta + \gamma &= 4 \\ \alpha^2 + \beta^2 + \gamma^2 &= 6.\end{aligned}$$

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

$$\begin{aligned} 2x - y &= 1 \\ 3x + ky &= b \end{aligned}$$

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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