

**ADVANCED SUBSIDIARY GCE
MATHEMATICS**

Further Pure Mathematics 1

4725

QUESTION PAPER

Candidates answer on the printed answer book.

OCR supplied materials:

- Printed answer book 4725
- List of Formulae (MF1)

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.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.

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 reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- The printed answer book consists of **12** 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.

- 1 The matrices **A**, **B** and **C** are given by $\mathbf{A} = \begin{pmatrix} 2 & 5 \end{pmatrix}$, $\mathbf{B} = \begin{pmatrix} 3 & -1 \end{pmatrix}$ and $\mathbf{C} = \begin{pmatrix} 4 \\ 2 \end{pmatrix}$. Find
- (i) $2\mathbf{A} + \mathbf{B}$, [2]
- (ii) \mathbf{AC} , [2]
- (iii) \mathbf{CB} . [3]
- 2 The complex numbers z and w are given by $z = 4 + 3i$ and $w = 6 - i$. Giving your answers in the form $x + iy$ and showing clearly how you obtain them, find
- (i) $3z - 4w$, [2]
- (ii) $\frac{z^*}{w}$. [4]
- 3 The sequence u_1, u_2, u_3, \dots is defined by $u_1 = 2$, and $u_{n+1} = 2u_n - 1$ for $n \geq 1$. Prove by induction that $u_n = 2^{n-1} + 1$. [4]
- 4 Given that $\sum_{r=1}^n (ar^3 + br) \equiv n(n-1)(n+1)(n+2)$, find the values of the constants a and b . [6]
- 5 Given that **A** and **B** are non-singular square matrices, simplify
- $$\mathbf{AB}(\mathbf{A}^{-1}\mathbf{B})^{-1}. \quad [3]$$
- 6 (i) Sketch on a single Argand diagram the loci given by
- (a) $|z| = |z - 8|$, [2]
- (b) $\arg(z + 2i) = \frac{1}{4}\pi$. [3]
- (ii) Indicate by shading the region of the Argand diagram for which
- $$|z| \leq |z - 8| \quad \text{and} \quad 0 \leq \arg(z + 2i) \leq \frac{1}{4}\pi. \quad [3]$$
- 7 (i) Write down the matrix, **A**, that represents a shear with x -axis invariant in which the image of the point $(1, 1)$ is $(4, 1)$. [2]
- (ii) The matrix **B** is given by $\mathbf{B} = \begin{pmatrix} \sqrt{3} & 0 \\ 0 & \sqrt{3} \end{pmatrix}$. Describe fully the geometrical transformation represented by **B**. [2]
- (iii) The matrix **C** is given by $\mathbf{C} = \begin{pmatrix} 2 & 6 \\ 0 & 2 \end{pmatrix}$.
- (a) Draw a diagram showing the unit square and its image under the transformation represented by **C**. [3]
- (b) Write down the determinant of **C** and explain briefly how this value relates to the transformation represented by **C**. [2]

- 8 The quadratic equation $2x^2 - x + 3 = 0$ has roots α and β , and the quadratic equation $x^2 - px + q = 0$ has roots $\alpha + \frac{1}{\alpha}$ and $\beta + \frac{1}{\beta}$.

(i) Show that $p = \frac{5}{6}$. [4]

(ii) Find the value of q . [5]

- 9 The matrix \mathbf{M} is given by $\mathbf{M} = \begin{pmatrix} a & -a & 1 \\ 3 & a & 1 \\ 4 & 2 & 1 \end{pmatrix}$.

(i) Find, in terms of a , the determinant of \mathbf{M} . [3]

(ii) Hence find the values of a for which \mathbf{M}^{-1} does not exist. [3]

- (iii) Determine whether the simultaneous equations

$$6x - 6y + z = 3k,$$

$$3x + 6y + z = 0,$$

$$4x + 2y + z = k,$$

where k is a non-zero constant, have a unique solution, no solution or an infinite number of solutions, justifying your answer. [3]

10 (i) Show that $\frac{1}{r} - \frac{2}{r+1} + \frac{1}{r+2} \equiv \frac{2}{r(r+1)(r+2)}$. [2]

- (ii) Hence find an expression, in terms of n , for

$$\sum_{r=1}^n \frac{2}{r(r+1)(r+2)}. \quad [6]$$

(iii) Show that $\sum_{r=n+1}^{\infty} \frac{2}{r(r+1)(r+2)} = \frac{1}{(n+1)(n+2)}$. [3]

There are no questions printed on this page.



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PRINTED ANSWER BOOK

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Candidate forename		Candidate surname	
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Centre number						Candidate number				
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1 (i)	
1 (ii)	
1 (iii)	

2 (i)	
2 (ii)	

3	

5	
6	

7 (i)	
7 (ii)	
7 (iii) (a)	
7 (iii) (b)	

8 (i)	
8 (ii)	

9 (i)	

9 (ii)	

9 (iii)	
10 (i)	

10 (ii)	

10 (iii)	



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