

**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  $\alpha$  and  $\beta$ , 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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<b>1 (i)</b>	
<b>1 (ii)</b>	
<b>1 (iii)</b>	

<b>2 (i)</b>	
<b>2 (ii)</b>	

3



4

5	
6	

<b>7 (i)</b>	
<b>7 (ii)</b>	
<b>7 (iii) (a)</b>	
<b>7 (iii) (b)</b>	

<b>8 (i)</b>	
<b>8 (ii)</b>	

<b>9 (i)</b>	
	<b>9 (ii)</b>

<b>9 (iii)</b>	
	<b>10 (i)</b>

**10 (ii)**

<b>10 (iii)</b>	



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