

**Monday 14 May 2018 – 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 inside 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.** If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- 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 barcodes.
- 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

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**Section A** (36 marks)

- 1 The matrices **A** and **B** are given by  $\mathbf{A} = \begin{pmatrix} 2 & 2k & -k \\ 0 & 1 & -1 \end{pmatrix}$  and  $\mathbf{B} = \begin{pmatrix} 1 & 2 \\ 3 & -3 \\ -2 & 4 \end{pmatrix}$ , where  $k$  is a constant.

(i) Find, in terms of  $k$ , the matrix  $\mathbf{AB}$ . [2]

(ii) Find the value of  $k$  for which matrix  $\mathbf{AB}$  is singular. [2]

- 2 The quadratic equation  $x^2 + px + q = 0$  has roots  $\alpha$  and  $\beta$ , where

$$\begin{aligned}\alpha^2 + \beta^2 &= -16, \\ \alpha - \beta &= 6j.\end{aligned}$$

By considering  $(\alpha - \beta)^2$ , find the value of  $\alpha\beta$ . Hence state the value of  $q$  and find the possible values of  $p$ . [5]

- 3 (i) Sketch on an Argand diagram the set of points representing complex numbers  $z$  for which

$$|z - (3 + 3j)| = 3. \quad [2]$$

(ii) Find the greatest possible value of  $|z|$  for this set of points. [2]

(iii) Mark on your Argand diagram the particular point for which  $\arg(z - (3 + 3j)) = \frac{2}{3}\pi$ . Find this value of  $z$  in the form  $a + jb$ . [3]

- 4 (i) Use standard series formulae to show that

$$\sum_{r=1}^n r(2 + 3r) = \frac{1}{2}n(n+1)(2n+3). \quad [4]$$

(ii) Hence find the value of  $n$  such that

$$\sum_{r=1}^{4n} r(2 + 3r) = 198n(4n+1). \quad [3]$$

- 5 You are given that  $z = 2 + 5j$  is a root of the cubic equation  $2z^3 - 5z^2 + pz + q = 0$ , where  $p$  and  $q$  are real constants. Find the values of  $p$  and  $q$ . [6]

- 6 Prove by induction that, for all positive integers  $n$ ,  $\sum_{r=1}^n r2^r = 2[1 + (n-1)2^n]$ . [7]

## Section B (36 marks)

7 A curve has equation  $y = \frac{2x^2 - 5x - 3}{x^2 + x - 2}$ .

(i) Find the values of  $x$  for which  $y = 0$ . [2]

(ii) Find 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  $x$ . [2]

(iv) Sketch the curve. [3]

(v) Solve the inequality  $\frac{2x^2 - 5x - 3}{x^2 + x - 2} \geq 0$ . [3]

8 You are given that  $\frac{1}{2r-1} - \frac{1}{2r+3} = \frac{4}{(2r-1)(2r+3)}$  for all integers  $r$ .

(i) Use the method of differences to show that

$$\sum_{r=1}^n \frac{1}{(2r-1)(2r+3)} = k - \frac{n+1}{(2n+1)(2n+3)},$$

stating the value of  $k$ .

[6]

(ii) The sum of the infinite series

$$\frac{1}{(2(n+1)-1)(2(n+1)+3)} + \frac{1}{(2(n+2)-1)(2(n+2)+3)} + \frac{1}{(2(n+3)-1)(2(n+3)+3)} + \dots$$

is  $\frac{7}{195}$ . Show that  $n$  satisfies  $28n^2 - 139n - 174 = 0$  and hence find the value of  $n$ . [5]

9 You are given that  $\mathbf{M} = \begin{pmatrix} 4 & a \\ -6 & -2 \end{pmatrix}$  and  $\mathbf{N} = \begin{pmatrix} -2 & 6 \\ -4a & -14 \end{pmatrix}$ , where  $a$  is a real constant. Find the possible value(s) of  $a$  in each of the following cases.

(i) The point  $(1, -2)$  is invariant under the transformation represented by matrix  $\mathbf{M}$ . [2]

(ii)  $(\mathbf{NM}^{-1})^{-1}\mathbf{NM} = \mathbf{N}$ . [4]

(iii) A triangle  $T_1$  has an area of 9 square units. The triangle  $T_1$  is transformed to triangle  $T_2$  by the transformation represented by matrix  $\mathbf{M}$ . The area of triangle  $T_2$  is 144 square units. [6]

END OF QUESTION PAPER

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