



Oxford Cambridge and RSA

# AS Level Further Mathematics B (MEI)

Y410/01 Core Pure

Question Paper

**Monday 14 May 2018 – Afternoon**

**Time allowed: 1 hour 15 minutes**



**You must have:**

- Printed Answer Booklet
- Formulae Further Mathematics B (MEI)

**You may use:**

- a scientific or graphical calculator

## INSTRUCTIONS

- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes provided on the Printed Answer Booklet with your name, centre number and candidate number.
- Answer **all** the questions.
- **Write your answer to each question in the space provided in the Printed Answer Booklet.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- 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

- The total number of marks for this paper is **60**.
- The marks for each question are shown in brackets [ ].
- 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 used. You should communicate your method with correct reasoning.
- The Printed Answer Booklet consists of **12** pages. The Question Paper consists of **4** pages.

Answer **all** the questions.

- 1 The matrices **A**, **B** and **C** are defined as follows:

$$\mathbf{A} = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}, \quad \mathbf{B} = \begin{pmatrix} 2 & 0 & 3 \\ 1 & -1 & 3 \end{pmatrix}, \quad \mathbf{C} = (1 \ 3).$$

Calculate all possible products formed from two of these three matrices. [4]

- 2 Find, to the nearest degree, the angle between the vectors  $\begin{pmatrix} 1 \\ 0 \\ -2 \end{pmatrix}$  and  $\begin{pmatrix} -2 \\ 3 \\ -3 \end{pmatrix}$ . [3]

- 3 Find real numbers  $a$  and  $b$  such that  $(a - 3i)(5 - i) = b - 17i$ . [5]

- 4 Find a cubic equation with real coefficients, two of whose roots are  $2 - i$  and  $3$ . [5]

- 5 A transformation of the  $x$ - $y$  plane is represented by the matrix  $\begin{pmatrix} \cos \theta & 2 \sin \theta \\ 2 \sin \theta & -\cos \theta \end{pmatrix}$ , where  $\theta$  is a positive acute angle.

(i) Write down the image of the point  $(2, 3)$  under this transformation. [2]

(ii) You are given that this image is the point  $(a, 0)$ . Find the value of  $a$ . [5]

- 6 Find the invariant line of the transformation of the  $x$ - $y$  plane represented by the matrix  $\begin{pmatrix} 2 & 0 \\ 4 & -1 \end{pmatrix}$ . [4]

- 7 (i) Express  $\frac{1}{2r-1} - \frac{1}{2r+1}$  as a single fraction. [2]

(ii) Find how many terms of the series

$$\frac{2}{1 \times 3} + \frac{2}{3 \times 5} + \frac{2}{5 \times 7} + \dots + \frac{2}{(2r-1)(2r+1)} + \dots$$

are needed for the sum to exceed 0.999999. [7]

- 8 Prove by induction that  $\begin{pmatrix} 1 & 1 \\ 0 & 2 \end{pmatrix}^n = \begin{pmatrix} 1 & 2^n - 1 \\ 0 & 2^n \end{pmatrix}$  for all positive integers  $n$ . [6]

- 9 Fig. 9 shows a sketch of the region OPQ of the Argand diagram defined by

$$\{z : |z| \leq 4\sqrt{2}\} \cap \{z : \frac{1}{4}\pi \leq \arg z \leq \frac{1}{3}\pi\}.$$

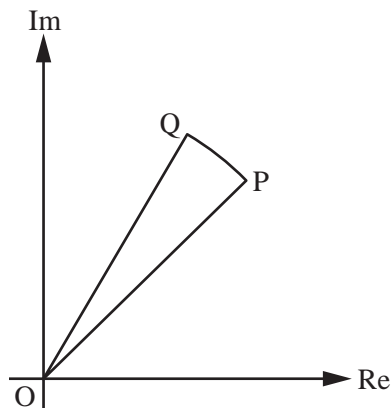


Fig. 9

- (i) Find, in modulus-argument form, the complex number represented by the point P. [2]
- (ii) Find, in the form  $a + ib$ , where  $a$  and  $b$  are exact real numbers, the complex number represented by the point Q. [3]
- (iii) **In this question you must show detailed reasoning.**

Determine whether the points representing the complex numbers

- $3 + 5i$
- $5.5(\cos 0.8 + i \sin 0.8)$

lie within this region.

[4]

- 10 Three planes have equations

$$-x + 2y + z = 0$$

$$2x - y - z = 0$$

$$x + y = a$$

where  $a$  is a constant.

- (i) Investigate the arrangement of the planes:

- when  $a = 0$ ;
- when  $a \neq 0$ .

[6]

- (ii) Chris claims that the position vectors  $-\mathbf{i} + 2\mathbf{j} + \mathbf{k}$ ,  $2\mathbf{i} - \mathbf{j} - \mathbf{k}$  and  $\mathbf{i} + \mathbf{j}$  lie in a plane. Determine whether or not Chris is correct. [2]

**END OF QUESTION PAPER**

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