



Oxford Cambridge and RSA

# AS Level Further Mathematics B (MEI)

Y410/01 Core Pure

## Practice Paper – Set 2

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 In this question you must show detailed reasoning.**

(i) Solve the equation  $z^2 - 2z + 4 = 0$ . [2]

(ii) Express the roots of the equation in part (i) in exact modulus-argument form. [4]

**2** The matrix  $\mathbf{M}$  is such that  $\mathbf{M} \begin{pmatrix} 1 & 0 & k \\ 2 & -1 & 1 \end{pmatrix} = \begin{pmatrix} 1 & -2 & 0 \end{pmatrix}$ .

Find

- the matrix  $\mathbf{M}$ ,
- the value of the constant  $k$ . [6]

**3 In this question you must show detailed reasoning.**

Given that  $\text{Im}[(2 + bi)^4] = 0$ , where  $b$  is real, find the possible values of  $b$ . [5]

**4** Prove by induction that the sum of the first  $n$  cube numbers is  $\frac{1}{4}n^2(n+1)^2$ . [5]

**5 In this question you must show detailed reasoning.**

The equation  $x^3 - 2x^2 + 3x + 1 = 0$  has roots  $\alpha$ ,  $\beta$  and  $\gamma$ .

(i) Find  $\alpha^2 + \beta^2 + \gamma^2$ . [3]

(ii) Find a cubic equation with integer coefficients whose roots are  $2\alpha - 1$ ,  $2\beta - 1$  and  $2\gamma - 1$ . [4]

**6** In the quartic equation  $z^4 + az^3 + bz^2 + cz + d = 0$ , the coefficients  $a$ ,  $b$ ,  $c$  and  $d$  are real. Two of the roots of the equation are  $i$  and  $2 - i$ .

Find the value of  $a$ ,  $b$ ,  $c$  and  $d$ . [6]

7 The matrix  $\mathbf{M}$  is given by  $\mathbf{M} = \begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix}$ .

(i) The unit square shown in the printed answer booklet has vertices  $O(0, 0)$ ,  $A(1, 0)$ ,  $B(1, 1)$  and  $C(0, 1)$ . Plot the image of the unit square under the linear transformation represented by the matrix  $\mathbf{M}$ . [2]

(ii) (A) Calculate  $\det \mathbf{M}$ . [1]

(B) Comment on the significance of the value of  $\det \mathbf{M}$  for the linear transformation represented by  $\mathbf{M}$ . [1]

Matrices  $\mathbf{S}$  and  $\mathbf{T}$  are given by  $\mathbf{S} = \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$  and  $\mathbf{T} = \mathbf{S}^{-1}\mathbf{M}$ .

(iii) (A) Calculate  $\mathbf{T}$ . [2]

(B) Deduce a sequence of two linear transformations equivalent to the transformation represented by  $\mathbf{M}$ . [3]

(C) How does this sequence of transformations relate to the answers in part (ii)? [1]

8 Fig. 8 shows a half line and a circle drawn in an Argand diagram. The centre of the circle is at the point representing  $3i$ . The half line passes through the point representing  $4i$ .

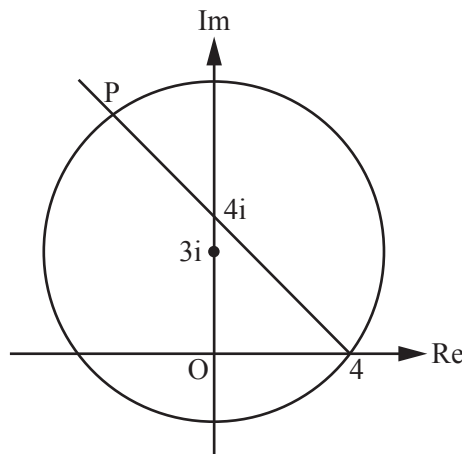


Fig. 8

(i) Find the conditions, involving a complex number  $z$ , that define

(A) the circle, [2]

(B) the half line. [1]

(ii) Find, in the form  $a + bi$ , the complex number represented by the point  $P$ . [5]

9 The plane  $\Pi$  has normal vector  $a\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}$ , where  $a$  is a positive constant, and the point  $(0, 1, 2)$  lies in  $\Pi$ . The vector  $\mathbf{j} + 7\mathbf{k}$  makes an angle of  $30^\circ$  with  $\Pi$ .

Find the cartesian equation of  $\Pi$ . [7]

END OF QUESTION PAPER

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