



Oxford Cambridge and RSA

AS Level Further Mathematics A

Y531/01 Pure Core

Practice Paper – Set 2

Time allowed: 1 hour 15 minutes

You must have:

- Printed Answer Booklet
- Formulae AS Level Further Mathematics A

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.** 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.
- 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.
- The acceleration due to gravity is denoted by $g \text{ m s}^{-2}$. Unless otherwise instructed, when a numerical value is needed, use $g = 9.8$.

INFORMATION

- The total mark for this paper is **60**.
- The marks for each question are shown in brackets [].
- **You are reminded of the need for clear presentation in your answers.**
- The Printed Answer Booklet consists of **12** pages. The Question Paper consists of **4** pages.

Answer **all** the questions.

- 1 (i) The complex number $3 - 4i$ is denoted by z_1 . Write z_1 in modulus-argument form, giving your angle in radians to 3 significant figures. [3]
- (ii) The complex number z_2 has modulus 6 and argument -2.5 radians. Express $z_1 z_2$ in modulus-argument form with the angle in radians correct to 3 significant figures. [3]

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

The quadratic equation $3x^2 - 7x + 5 = 0$ has roots α and β .

- (i) Write down the values of $\alpha + \beta$ and $\alpha\beta$. [2]

- (ii) Hence find the values of the following expressions.

(a) $\frac{1}{\alpha} + \frac{1}{\beta}$ [1]

(b) $\alpha^2 + \beta^2$ [2]

- 3 l_1 and l_2 are two intersecting straight lines with the following equations.

$$l_1: \mathbf{r} = \begin{pmatrix} 3 \\ 3 \\ -5 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ 3 \\ -2 \end{pmatrix}$$

$$l_2: \mathbf{r} = \begin{pmatrix} 1 \\ a \\ 1 \end{pmatrix} + \mu \begin{pmatrix} 2 \\ 2 \\ -3 \end{pmatrix}$$

- (i) Find the position vector of the point of intersection of l_1 and l_2 . [4]

- (ii) Determine the value of a . [2]

- 4 Find, in exact form, the area of the region on an Argand diagram which represents the locus of points for which $|z - 5 - 2i| \leq \sqrt{32}$ and $\operatorname{Re}(z) \geq 9$. [6]

5 The matrix \mathbf{A} is given by $\begin{pmatrix} 1 & 0 & 0 \\ 0 & a^2 & 0 \\ 0 & 0 & 1 \end{pmatrix}$ and the matrix \mathbf{B} is given by $\begin{pmatrix} 0.6 & b & 0 \\ -b & 0.6 & 0 \\ 0 & 0 & 1 \end{pmatrix}$.

(i) \mathbf{A} represents a reflection. Write down the value of $\det \mathbf{A}$. [1]

(ii) Hence find the possible values of a . [2]

(iii) \mathbf{r} is the position vector of a point R . Given that $\mathbf{A}\mathbf{r} = \mathbf{r}$ describe the location of R . [1]

(iv) \mathbf{B} represents a rotation. Write down the value of $\det \mathbf{B}$. [1]

(v) Hence find the possible values of b . [2]

6 The matrix \mathbf{A} is given by $\begin{pmatrix} 1 & 2 \\ 1 & a \end{pmatrix}$ and the matrix \mathbf{B} is given by $\begin{pmatrix} 2 & 1 \\ -1 & b \end{pmatrix}$.

(i) Find the matrix \mathbf{AB} . [2]

(ii) State the conditions on a and b for \mathbf{AB} to be a singular matrix. [4]

$PQRS$ is a quadrilateral and the vertices P , Q , R and S are in clockwise order. A transformation, T , is represented by the matrix \mathbf{AB} .

(iii) State the effect on both the area and also the orientation of the image of $PQRS$ under T in each of the following cases.

(a) $a = 1$ and $b = 1$ [2]

(b) $a = 2$ and $b = 3$ [2]

7 In this question you must show detailed reasoning.

(i) Find the square roots of the number $528 + 46i$ giving your answers in the form $a + bi$. [5]

(ii) $3 + 2i$ is a root of the equation $x^3 - ax + 78 = 0$, where a is a real number.

Find the value of a . [4]

8 In this question you must show detailed reasoning.

A sequence of vectors $\mathbf{a}_1, \mathbf{a}_2, \mathbf{a}_3, \dots$ is defined by

- $\mathbf{a}_1 = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$

- $\mathbf{a}_{n+1} = (\mathbf{a}_n \times \mathbf{b}) \times \mathbf{b}$, for integers $n \geq 1$, where \mathbf{b} is the vector $\frac{1}{4} \begin{pmatrix} -3 \\ 1 \\ 2 \end{pmatrix}$.

(i) Prove by induction that $\mathbf{a}_n = \left(-\frac{7}{8}\right)^{n-1} \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$ for all integers $n \geq 1$. [8]

(ii) Use an algebraic method to find the smallest value of n such that $|\mathbf{a}_n| < 0.001$. [3]

END OF QUESTION PAPER

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