



Oxford Cambridge and RSA

Monday 12 May 2025 – Afternoon

AS Level Further Mathematics A

Y531/01 Pure Core

Time allowed: 1 hour 15 minutes



You must have:

- the Printed Answer Booklet
- the Formulae Booklet for AS Level Further Mathematics A
- a scientific or graphical calculator

QP

INSTRUCTIONS

- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided in the **Printed Answer Booklet**. If you need extra space use the lined page at the end of the Printed Answer Booklet. The question numbers must be clearly shown.
- Fill in the boxes on the front of the Printed Answer Booklet.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.
- Give non-exact numerical answers correct to **3** significant figures unless a different degree of accuracy is specified in the question.
- The acceleration due to gravity is denoted by $g \text{ ms}^{-2}$. When a numerical value is needed use $g = 9.8$ unless a different value is specified in the question.
- Do **not** send this Question Paper for marking. Keep it in the centre or recycle it.

INFORMATION

- The total mark for this paper is **60**.
- The marks for each question are shown in brackets [].
- This document has **4** pages.

ADVICE

- Read each question carefully before you start your answer.

- 1 (a) The complex number z is such that $|z| = 7$ and $\arg(z) = 2.2$ radians.
Express z in cartesian form. [3]
- (b) Use an algebraic method to determine the exact square roots of $1 + (4\sqrt{3})i$. [5]

- 2 Two vectors, $\mathbf{a}$ and $\mathbf{b}$, are given by $\mathbf{a} = \begin{pmatrix} 2 \\ -3 \\ 13 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} -4 \\ 6 \\ p \end{pmatrix}$ where p is a constant.

(a) Find expressions in terms of p for each of the following.

- $\mathbf{a} \cdot \mathbf{b}$
- $\mathbf{a} \times \mathbf{b}$

[3]

(b) Hence or otherwise find the value of p in each of the following cases.

- $\mathbf{a}$ and $\mathbf{b}$ are perpendicular
- $\mathbf{a}$ and $\mathbf{b}$ are parallel

[2]

- 3 The roots of the equation $2x^2 + 3x + 5 = 0$ are denoted by α and β .

(a) Write down the value of $\alpha + \beta$ and the value of $\alpha\beta$.

[2]

(b) Using the answers to part (a) determine the value of each of the following.

- $\alpha^2 + \beta^2$
- $\frac{1}{\alpha} + \frac{1}{\beta}$

[4]

- 4 Two transformations, T_A and T_B , are represented by matrices $\mathbf{A}$ and $\mathbf{B}$ respectively.

The matrix $\mathbf{A}$ is given by $\mathbf{A} = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$.

- (a) (i) Describe the transformation T_A . [1]
 (ii) Explain geometrically why $\mathbf{A}^{-1} = \mathbf{A}$. [1]

The matrix $\mathbf{B}$ is given by $\mathbf{B} = \frac{1}{2} \begin{pmatrix} 1 & -\sqrt{3} \\ \sqrt{3} & 1 \end{pmatrix}$.

- (b) Describe the transformation T_B . [2]

The transformation T_C is equivalent to T_A followed by T_B .

- (c) Determine the single matrix which represents T_C . [2]

- 5 The locus L is defined by $L = \{z : z \in \mathbb{C}, |z - (20 + 15i)| \leq 7\}$.

- (a) On the Argand diagram in the Printed Answer Booklet, sketch and label L . [2]
 (b) Determine the value of $z \in L$ for which the value of $|z|$ is smallest. Give your answer in cartesian form. [3]
 (c) Determine the largest value of $\arg(z)$ for $z \in L$. [3]

- 6 The equations of two lines, l_1 and l_2 , are $l_1 : \mathbf{r} = \begin{pmatrix} 16 \\ -1 \\ 3 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ -27 \\ -19 \end{pmatrix}$ and $l_2 : \mathbf{r} = \begin{pmatrix} 3 \\ 10 \\ -10 \end{pmatrix} + \mu \begin{pmatrix} 1 \\ 10 \\ 10 \end{pmatrix}$.

- (a) Show that l_1 and l_2 intersect at a single point, P , giving the coordinates of P . [5]

O is the origin of the coordinate system. The point Q lies on the line segment OP .

- (b) Comment on the claim that the distance OQ is less than 100. [2]

7 Prove by induction that $n! > 20^n$ for all integers $n \geq 52$. [5]

8 Matrix $\mathbf{A}$ is given by $\mathbf{A} = \begin{pmatrix} 5+a & 5 & 1 \\ 3 & 13+a & 6 \\ a-4 & -20 & -9 \end{pmatrix}$ where a is a constant and all entries of $\mathbf{A}$ are integers.

The transformation represented by $\mathbf{A}$ is applied to a shape of volume 8 units.
The image shape has volume 40 units and the orientation of the image is reversed.

Determine the image under $\mathbf{A}$ of the point $(1, 2, 3)$. [7]

9 (a) Prove that if z is any complex number then $z(z^*) = |z|^2$. [1]

(b) Prove that if w and z are any complex numbers then $(wz)^* = w^*z^*$. [2]

The complex number v is defined by $v = (10 + 3i)(9 + 4i)$.

(c) **In this question you must show detailed reasoning.**

Express v in the form $a + bi$ where a and b are real. [2]

(d) **In this question you must show detailed reasoning.**

By considering $v(v^*)$, write 10573 as the product of two prime factors. [3]

END OF QUESTION PAPER

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