

**INTERIM JOINT MATRICULATION BOARD
AHMADU BELLO UNIVERSITY
ZARIA**



INTERIM JOINT MATRICULATION BOARD EXAMINATION 2016

SUBJECT: 'A' LEVEL MATHEMATICS PAPER I
DATE SCHEDULED: SATURDAY 20TH FEBRUARY, 2016
TIME ALLOWED: TWO HOURS (2 HRS)

Instructions:

- (i) Unless otherwise restricted, the use of mathematical tables is PERMITTED.
- (ii) Use of SCIENTIFIC calculator is ALLOWED.
- (iii) Marks for each question are indicated at the end.
- (iv) Do not spend more than HALF (1/2) HOUR on section A.
- (v) Attempt ALL questions in section A; and FOUR (4) questions from other sections, choosing at least ONE (1) question from each of sections B and C.

SECTION A (20%)

1. Given that $\sin 30^\circ = \frac{1}{2}$, obtain in surd form $\tan 15^\circ$. [04marks]
2. Express $\frac{\sqrt{3} + \sqrt{2}i}{\sqrt{3} - \sqrt{2}i}$ in the form $x + iy$. [04marks]
3. Obtain the quadratic equation whose roots are the reciprocals of the roots of the equation $ax^2 + x + c = 0$. [04marks]
4. What is the remainder when the polynomial $3x^3 - 2x^2 + 6x - 1$ is divided by $(x + 1)$? [04marks]
5. Show that $\sin \phi = \frac{2 \tan \frac{\phi}{2}}{1 + \tan^2 \frac{\phi}{2}}$ [04marks]

SECTION B: ALGEBRA

6. (a) Prove by mathematical induction that
 - (i) $1^3 + 2^3 + 3^3 + \dots + n^3 = \frac{n^2(n+1)^2}{4}$
 - (ii) $4^{2n} - 1$ is a multiple of 5. [10marks]

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(b) The polynomial $px^3 + 3x^2 + 3x + q$ has a remainder $19x - 11$ when divided by $x^2 - 3x + 2$. Find the values of p and q . With these values of p and q factorize the polynomial into linear factors. [10marks]

7. (a) Solve the inequality $\frac{(x-1)(x+3)}{x+2} \geq 0$ [12marks]

(b) If the roots of the quadratic equation $cx^2 + ax - b = 0$ are α and β , obtain the quadratic equation whose roots are $\frac{\alpha^2}{\beta}, \frac{\beta^2}{\alpha}$. [08marks]

8. (a) Given that $A = \begin{pmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & -1 & 2 \\ 0 & 1 & -1 \\ 0 & 0 & 1 \end{pmatrix}$, show that $(A+B)^2 \neq A^2 + 2AB + B^2$.

[11marks]

(b) Resolve $\frac{x^2+1}{x(x-1)(x+1)}$ into partial fractions. Hence obtain its binomial expansion up to term in x^3 . [09marks]

SECTION C: TRIGONOMETRY AND COMPLEX NUMBERS

9. (a). Find roots of the equation $Z^5 - 1 = 0$ where $Z = x + iy$ [10marks]

(b). Express $\tan 3\theta$ in terms of $\tan \theta$. [10marks]

10. (a) If $\cos(x + \theta) = \cos(x - \phi)$, find $\cot x$ in terms of θ and ϕ . [08marks]

(b). If $\sin A = \frac{-4}{5}$ and $\cos B = \frac{12}{13}$ where A and B are both in quadrant IV, find without using tables, the values of (i) $\cos(A + B)$; (ii) $\sin(A - B)$. [12marks]

11. (a) Describe the locus defined by $|Z + i| = 2|3Z + i|$ where $Z = x + iy$. [12marks]

(b). Express $12 \sin \theta - 5 \cos \theta$ in terms of $R \sin(\theta - \alpha)$ and hence solve the equation $12 \sin \theta - 5 \cos \theta = 6.5$ for $0 \leq \theta \leq 360^\circ$. [08marks]