

INTERIM JOINT MATRICULATION BOARD  
AHMADU BELLO UNIVERSITY  
ZARIA



INTERIM JOINT MATRICULATION BOARD EXAMINATION 2016

**SUBJECT:** 'A' LEVEL MATHEMATICS PAPER II  
**DATE SCHEDULED:** TUESDAY 16TH 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. Differentiate  $\cos^{-1}\left(\frac{1-x}{1+x}\right)$ . You may simplify your answer. [04marks]
2. Evaluate  $\lim_{x \rightarrow 9} \left(\frac{x-9}{\sqrt{x}-3}\right)$ . [04marks]
3. Find the values of  $\beta$  such that  $\beta\mathbf{i} - 2\mathbf{j} - \beta\mathbf{k}$  is perpendicular to  $\beta\mathbf{i} + 4\mathbf{j} - \beta\mathbf{k}$ . [04marks]
4. Solve the equation  $\frac{dy}{dt} = t^2(1+y)$ . [04marks]
5. Evaluate  $\int_0^2 \frac{7x}{10+x^2} dx$ . [04marks]

SECTION B: CALCULUS

6. (a). Find  $\frac{dy}{dx}$  and  $\frac{d^2y}{dx^2}$  at (1,1) if  $\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$ . [10marks]  
(b). If  $y = e^{5x} \sin 4x$ , show that  $y'' - 10y' + 41y = 0$ . \* [10marks]
7. (a). Differentiate from first principle  $y = 100 + 3x - 5x^3$ . [10marks]

**2016 IJMBE A/L MATHEMATICS II contd.**

(b). Find  $\int \frac{(x^2 + 1)dx}{x(x-1)(x+1)}$ . [10marks]

8. (a). If  $y = \sinh(k \sin^{-1} x)$ , show that  $(1 - x^2)y'' - xy' - k^2y = 0$ . [06marks]

(b). Using integration by parts, show that  $nI_n = \sin x \cos^{n-1} x + (n-1)I_{n-2}$ , given that

$I_n = \int \cos^n x dx$ . Hence evaluate  $\int_0^{\frac{\pi}{2}} \cos^5 x dx$ . [14marks]

**SECTION C: DIFFERENTIAL EQUATIONS AND VECTORS**

9. (a). Solve the equation  $(2x - y)dx - ydy = 0$ . [12marks]

(b). The vertices of  $\Delta ABC$  are represented by the vectors  $2\mathbf{i} + \mathbf{j} + \mathbf{k}$ ,  $\mathbf{i} - 2\mathbf{j} + \mathbf{k}$  and  $\mathbf{i} + \mathbf{j} - 2\mathbf{k}$ , respectively. Show that  $\Delta ABC$  is an isosceles triangle and obtain its area. [08marks]

10. (a). Calculate the unit vector in direction of the sum of the vectors  $\mathbf{a} = 3\mathbf{i} - \mathbf{j} + 3\mathbf{k}$  and

$\mathbf{b} = 3\mathbf{i} + \mathbf{j} - \mathbf{k}$ . Hence obtain the angle between it and vectors  $\mathbf{a}$ . [10marks]

(b). Solve the equation  $y \frac{dy}{dx} = xe^{x^2 - 3y^2}$ . [10marks]

11. (a). Solve the equation  $(x + 2) \frac{dy}{dx} - 2y = (x + 2)^{-1}$ . [10marks]

(b). Given that  $\mathbf{p} = \mathbf{i} + 3\mathbf{j} + 2\mathbf{k}$  and  $\mathbf{q} = \mathbf{i} - 3\mathbf{j} - 3\mathbf{k}$ , find the projection of the vector  $\mathbf{p} - 2\mathbf{q}$  on  $2\mathbf{p} + \mathbf{q}$ . [10marks]