



**NATIONAL OPEN UNIVERSITY OF NIGERIA PLOT 91, CADASTRAL ZONE,
NNAMDI AZIKIWE EXPRESSWAY, JABI – ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF CHEMISTRY
2025_2 EXAMINATIONS**

COURSE CODE: CHM 307

COURSE TITLE: ATOMIC AND MOLECULAR STRUCTURE AND SYMMETRY

COURSE UNIT: 3

INSTRUCTION: Answer question one (1) and any other three questions

Time: 3 Hours

QUESTION 1

- 1 (a) List six (6) sets of symmetry operations (6 marks)
- (b) State Pauli's Exclusion Principle (2 marks)
- (c) Using the concept of bond order, why is it impossible for He_2 to exist? (4 marks)
- (d) Write the electronic configuration of Na^{3+} , N^{2-} , Pb^{2+} , and Al^{4+} (8 marks)
- (e) Draw the energy level diagram in hydrogen molecule (5 marks)

QUESTION 2

- a) State Hund's rule (5 marks)
- b) Briefly explain bond energy (5 marks)
- c) Explain J-J coupling (5 marks)

QUESTION 3

- a) What do you understand by Commutation of operators? (5 marks)
- bi) Briefly explain bond energy (4 marks)
- bii) Define bond length (3 marks)
- c) What is atomic spectrum? (3 marks)

QUESTION 4

- a) Briefly explain the effect of vibration on rotation (4 marks)
- b) What do you understand by Linearity of an operator? (3 marks)
- ci) What is the wavelength of a 100eV electron? (5 marks)
- cii) State the application of valence bond theory (3 marks)

QUESTION 5

- a) Explain bond dissociation energy (4 marks)
- b) Briefly explain principal quantum number (6 marks)
- c) Define L-S coupling (5 marks)

QUESTION 6

- a) What is the major limitation of Bohr's model? (6 marks)
- b) Calculate the wave length of electron moving at $2 \times 10^6 \text{ m/s}$ using the de Broglie equation (4 marks)
- ci) What is spin orbital? (2 marks)
- cii) What is the significant of hybridization in valence bond theory? (3 marks)