NATIONAL OPEN UNIVERSITY OF NIGERIA
14-16 AHMADU BELLO WAY, VICTORIA ISLAND, LAGOS
SCHOOL OF SCIENCE AND TECHNOLOGY
JANUARY/FEBRUARY 2013 EXAMINATION

COURSE TITLE : ATOMIC AND MOLECULAR STRUCTURE AND SYMMETRY
COURSE CODE: CHM 307
INSTRUCTION: ANSWER ANY FIVE QUESTIONS
TIME : 2½ Hrs

QUESTION 1

(a) (i) What is an orbital? (ii) List the different types of orbitals
(b) (i) What do you understand by the term 'hybridization'? (ii) What is the hybridization of carbon in ethane? (ii) Describe the hybrid orbitals in ethene
(c) State Hund's Rule.
(d) State Pauli's Exclusion Principle. (14 marks)

QUESTION 2

(a) Define Molecular Orbital.
(b) Give the appropriate combinations of atomic orbitals.
(c) (i) Describe briefly the valence bond theory (ii) Explain how a chemical bond is formed according to this theory. 14 marks)

QUESTION 3

(a) What is bond order
(b) Discuss briefly the relationship between bond order, bond length and bond strength.
(c) What information could be obtained from bond order?
(d) The ground state electron configuration of N_2, with even valence electrons is
$1\sigma_g^2 1\sigma_u^2 1\pi_u^4 2\sigma_g^2$.
(i) Calculate the bond order (ii) Is N_2 diamagnetic or paramagnetic?
(iii) Predict the stability of the molecule and give reasons. (14 marks)

QUESTION 4

(a) Classify molecules based on the symmetry of their structures.
(b) Briefly describe the following terms with respect to internal coordinates
(i) Strethching (ii) Bending (iii) Rocking (iv)Wagging (14 marks)

QUESTION 5

(a) State the kinds of motion responsible for the total wave function of electronic energy levels.
(b) Explain the physical significance of the Franck-Condon factor
(c) What does it mean if an object is said to be 'symmetrical'?
(d) i. List 5 symmetry elements that any molecule can possess.
ii. Choose any three of the symmetry elements listed in 5d (i) above and explain in brief.
(14 marks)

QUESTION 6

(a) Give the full meaning of the following acronyms;
i) HOMO

ii) LUMO

(b) Give explanation on the difference in energies of the HOMO and LUMO.

(c) Highlight the steps to writing Resonance structures. (14 marks)

QUESTION 7

(a) Differentiate between bonding orbital and anti-bonding orbital .

(b) List the properties of a molecular orbital.

(c) Discuss spin-orbit coupling. (14 marks)