NATIONAL OPEN UNVERSITY OF NIGERIA
14/15 AHMADU BELLO WAY, VICTORIA ISLAND, LAGOS

SCHOOL OF SCIENCE AND TECHNOLOGY
OCTOBER 2013 EXAMINATION

Course Code: CHM307

Course Title: ATOMIC AND MOLECULAR STRUCTURE AND SYMMETRY

INSTRUCTION: ATTEMPT ANY FIVE QUESTIONS   TIME: 2½ HOURS

1. (a) Highlight the conditions for the formation of symmetry point group.   (5 marks)
    (b) List the symmetry elements that a molecule can possess.   (4 marks)
    (c) With respect to symmetry, briefly write on the following;
        (i) Mirror plane   (ii) Inversion   (5 marks)

2. (a) Show the steps required to determine point groups for different molecules. (4 marks)
    (b) List the symmetry elements of the following molecules:
        (i) BCl_3(ii) NH_3(iii) BF_3 (6 marks)
   (c)Discuss the implication of symmetry on the properties of molecules.(4 marks)

3. (a)What is an electronic spectrum?   (4 marks)
    (b) Discuss briefly the Franck-Condon Principle.   (6 marks)
    (c)Explainthe selection rules for a harmonic oscillator.   (4 marks)

4. (a) Write a short note on Vibration Spectroscopy.   (6 marks)
    (b) What are internal coordinates?   (4 marks)
    (c) What are the uses of microscope spectroscopy?   (4 marks)

5. (a) Write a short note onRotational spectroscopy.   (6 marks)
    (b) Discuss the classes molecules based on rotational behavior. (8 marks)

 6. (a) Highlight the steps to writing resonance structures; and show resonance in Ozone and
    Benzene.   (7 marks)
   (b) What is Nuclear Coupling?(3 marks)
   (c) State the usefulness of Quantum Mechanics.(4 marks)

7. (a)   What is bond order?(3 marks)
    (b) State the relationship between bond order, bond length and bond strength. (3 marks)
    (c) What information could be obtained from bond order?   (3 marks)
    (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?
                                                          (1½ each; = 3 marks)
        (iii) Is N_2stable?give reasons.   (2 marks)