NATIONAL OPEN UNVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PURE & APPLIED SCIENCES
SEPTEMBER, 2020 EXAMINATION

CHM 307: ATOMIC AND MOLECULAR STRUCTURE AND SYMMETRY
COURSE UNIT: 3
TIME ALLOWED 3 HOURS

INSTRUCTIONS: ANSWER QUESTION 1 AND ANY FOUR QUESTIONS

QUESTION 1
  a. Using the Molecular Orbital Model , explain why some molecules do not exist. **(7 marks)**
  b. Write equation for the 3D Schrodinger wave equation. **(5marks)**
  c. Write short note on angular momentum. **(7marks)**
  d. Construct a molecular orbital diagram for He_2 **(6 marks)**
QUESTION 2
  a. State the steps to be taken in writing resonance structures.(6 marks)
  b. Write resonance structures for each of the following
  (i) ozone   **(3 marks)**
  (ii) benzene   **(3 marks)**
  (iii) the allyl cation.   **(3 marks)**
QUESTION 3
  3a. Explain the following terms and express each mathematically
  (i)   Rusell-Saunder's coupling   **(2.5 marks)**
  (ii)   JJ coupling   **(2.5 marks)**
  (iii)   Nuclear coupling   **(2.5 marks)**
  3b. Explain the following terms
  (i)   spin-spin coupling   **(2.5 marks)**
  (ii)   orbit-orbit coupling   **(2.5marks)**
  (iii)   spin-orbit coupling   **(2.5marks)**
QUESTION 4
  4a. Briefly define bond order and show the relationships between it and each of:
  bond dissociation energy, bond length and force constant.   **(7 marks)**
  b. Draw molecular orbital energy diagrams for diatomic molecules.   **(8 marks)**
QUESTION 5
  5a. Define wave function.   **(7 marks)**
  b. Explain the usefulness of wave function, nature of wave function

and uncertainty principle.   **(8 marks)**
QUESTION 6
a.   Draw the diagram for the quantized energy levels of a particle in a 3D Schrodinger
        (7 marks)
b.   Explain the theory of rotational spectroscopy.   **(8 marks)**