



NATIONAL OPEN UNIVERSITY OF NIGERIA
DEPARTMENT OF PURE AND APPLIED SCIENCES
2021_1 EXAMINATION

COURSE CODE: CHM307

CREDIT UNIT: 3

COURSE TITLE: Atomic and Molecular Structure and Symmetry

TIME: 3 HRS

INSTRUCTION: Answer question 1 and any other 4 questions

QUESTION ONE

- With the aid of a well-labeled diagram, draw the energy levels in a H_2 molecule (5 marks)
- State five (5) steps you would take in writing resonance structures (5 marks)
- Atomic radii increase down a group and decrease across a period. Why? (5 marks)
- Highlight two (2) main limitations of Crystal Field Theory (CFT) (4 marks)
- Write the Schrodinger wave equation for 3D box (3 marks)

QUESTION TWO

- Calculate the wavelength of the visible line in the hydrogen spectrum that has the longest wavelength given that Rydberg constant $R = 1.097 \times 10^5 \text{ cm}^{-1}$. (6 marks)
- Highlight three differences between molecular orbital and valence bond theory (6 marks)

QUESTION THREE

Write out the hybrid orbitals and shapes of the following molecules: (12 marks)

- CH_3Cl
- BF_3
- PF_5
- BeF_2

QUESTION FOUR

With a well-illustrated diagram show the molecular orbital for each of the following molecules:

- Ethane (6 marks)
- Ethene (6 marks)

QUESTION FIVE

- List any three (3) types of internal coordinates (6 marks)
- Give any six (6) appropriate combinations of atomic orbitals (6 marks)

QUESTION SIX

- a) Write resonance structures for each of the following compounds: (4 marks)
- (i). Ozone (ii). Allyl Cation
- b) State the two (2) conditions for the formation of chemical bond (4 marks)
- c) Itemize four (4) classes of molecules based on rotational behavior (4 marks)