



**DEPARTMENT OF CHEMISTRY,
SCHOOL OF PHYSICAL SCIENCES
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SECOND SEMESTER EXAMINATION: 2021/2022 SESSION**

COURSE: CHM 223

UNITS: 2

COURSE TITLE: Structures and Bonding

TIME ALLOWED: 2 hours

INSTRUCTION: Answer any three questions.

Useful Constants: Rydberg (R_H) = 2.18×10^{-18} ; Planck (h) = 6.628×10^{-34} Js;
Velocity of light (C) = 2.998×10^8 ms⁻¹

- Q1a.** Express the equation of each of the Energy, Frequency and wavelength of electron transition from $n=3$ to $n=5$ in hydrogen atom. Define the terms. [3 Marks]
- b. State two shortcomings of Lewis concept and discuss how hybridization concept overcomes this, using BeH_2 example. [4 Marks]
- c. State the hybridization, VSEPR symbol, bond angle and shape of the following molecules:
- i. NO_2 ii. $(\text{CH}_3)_4\text{N}^+$ [8 Marks]
- d. State and explain the order of bond angle in the following molecular list:
- i. NH_3 , H_2O and CH_4 ii. H_2Se , H_2S and H_2Te [5 Marks]
- Q2a.** How is single chemical bond formed? [2marks]
- b. If BF_4 is trigonal planar, calculate the valence electrons for the following species:
 CO_3^{2-} , CH_3COCH_3
[6marks]
- c. Predict and draw the shapes if the following molecules giving reasons for your prediction:
 CO_2 , NO_2 , H_2SO_4 , and BrO_4^- [12 Marks]
- Q3 a.** Based on the Lewis concept, illustrate the structures of:
- i. HCl ii. SCN iii. NH_3 [3 Marks]
- b. Give comparisons of bonding and anti-bonding molecular orbital [9 Marks]
- c. Name quantum numbers [2 Marks]
- d. Enumerate and illustrate the information derivable from the study of two quantum numbers [6 Marks]
- Q4a.** State Gillespie-Nyholm rule for unsymmetrical molecules [2 Marks]
- b. Discuss the following concepts and illustrate each of them with four(4) examples:
- i. Walsh rule [9 Marks]
- ii. Isoelectronic principle. [9 Marks]