



NATIONAL OPEN UNIVERSITY OF NIGERIA
UNIVERSITY VILLAGE, PLOT 91 CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESS WAY, JABI - ABUJA.
FACULTY OF SCIENCES
DEPARTMENT OF PURE AND APPLIED SCIENCE
OCTOBER/NOVEMBER 2019, SECOND SEMESTER EXAMINATION

COURSE CODE: CHM 402
COURSE TITLE: Theory of Molecular Spectroscopy
COURSE UNIT: 2 Units
TIME: 2 Hours
INSTRUCTION: Answer question one and any three questions.

QUESTION ONE

- 1a. Write the formular for Schrödinger equation and define all the terms in the equation. (5marks)
- 1b. Describe the principles of microwave spectroscopy. (3 marks)
- 1c. With a cogent reason, state which of the molecule (O_2 and HCl) is infrared active. (3 marks)
- 1di. State Beer-Lamberts law. (2 marks)
- 1dii. Calculate the concentration of a solution of a compound with molar absorptivity constant of $25000M^{-1}dm^3cm^{-1}$ and absorbance of 0.50 at λ_{max} of 465nm with a path length of 1.6cm? (3 marks)
- 1e. Explain the term “chromophore” (5 marks)
- 1f. Highlight the basic principle of NMR. (4 marks)

QUESTION TWO

- 2a. Explain why light absorption by beta- carotene occurs in the visible rather than the UV region. (4 marks)
- 2b. Under what condition is a system said to be in resonance. Hence state the factors responsible for such. (5 marks)
- 2c. Explain the followings;
- i) Signal strength or peak area (2 marks)
- ii) Chemical shift (4 marks)

QUESTION THREE

- 3a. Give five advantages of Raman spectroscopy over other techniques. (5 marks)
- 3b. State two differences between Raman and Infrared spectroscopy. (4 marks)
- 3c. Explain the theory of Nuclear Quadropole Resonance (NQR) (6 marks)

QUESTION FOUR

- 4a. Indicate one major reason why ESR, NQR and Mossbauer spectroscopy are related to NMR. (3marks)
- 4b. Explain the terms “shielding and deshielding with reference to NMR Spectroscopy. (10 marks)

4c. List four categories of microwave active molecules.

(2 marks)

QUESTION FIVE

5a. Define fingerprint region and state its major usage.

(4 marks)

5b. Explain Anti- Stokes scattering.

(3 marks)

5c. State (with reasons) if H_2O_2 and $\text{CH}_2=\text{CH}_2$ are infrared active or not .

(3 marks)

5d. Explain Hypochromic shift using aniline in acid medium as example.

(5 marks)