



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
SEPTEMBER, 2020_1 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. Discuss briefly the principle of Raman spectroscopy. 5mks
- 1b. What are the names given to the three types of lines in a Raman spectrum? Account for the relative intensities of these lines. 6 mks
- 1c. What is the function of Doppler effect in Mössbauer spectroscopy? 3 mks
- 1d. The following data were obtained for solutions of compound X at a wavelength of 650nm in a 1 cm cell:

Conc. (mol dm ⁻³)	Absorbance
1 x10 ⁵	0.312
2 x10 ⁵	0.589
3 x10 ⁵	0.913
4 x10 ⁵	1.179
5 x10 ⁵	1.498

- (i) Make a Beer-Lambert's plot of the data 6 mks
- (ii) From the plot or using Beer-Lambert's relationship, determine the molarity of X solution whose absorbance is 0.170 at 650 nm. 5 mks

QUESTION TWO

- 2a. Discuss the Born-Oppenheimer approximation in solving the Schrödinger equation. 7½ mks
- 2b. Discuss briefly any three (3) of the five categories of microwave active molecules. 7½ mks

QUESTION THREE

- 3a. Describe the modes of vibration in a polyatomic molecule. 5 mks
- 3b. With the aid of appropriate diagrams, show the difference between stretching and bending (deformation) vibrations of Methylene (-CH₂). 6 mks
- 3c. State two features of the gas-phase IR spectra of molecules. 4 mks

QUESTION FOUR

- 4a. Explain briefly the preparation of solid samples in IR spectroscopy. 8 mks
- 4b. Analysis of the vibrational-rotational spectrum of the H³⁵Cl molecule shows that its fundamental vibration frequency ν_0 is 2988 cm⁻¹. Calculate the force constant of the H-Cl bond. Given that the speed of light, $C = 2.998 \times 10^8$ ms⁻¹ 7 mks

QUESTION FIVE

- 5a. State FOUR advantages inherent in the use of Raman spectroscopy. 6 mks
- 5b. With the aid of a schematic diagram, state the basic components of a Raman spectrometer. 6 mks
- 5c. Distinguish between elastic and inelastic scattering in Raman spectroscopy. 3 mks