

## M.Sc. (Previous) Due Examination, 2020

**CHEMISTRY**  
**Paper - IV (CH-404)**  
**(Spectroscopy)**

Time: Two Hours

Maximum Marks : 45

**Note:** (i) Boundations of compulsory question and sections are abolished.

(ii) If there are parts in any question then attempt all the parts

(iii) Attempt any three questions

(iv) No supplementary answer book will be given to any candidate. Hence the candidates should write the answers precisely in the main answer book only

- 1 (a) Estimate the frequency of the  $J = 0$  to  $J = 1$  transition of  $^1\text{H}^{35}\text{Cl}$  molecule. The masses of the two atoms are  $1.673 \times 10^{-27}$  kg and  $5.807 \times 10^{-26}$  kg respectively, and the equilibrium bond length is 127.4 pm.  
 (Given Planck constant  $h = 6.626 \times 10^{-34}$  Js) 8
- (b) Discuss conditions of microwave active rotations 3
- (c) Explain prolate and oblate tops with suitable examples 4
- 2 (a) How would you distinguish in following pairs from IR spectral data 2×5=10
- (i) Benzoic anhydride and ethanoicmethanoic anhydride
- (ii) Meta-xylene and para-xylene
- (iii) Methoxymethane and methyl methanoate
- (iv) Bromoethane and chlorobenzene
- (v) Propanol and propanone
- (b) Draw a potential energy curve for diatomic anharmonic oscillator.

3. (a) Match the following typical wavenumbers

1×3=3

List-I (Vibration type)	List-II (cm <sup>-1</sup> )
(i) C-H (stretch)	(a) 1640-1750 (V)
(ii) C=C (stretch)	(b) 2100-2200 (V)
(iii) C=N (stretch)	(c) 2200-2300 (V)
(iv) N-H (stretch)	(d) 3500-3700 (V)
(v) O-H (stretch)	(e) 3200-3500
(vi) C=O (stretch)	(f) 2850-2950

(b) Write short notes on the following

3+3=6

- Pure rotational Raman spectra
- Mutual Exclusion principle
- CARS

4. (a) Calculate emitted energy in terms of percent meter for He<sup>+</sup> ion when its electron jumps from second excited state to ground state

(Given Rydberg constant for hydrogen =  $1.097 \times 10^7 \text{ m}^{-1}$ )

8

(b) Write a note in vector representation of magnetic and spin-orbit coupling

7

5. Write short notes on the following

5+5=10

- Auger electron spectroscopy
- Photoelectron spectra of simple molecules
- Charge transfer spectra

6. (a) Draw the following planes in cubical boxes having Miller indices as

2×3

- 210
- 102
- 012

(b) Give a detailed comparison between electron diffraction and neutron diffraction

6

(c) Discuss Wierl equation

3