

Reg. No .....

Name .....

23U560

**B.Sc. DEGREE END SEMESTER EXAMINATION : NOVEMBER 2023**

**SEMESTER 5 : CHEMISTRY**

**COURSE : 19U5RCHE08 : PHYSICAL CHEMISTRY – II**

*(For Regular 2021 Admission and Supplementary 2020/2019 Admissions)*

Time : Three Hours

Max. Marks: 60

**PART A**

**Answer All(1 mark each)**

1. Pick out, from the following, those which would give microwave spectrum:  
O<sub>2</sub>, HCl, NH<sub>3</sub>, CO<sub>2</sub> and HCN
2. The chemical shift range ( $\delta$  value) for aldehydic proton is .....
3. What is Raman shift?
4. Which of the following nuclei have nuclear spin?  
<sup>1</sup>H, <sup>2</sup>D, <sup>14</sup>C, <sup>13</sup>C, <sup>17</sup>O, <sup>16</sup>O, <sup>19</sup>F
5. Why do Electronic spectra show broad bands in solution?
6. Calculate the wavelength of a radiation that has an energy  $4.95 \times 10^{-19}$  J.
7. How many normal modes of vibrations are possible for CO<sub>2</sub> and H<sub>2</sub>O molecules?
8. State Stark-Einstein law.

**(1 x 8 = 8)**

**PART B**

**Answer any 6 (2 marks each)**

9. Explain the basic principle of mass spectroscopy.
10. What is meant by chemical equivalence of a set of nuclei? How many NMR signals would a set of three chemically equivalent nuclei yield?
11. What are hot bands?
12. Explain hypochromic shift taking a specific example?
13. Name and sketch the vibration of CO<sub>2</sub> that are Raman active but IR inactive.
14. Calculate the energy of an Einstein of radiation of wavelength 250 nm.
15. Explain how band length of molecules can be determined using rotational spectroscopy.
16. Calculate the energy per photon for a radiation of wavelength 200 nm.

**(2 x 6 = 12)**

**PART C**

**Answer any 4 (5 marks each)**

17. Discuss briefly the nature of fragmentation that can happen in a mass spectrometric experiment?
18. Discuss the quantum mechanical concept of Raman effect and explain Stokes and anti-Stokes lines.
19. Discuss the anharmonic oscillator model of the vibrating diatomic molecule. How is the selection rule for vibrational transitions modified for an anharmonic oscillator?

20. Explain the terms chromophores and auxochromes.
21. How will you distinguish between 1-chloropropane and 2-chloropropane from their NMR spectra?
22. Define quantum yield of a photochemical reaction. Explain the high quantum yield for the hydrogen chlorine reaction.

**(5 x 4 = 20)**

**PART D**

**Answer any 2 (10 marks each)**

23. Give a detailed account of the Jablonski diagram and explain the process.
24. a) Explain spin-spin coupling using 1-chloropropane as an example.  
b) Draw the schematic NMR spectrum of (i) ultrapure ethanol (ii) acidified ethanol and highlight the difference between two.
25. a) Derive the expression for the rotational energy of a diatomic molecule treated as a rigid rotator. Show that the spectral lines for such a molecule are equally spaced. (5 marks)  
b) Explain the terms bathochromic and hypsochromic shift with suitable examples. (5 marks)
26. Explain the vibrational spectrum of a diatomic molecule based on the simple harmonic oscillator model. Comment on fundamental vibrational frequency and zero point energy.

**(10 x 2 = 20)**