

Reg. No: Name: **P242**

MSc DEGREE END SEMESTER EXAMINATION APRIL - 2016

SEMESTER - 2: **CHEMISTRY /APPLIED CHEMISTRY**

COURSE: **P2CHET08, P2CPHT08 - MOLECULAR SPECTROSCOPY**

(Common for Regular- 2015 Admission /Supplementary- 2014 Admission)

Time: Three Hours

Maximum Marks: 75

SECTION-A

(Answer any **10** questions. Each question carries 2 marks)

1. Find the frequency, wavelength, and wave number of light with photon of energy 1.00 eV per photon.
2. Explain the basis for the classification of molecules into symmetric top, asymmetric top and spherical top.
3. Explain the selection rules of IR and Raman Spectra.
4. How many fundamental modes of vibration would you predict for (a) benzene (b) toluene and (c) naphthalene
5. If a spectral peak is broadened, can you always conclude that the excited state has a short life time? Explain
6. What are non-rigid rotors
7. What is the outstanding difference between the high resolution electronic absorption spectrum of $^{16}\text{O}^{18}\text{O}$ and $^{16}\text{O}^{16}\text{O}$.
8. Explain the principle of mutual exclusion regarding IR and Raman activity of vibrations.
9. What do you mean by Finger print region in IR?
10. Does the initial excitation in Raman spectroscopy takes place to a stationary state of the system? Explain your answer.
11. State and explain Franck-Condon principle.
12. How intermolecular and intramolecular hydrogen bonding can be distinguish by NMR studies
13. Explain Nuclear Quadrupole Interaction (10 x 2 = 20)

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SECTION B

Answer only **5** questions by attempting not more than **3** questions from each bunch.

Each question carries **5** marks

Bunch I

14. Explain the following: (i) Overtones and combination, (ii) Width and intensity of spectral lines, (iii) Fermi resonance
15. Discuss on the correlation between electronic absorption spectra and molecular structure with examples
16. Briefly explain the term ‘term symbols’ and their use
17. Explain polarized and depolarized Raman lines. Suggest an experiment to prove whether an unknown molecule has a center of symmetry.

Bunch II

18. Place the following rotational energy information in order of increasing energy:

$$B_e = 10.0 \text{ cm}^{-1}; \quad B^* = 1.0 \times 10^{-23} \text{ J}; \quad \nu = 10000.0 \text{ MHz}; \quad \lambda = 0.01 \text{ m}$$

19. Calculate the bond length in $^{12}\text{C}^{16}\text{O}$ using $B_e = 1.9302 \text{ cm}^{-1}$. The molar masses are $15.994 \text{ g mol}^{-1}$ for ^{16}O and $12.000 \text{ g mol}^{-1}$ for ^{12}C .
20. The rotational Raman spectrum of H_2 gas is found to consist of a series of Stokes and anti-Stokes lines the first of it appears at 3459 cm^{-1} relative to the source of excitation. Calculate the bond distance of H_2 .
21. The low-resolution NMR spectrum of cyclohexane, C_6H_{12} , appeared 96 Hz downfield from the TMS standard in a 60-MHz spectrometer. What is the value of the chemical shift?

(5 x 5 = 25)

SECTION C

(Answer any **2** questions. Each question carries **15** marks)

22. (a) Give an account of the application of microwave spectroscopy for the determination of bond angles and bond distances.
(b) What are P, Q, and R branches of rotational vibrational spectrum
23. (a) Write an account of the principle and method of electronic absorption spectroscopy
(b) Explain the working principle of X-ray photoelectron spectroscopy.
24. (a) Discuss the origin of spin-spin splitting in NMR and illustrate how structural information can be obtained from coupling constant
(b) Explain the mechanism of hyperfine interaction in the ESR spectra organic radicals
25. (a). How is NQR used for studying the nature of chemical bond?
(b). Discuss the application of Mossbauer spectroscopy for the study of metal complexes

(2 x 15 = 30)
