LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – CHEMISTRY

THIRD SEMESTER – APRIL 2017

CH 3810- MOLECULAR SPECTROSCOPY

Date: 28-04-2017   Dept. No.   Max. : 100 Marks
Time: 01:00-04:00

Part-A

Answer ALL questions.   (10 × 2= 20)

1. A spectroscopic transition involves an energy change of 3×10^{-21} J/molecule. If there are 1500 molecules in the ground state, what is the equilibrium population of the state when the temperature is 300 K?
2. What is prolate symmetric top molecule? Give an example.
3. Differentiate between stokes and antistokes lines in Raman spectra.
4. What is the principle of LASER?
5. State Franck-Condon principle.
6. What are isochronous protons?
7. Sketch the ^{31}P-NMR of PH_3.
8. Obtain the g-value for a completely filled orbital.
9. How many lines are possible in the EPR of the radical $\cdot CD_3$?
10. Predict the number of nuclear orientations possible for N atom.

Part-B

Answer any EIGHT questions.   (8 × 5= 40)

11. Write a note on the collision and Doppler broadening.
12. Discuss the effect of isotope on the rotational spectra.
13. Explain the Stark effect of $J=0 \rightarrow J=1$ transition of a linear molecule.
14. Discuss briefly on the various types of electronic transitions using examples.
15. The spectroscopic bond dissociation energy of $^{35}Cl^{16}O$ radical is 1.9 eV. Calculate the equilibrium bond dissociation energy of ClO, if the fundamental vibrational frequency is 780 cm^{-1}.
16. Explain the energy levels of a diatomic molecule using Morse curve.
17. How will you compare the chemical shifts of vinylic and acetylenic protons?
18. Explain vicinal and geminal coupling with suitable examples.
19. What is zero field splitting? Give an example.
20. Low spin Fe(II) complex does not exhibit quadrupole splitting- Justify.
21. Molecules of Tetrahedral geometry do not require magnetic field for quadrupole transitions. Justify.
22. Explain recoilless nuclear resonant emission and absorption with an example.

Part-C

Answer any FOUR questions.   **(4 × 10 = 40)**

23.   Explain the rotational energy levels and transitions for a rigid diatomic molecule in brief.

24.   Write a short note on the Raman spectrum of a symmetric top molecule with a suitable example.

25.   Discuss the rotational levels of the vibrational states $v=0$ and $v=1$ for a diatomic vibrating rotor molecule.

26a. Describe the splitting pattern observed in the low and high resolution proton NMR spectrum of propanaldehyde.

   b. Discuss the principle of correlation spectroscopy.   (5+5)

27a. Explain the quadrupole transitions possible for a molecule with $I = 3/2$ in an axially symmetric field.

   b. Mention the conditions for a compound to be characterized using Mossbauer spectroscopy.

                                                   (5+5)

28a.   Discuss the significance of asymmetry parameter and quadrupole coupling constant with relevant examples.

   b. Explain Kramer's degeneracy with an example.   (6+4)

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