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(May)

CHEMISTRY

(Major)

Course : 607

(**Spectroscopy**)

Full Marks : 48
Pass Marks : 19

Time : 3 hours

The figures in the margin indicate full marks
for the questions

1. Choose the correct option : $1\times5=5$

(a) The internal energy of a molecule is its

　(i) rotational energy

　(ii) vibrational energy

　(iii) translational energy

　(iv) All of the above

(b) The rotational spectra involve

  (i) a very high energy change

  (ii) small energy change

  (iii) no energy change

  (iv) None of the above

(c) In the Raman spectrum, the middle line is called

  (i) Raman line

  (ii) Rayleigh line

  (iii) functional group line

  (iv) None of the above

(d) Using a 60-MHz NMR machine, the difference in frequency between absorption by a proton in a compound and that by protons of TMS was found to be 430 Hz. The chemical shift in ppm will be

  (i) 7·17

  (ii) 7·71×10⁻⁶

  (iii) 0·717

  (iv) None of the above

(e) The electronic spectra consist of

  (i) a large number of absorption bands

  (ii) a large number of closely packed lines

  (iii) a large number of peaks

  (iv) None of the above

2. Answer any *five* of the following :   2×5=10

(a) The nuclei ^1H and ^{13}C are suitable for NMR investigation. Explain why.

(b) Calculate the precessional frequency of electrons in a 15000 G field. Given $g_e = 2·0$, $\mu_B = 9·273 \times 10^{-28}$ JG⁻¹.

(c) Discuss the term 'hot bands' in vibrational spectra.

(d) Stokes lines are more intense than anti-Stokes lines. Explain.

(e) Explain, why ethanol is a good solvent for UV-measurement but not for IR.

(f) Microwave studies are done only in gaseous state. Why?

UNIT—I

3. (a) Show that the lines in the rotational spectrum of a diatomic molecule are equispaced under rigid rotator approximation.

(b) The pure rotational spectrum of gaseous HCl contains a series of equally spaced lines separated by $20 \cdot 80$ cm^{-1}. Calculate the bond length of H—Cl bond.

UNIT—II

4. (a) Sketch the normal modes of vibration of a linear triatomic molecule AB_2 and predict the IR active bands. Give reason in support of your answer.

(b) The fundamental vibrational frequency of CO is 2140 cm^{-1}. Calculate the force constant of the molecule.

(c) Discuss 'combination band' with one example.

UNIT—III

5. (a) State and explain the rule of mutual exclusion with example.

(b) Explain, giving examples, the application of Raman spectroscopy in determining the structure of a molecule.   3

(c) Mention the essential condition for a molecule to be Raman active.   1

UNIT—IV

6. (a) State and explain Franck-Condon principle.   3

(b) What do you mean by molar extinction coefficient? What information can be obtained from it?   2

Or

The intensity of $\pi \rightarrow \pi^*$ transitions is 10 to 100 times stronger than $n \rightarrow \pi^*$ transitions. Explain.   2

(c) Define chromophore with example.   1

UNIT—V

7. (a) Describe the ESR spectrum of—

(i) a single electron in contact with a single proton;

(ii) methyl radical.   3

Or

Discuss briefly the principle of ESR spectroscopy.

(b) What is chemical shift? Explain why TMS is used as a reference substance in NMR spectroscopy.

(c) Draw the high resolution NMR spectra of ethanol.

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