

K-416

Total Pages : 4

Roll No.

MSCPH-507

SPECTROSCOPY

M.Sc. Physics (MSCPH)

2nd Semester Examination, 2023 (Dec.)

Time : 2 Hours]

Max. Marks : 70

Note : This paper is of Seventy (70) marks divided into two (02) Sections A and B. Attempt the questions contained in these sections according to the detailed instructions given therein. Candidates should limit their answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.

SECTION–A

(Long Answer Type Questions)

Note : Section 'A' contains Five (05) long answer type questions of Nineteen (19) marks each. Learners are required to answer any Two (02) questions only.

(2×19=38)

1. Distinguish between L-S and j-j coupling schemes. Calculate the expression for interaction energy in the case of L-S coupling and with its application, explain splitting of levels for pd electron configuration.
2. Write short notes on any *three* of the following :
 - (a) Paschen Back effect.
 - (b) Fine structure of spectrum of hydrogen atom.
 - (c) Space quantization.
 - (d) Franck Condon principle.
3. Explain the Raman Spectra of diatomic molecules and discuss the quantum theory of Raman effect and on its basis explain the intensity distribution of Stoke's and antistoke's lines.
4. Write down the expression for energy of an anharmonic oscillator of a diatomic molecule and explain the infrared spectra. How from infrared band position the vibrational constants ω_e and $\omega_e X_e$ can be determined? (ω_e – equilibrium frequency of vibration, X_e – equilibrium anharmonicity constant)
5. Discuss the observation of progression and sequences in the spectra of diatomic molecules. Show how from the observation of v'' – progressions and v' – progressions respectively, the vibrational quanta in the upper and the lower electronic states of the molecules are determined.

SECTION-B

(Short Answer Type Questions)

Note : Section 'B' contains Eight (08) short answer type questions of Eight (08) marks each. Learners are required to answer any Four (04) questions only. (4×8=32)

1. What is Bohr-Sommerfield quantization rule? Show that for a circular orbit, this reduces to Bohr quantization rule.
2. In the far infrared spectrum of HCl molecule, the first line falls at 20.68 cm^{-1} . Calculate the moment of inertia and bond length of the molecule, ($h = 6.63 \times 10^{-34} \text{ Js}$, $N = 6.023 \times 10^{23} \text{ mole}^{-1}$)
3. What is Zeeman effect? Explain how the nature of splitting changes in a transition from weak to strong magnetic field.
4. Discuss the factors governing the breadth of spectral lines. Explain natural width.
5. Give the following states in spectroscopic notations.
 - (a) $L = 1, S = 1/2$
 - (b) $L = 2, S = 7/2$
 - (c) $L = 3, S = 3.$

6. What is isotope effect? Mention briefly its applications.
 7. What is P, Q and R branches in the vibration-rotation spectra? Explain their origin.
 8. Explain the characteristic X-ray spectra in emission and absorption. How do they differ from optical spectra?
-