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Reg. No. :

Code No. : 6387

Sub. Code : HPHM 42

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2017.

Fourth Semester

Physics

MOLECULAR SPECTROSCOPY

(For those who joined in July 2012 – 2015)

Time : Three hours

Maximum : 75 marks

SECTION A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. For symmetric Top molecular

- (a) $I_B = I_C \neq I_A; I_A \neq 0$
- (b) $I_B = I_C = I_A$
- (c) $I_B \neq I_C \neq I_A$
- (d) $I_A = I_B = I_C = 0$

2. Selection rule for the rigid diatomic rotator

- (a) $\Delta J = +1$
- (b) $\Delta J = -1$
- (c) $\Delta J = 0$
- (d) $\Delta J = \pm 1$

3. Zero point energy of harmonic oscillator is

- (a) hw
- (b) $2 hw$
- (c) $\frac{1}{2} hw$
- (d) $\frac{w}{2h}$

4. For a diatomic vibrating rotator, the selection rule is given by

- (a) $\Delta v = \pm 1, \pm 2, \dots$
- (b) $\Delta v = \pm 1, \pm 2, \dots; \Delta J = \pm 1$
- (c) $\Delta v = \pm 1, \Delta J = \pm 1$
- (d) $\Delta v = \Delta J = 0$

5. Pure rotations of spherical top molecules are

- (a) Raman inactive
- (b) Raman active
- (c) IR inactive
- (d) Microwave inactive

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6. If there is change in polarizability for a molecule the molecule is said to be
 (a) Raman inactive (b) Raman active
 (c) IR active (d) IR inactive
7. Born-Oppernheimer approximation is
 (a) $E_T = E_e + E_v + E_r$
 (b) $E_T = E_e$
 (c) $E_T = E_v$
 (d) $E_T = E_r$
8. If $B' < B''$ then the band head occurs
 (a) Q branch (b) S branch
 (c) P branch (d) R branch
9. In ESR, g factor is equal to
 (a) $\frac{h\gamma}{\beta B_z}$ (b) $\frac{h\gamma}{B_z}$
 (c) $\frac{h\gamma}{\beta}$ (d) $\frac{h\gamma}{I}$
10. In NMR, the approximate doubling of the signal intensity is known as
 (a) population inversion
 (b) spin pumping
 (c) spin doubling
 (d) frequency doubling

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Explain the classification of molecules on the basis of moment of inertia.
 Or
 (b) Explain intensity of rotational lines.
12. (a) Deduce the vibrational energy of a diatomic molecule.
 Or
 (b) What is known as vibration band? Explain briefly.
13. (a) Give the classical theory of Raman effect.
 Or
 (b) Explain the Hyper Raman effect.
14. (a) Discuss the vibrational coarse structure.
 Or
 (b) Explain the Frank Condon principle.



15. (a) List the magnetic properties of nuclei.

Or

- (b) Write a note on chemical shift.

SECTION C — ($5 \times 8 = 40$ marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Obtain the rotational spectra of rigid diatomic molecule and the effect of isotope in rotational spectra.

Or

- (b) Derive the rotational frequencies of symmetric and asymmetric molecules.

17. (a) Derive the rotational vibrational spectra of polyatomic molecules.

Or

- (b) Illustrate with suitable example the vibrational spectra of linear and top molecule.

18. (a) Discuss the coherent anti-stokes Raman scattering.

Or

- (b) Discuss the photoacoustic Raman scattering.

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19. (a) Explain the construction of Deslandres table.

Or

- (b) Describe the rotational fine structure of electronic vibrational spectra.

20. (a) Derive the Bloch equations.

Or

- (b) Give the principle, construction and working of NQR spectrometer.
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