

Kolhan University, Chaibasa

B.Sc. Semester-6 Examination 2020
Chemistry B.Sc. (Hons.)

Semester-VI

DSE-3

Spectroscopy (Physical Chemistry)

By

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Time: 03 hrs

Full marks: 70

General instructions:

Candidates are required to give their answer in their own words as far practicable. Their figures in the margin indicate full marks.

Group-A

Answer all questions:

1. Fill in the blanks:

10x2=20.

- (i) The spectral transitions which obey a given selection rule are termed as and those which violate a selection rule are termed as
- (ii) The microwave spectra obtained in most of the molecules are
- (iii) An IR spectrum of a chemical substance is a for its identification.
- (iv) Raman shift would be equal to the frequency of rotation of molecule.
- (v) It is possible for vibrational and rotational transition to occur simultaneously in a Raman transition. The selection rules governing such simultaneous changes in rotational and vibrational energy will be $\Delta J = \dots\dots\dots$ and $\Delta v = \dots\dots\dots$
- (vi) A nucleus which alternately becomes excited and unexcited is said to be in a state of
- (vii) β is the Bohr's magneton which is a factor for converting angular momentum into magnetic moment. The value of β is
- (viii) The ESR frequency of an unpaired electron in a magnetic field of 3000 G (0.3 T) is equal to

(ix) According to Born-Oppenheimer approximation the total energy of a molecule
 $E = E_{tr} + E_{rot} + \dots + E_{el}$.

(x) The groups containing π -electrons, which are mainly responsible for the colour of the substance containing such groups are known as ~~conjugated~~.

Group - B

Answer any four questions:

4 × 5 = 20

2. State and rationalize the Franck-Condon Principle and indicate its importance.
3. Compare infrared and Raman spectroscopy.
4. The Born-Oppenheimer approximation states that a diatomic's electronic energy depends only on the internuclear separation. Use this information to sketch and explain the relative location of the first few vibrational levels for H_2 and D_2 .
5. Explain the terms wavelength, wave number and frequency of light. How they interrelated? What is the range of UV and IR regions of radiations?
6. What are the degenerations of the following diatomic rotational energy levels: (a) 0 (b) $\frac{h^2}{8\pi^2 I}$ (c) $6 \frac{h^2}{8\pi^2 I}$
7. Calculate ν , $\bar{\nu}$ and E for typical UV-radiation of $\lambda = 2 \times 10^3 \text{ \AA}$.
8. Suggest an experiment to prove whether an unknown molecule has a centre of symmetry.
9. Explain why in Raman-spectra the Stokes lines are far more intense than the Anti-Stokes lines which are sometimes too weak to be observed?

Group - C

Answer any two questions:

2 × 15 = 30

10. (a) Explain Quantum Theory of Raman effect. 10 + 5
(b) Discuss characteristic parameters of spectral lines. = 15

11. Write short notes on the following:

(a) Chemical shift.

$3 \times 5 = 15$

(b) Degrees of freedom.

(c) Selection Rule for Raman spectroscopy.

12. (a) Explain the theory of IR Absorption spectroscopy.

$8 + 7 = 15$

(b) Discuss Nuclear spin interactions in NMR.

13. (a) Discuss vibrational Rotational Raman spectra.

$8 + 7 = 15$

(b) Explain vibrational coarse structure of electronic spectra.



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Semester - VI

DSE-3

spectroscopy (Physical chemistry)

(1) Answer

(i) Allowed transition & forbidden transition

(ii) Absorption Spectra

(iii) Finger Print

(iv) Twice

(v) $\Delta J = 0, \pm 2$ $\Delta V = \pm 1$

(vi) Resonance

(vii) $\beta = \frac{eh}{4\pi mc} = 0.9723 \times 10^{20} \text{ erg/gauss.}$

(viii) 8.397 KMHZ

(ix) E_v

(x) Chromophores.

_____ X _____

Sayed's
26/04/2020