

The University of Burdwan
B. Sc. (Honours) Sem-VI Examination, 2021
Subject: Chemistry
Paper: CC-14 (Physical Chemistry-IV)

Full Marks: 40
Attempt any eight questions

Time: 2 hours
 $8 \times 5 = 40$

- (i) Write down the basic difference between internal conversion (IC) and intersystem crossing (ISC). (ii) Why is phosphorescence a slower process than fluorescence?
- (i) Briefly describe the Larmor precession in the context of NMR spectroscopy.
(ii) Calculate the frequency of electromagnetic radiation required for transition when a bare proton is placed under an external magnetic field of 1 T.
[Given: $g = 5.585$, $\beta_N = 5.052 \times 10^{-24} \text{ erg} \cdot \text{G}^{-1}$]
- (i) Classify the following molecules into different rotational tops
(a) CCl_4 (b) CH_3Cl (c) $\text{CH}_2 = \text{CHCl}$ (d) HD (e) CHCl_3 (f) CH_4
(ii) Calculate the population ratio between the 5-th and 6-th rotational energy levels at 300 K.
[Given: $B = 2.22775 \text{ cm}^{-1}$]
- The fundamental and first overtone transitions of $^{14}\text{N}^{16}\text{O}$ appeared at 1876.06 cm^{-1} and 3724.20 cm^{-1} respectively. Calculate the equilibrium vibration frequency, the anharmonicity, zero-point energy and the force constant of the molecule.
- (i) Predict the $^1\text{H}^1$ -NMR signal pattern for CH_3CHDOH under low and high resolution.
(ii) Write the mutual exclusion rule in the context of vibrational spectroscopy.
- (i) What is quantum yield of fluorescence?
(ii) A uranyl-oxalate actinometer is irradiated for 15 minutes with light of wavelength 450 nm and oxalic acid equivalent to 12.0 cc of 0.001 M KMnO_4 is found to have been decomposed. The quantum efficiency of the actinometer at this wavelength is 0.60. Calculate the average intensity of light used.
- Show that the initial quantum yield is 2 for photochemical decomposition of HI and the quantum yield decreases from its initial value as the reaction proceeds.
- (i) Mention with brief reasons, the effect of temperature on CMC.
(ii) The adsorption of acetic acid from aqueous solution of charcoal was governed by the relation
$$\frac{x}{m} = 0.5C^{0.33}$$
in which x/m and C are expressed in g per g and g/litre respectively. Find out the quantity of acetic acid that will be absorbed by a gram of charcoal from a litre of 0.2% (w/v) acetic acid solution.
- Write a short note on Stern double layer and zeta potential.
- What is surface excess? Show that the Gibbs adsorption isotherm is analogous to the two-dimensional ideal gas law.