



বিদ্যাসাগর বিশ্ববিদ্যালয়
VIDYASAGAR UNIVERSITY

Question Paper

B.Sc. Honours Examinations 2021

(Under CBCS Pattern)

Semester - VI

Subject: CHEMISTRY

Paper: C 14-T & P

(Physical Chemistry - V)

Full Marks : 60

Time : 3 Hours

Candidates are required to give their answer in their own words as far as practicable.

The figures in the margin indicate full marks.

THEORY (Marks : 40)

Group A

Answer any ***two*** from the following :

$2 \times 15 = 30$

1. (a) What are the essential conditions for a molecule to be Microwave and Infra-red active?
Explain with suitable examples. 3
- (b) What do you mean by isoelectric point and gold number? 2
- (c) State the laws of photochemistry. 2
- (d) Why Stokes lines are more intense than anti-Stokes lines ? 2

- (e) How the surface area of adsorbents can be determined using BET equation? 3
- (f) The fundamental and first overtone transitions of NO molecules are observed at 1876 cm^{-1} and 3724 cm^{-1} respectively. Calculate the equilibrium vibrational frequency and zero point energy. 3
2. (a) Show that according to rigid rotator model, rotational energy levels of a diatomic molecule are not equispaced but the corresponding spectral lines are equispaced. 3
- (b) 100 cc of a silver sol contains 2×10^{10} particles, each of diameter 10 Å. The solution requires 1.8×10^{-4} g of Al^{3+} to attain isoelectric point. Calculate the charge density on silver particles. 3
- (c) What do you mean by photosensitized reactions ? Give an example of a photosensitized reaction which is useful to the mankind. 2
- (d) Write the expression of BET adsorption isotherm and explain the terms involved. 2
- (e) State and briefly explain Franck-Condon principle. 2
- (f) Explain how surface tension can be determined by capillary rise method. 3
3. (a) In Raman spectroscopy, the energy of the incident monochromatic light is much higher than the energy gaps between two vibrational energy levels. In spite of that how it can be used to determine the spacings of the vibrational energy levels of the molecule? Explain. 3
- (b) What do you mean by chemiluminescence? Explain with an example. 2
- (c) What do you mean by zeta potential? 2
- (d) How Gibbs adsorption equation can be used to explain the variation of surface tension of a liquid due to addition of different types of solutes. 2
- (e) What is an actinometer ? Explain the working principle of a chemical actinometer. 3
- (f) How methyl acetate ($\text{CH}_3\text{COOCH}_3$) and ethyl formate (HCOOC_2H_5) can be distinguished using ^1H NMR spectroscopy ? 3
4. (a) Derive an expression of the rotational quantum number (J_{\max}) at which population is maximum. 3
- (b) Why lyophilic colloids are more stable than lyophobic colloids ? 3

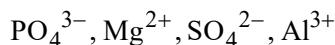
- (c) An uranyl oxalate actinometer is irradiated for 15 minutes with a light of wavelength 4350 Å. After that it is observed that oxalic acid equivalent to 12 ml of 0.001(M) KMnO_4 solution is decomposed by light. The quantum efficiency of the actinometer is 0.58. Calculate the energy absorbed in erg/s. 3
- (d) Explain why the presence of H_2S is essential in As_2S_3 sol. 2
- (e) Explain why water rises in a capillary? 2
- (f) The surface tension of dilute solutions of a solute varies linearly with solute concentration (c_2) as $\gamma = \gamma_0 - ac_2$, where γ_0 is the surface tension of the solvent and 'a' is a constant.
Show that $\Gamma_2 = \frac{(\gamma_0 - \gamma)}{RT}$ 2

Group - B

Answer any **one** question from the following :

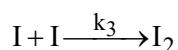
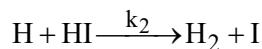
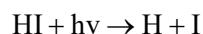
$1 \times 10 = 10$

5. (a) Calculate the shift in frequencies of a NMR transition when two protons in different chemical environments, characterised by δ values of 6 and 3, are studied in a 60 MHz spectrometer. 3
- (b) When ΔS can be positive as a result of adsorption? Explain with an example. 2
- (c) Among the following ions which one is most effective to cause coagulation of a negatively charged sol ?



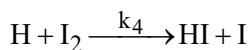
Write the appropriate rule. 2

- (d) (i) Photochemical decomposition of HI proceeds according to the following mechanism.



Show that the quantum yield of this reaction with respect to HI is 2.

(ii) However as this reaction proceeds, the following reaction becomes appreciable.



Show that under this condition, the quantum yield becomes less than 2.

3

6. (a) Distinguish between internal conversion and intersystem crossing. 2
- (b) What do you mean by micelles and emulsions ? 2
- (c) Show that Freundlich adsorption isotherm is a special case of Langmuir isotherm. 3
- (d) Calculate the ratio of molecules in rotational level $J = 2$ relative to $J = 0$ level for a diatomic molecule with $B = 1.2 \text{ cm}^{-1}$ at 300 K. 3

PRACTICAL (Marks : 20)

Paper : C 14P

Answer any **one** question from the following :

1×20

1. Derive Lambert-Beer law and define molar extinction coefficient. Write the theory of verification of Lambert-Beer law and briefly discuss about the method of determination of the concentration of an unknown solution.
2. Write the theory of spectrophotometric determination of rate constant of the reaction between $K_2S_2O_8$ and KI and briefly discuss about the experimental procedure.
3. Define surface tension. Discuss the effect of temperature on the surface tension of a liquid. Derive the working formula for the determination of surface tension of a liquid by drop counting method using a stalagmometer and briefly discuss about the experimental procedure.