VIDYASAGAR UNIVERSITY

Question Paper

B.Sc. Honours Examinations 2022

(Under CBCS Pattern)

Semester - VI

Subject: CHEMISTRY

Paper : C 14 - T

(Physical Chemistry V)

Full Marks : 40

Time : 2 Hours

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

Group - A

Answer any *four* from the following questions :   5×4=20

1. (a) What is the essential condition for a molecule to be Raman active?   2

    (b) How Avogadro number can be determined by Perrin's method?   3

2. (a) How the microwave spectra of ^{12}CO will change when ^{12}C is replaced by ^{13}C? 3

    (b) Derive an expression of Langmuir equation for dissociative adsorption.   2

3. (a) With the help of Jablonski diagram, discuss various photophysical processes.   3

    (b) The chemisorption of H_2 on manganese is 35% faster at 1000 K than at 600 K. Calculate the activation energy of chemisorption.   2

4. (a) Write a short note on electro-osmosis.   3

(b) Draw the schematic low resolution and high resolution NMR spectra of C_2H_5OH.

2

5. (a) Derive an expression of the true dissociation energy of a diatomic molecule according to the anharmonic oscillator model.

3

(b) Discuss about the mechanism of micelle formation.

2

6. (a) When a light of 424 nm is irradiated on a sample of $C_2H_4I_2$, the amount of I_2 formed after 20 minutes required 41.4 ml of 0.005 (M) sodium thiosulphate solution. If the intensity of the incident light is 9.15 erg per second, calculate the quantum yield.

3

(b) At the critical temperature, surface tension of a liquid will be zero. Justify or criticise.

2

Group - B

Answer any *two* questions from the following : $10 \times 2 = 20$

1. (a) The rotational Raman spectrum of Cl_2 shows a series of Stokes lines which are separated by 0.9752 cm^{-1}. Calculate the bond length of the molecule.

3

(b) Why phosphorescence is more intense in solid samples?

2

(c) Colloid solutions are thermodynamically unstable. Comment.

2

(d) Write a short note on Larmor precession.

3

2. (a) What do you mean by P, Q and R branches of spectrum? Derive an expression of them according to the simple harmonic oscillator model.

3

(b) Is the Einstein law of photochemical equivalence always valid ?

2

(c) Write the main difference between Raman effect and fluorescence.

2

(d) In a coagulation experiment 5 ml of AgI is mixed with distilled water and 0.1(M) solution of NaCl so that total volume is 10 ml. When the volume of NaCl becomes more than 4.9 ml, coagulation occurs within 5 minutes. Calculate the flocculation value of NaCl in AgI.

3

3. (a) Show that according to the anharmonic oscillator model, difference in energy between two adjacent vibrational levels of a diatomic molecule decreases gradually with increasing vibrational quantum number.

3

(b) Why water cannot be used as a solvent in IR spectroscopy ?

2

(c) A long chain fatty acid of molecular weight 284 has a density of 0.82 gm/cc. If 0.102 mg of the acid occupies an area of 400 cm^2 as a close packed monolayer on water, find the area of cross section and length of the acid molecule. 3

(d) Why TMS is used as a reference compound in the measurement of chemical shifts of protons ? 2

4. (a) Write the differences between physical adsorption and chemisorption. 3

(b) How will you distinguish between the overtones and hot bands of a spectrum? 2

(c) Can adsorption be endothermic ? 2

(d) In a 60 MHz NMR spectrometer a compound gives two proton peaks at 480 Hz and 230 Hz. The reference compound (TMS) gives peak at 0.0 Hz. Calculate the chemical shifts of these two protons. What will be the separation between these two signals on a 270 MHz spectrometer ? 3

———————