

2023

Chemistry

B.Sc. Fifth Semester End Examination - 2023

PAPER - CC11T

Full Marks : 40

Time : 2 hours

*The figures in the right-hand margin indicate marks.*

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

*Illustrate the answers wherever necessary.*

**Group - A**

Answer any five questions :

5×2=10

1. (a) If the  $J=2$  to  $3$  rotational transition for a diatomic molecule occurs at  $\lambda=2.00\text{cm}$ , find  $\lambda$  for the  $J=6$  to  $7$  transition of this molecule.
- (b) Why life time of phosphorescence is greater than that of fluorescence? Explain.
- (c) At what temperature surface tension of a liquid becomes zero? Explain using proper equation.

(Turn Over)

( 2 )

- (d) The infrared and Raman spectra of triatomic molecule of the type  $MX_2$  show two infrared frequencies and one Raman frequency. Determine whether the molecule is linear or nonlinear?
- (e) Decomposition of  $NH_3$  on Tungsten surface is zero order reaction. Explain.
- (f) Arrange the following anion for their capability of salting out the lyophobic micellies?  
Ac,  $Cl^-$ ,  $NO_3^-$ ,  $Br^-$ ,  $I^-$
- (g) Which one will show more adsorption of solids having Miller indices (222) and (100).
- (h) Why is the diffraction of UV light by atomic crystals not observed?

**Group - B**

Answer any four questions :

4×5=20

2. (a) What are P, Q, R rotational - vibration spectrum? Explain.
- (b) Show that a diatomic molecule dissociates into atoms if it is present in the vibration state of vibration quantum number  $= \left( \frac{1}{2x_e} - \frac{1}{2} \right)$ , where  $x_e$  is the anharmonicity constant.

3+2

B.Sc. RNLKWC(A)-CHEM/CC11T/SEM-V/2023

(Continued)

( 3 )

3. (a) A 0.001 M solution of certain dye in a cell of 0.5 cm optical path length transmits 4% of a monochromatic incident light of wave length 480 nm. Calculate the molar absorption coefficient of the dye.
- (b) Does the optical density depend on wave length of the radiation? Justify. 3+2
4. (a) What do you mean by spreading of liquid and what is spreading coefficient?
- (b) If the height of water column in a capillary be 2.5 cm and if the capillary tube be broken at 2 cm height, would the water move up and flow out of the tube perpetually? 2+3
5. (a) A decrease of temperature of the system would result in an increase of adsorption. Explain.
- (b) Under what condition Langmuir adsorption isotherm obey Freundlich adsorption isotherm? Explain. 2+3
6. (a) What is Zeta potential and electrical double layer?
- (b) Explain for a molecule the wave length of fluorescence is less than that of absorbed radiation. 2+3
7. (a) Copper has a face centred cubic lattice with a unit cell

B.Sc. RNLKWC(A)-CHEM/CC11T/SEM-V/2023

(Turn Over)

( 4 )

edge length of 0.361 nm. What is the diameter of the largest atom that could fit into the (i) octahedral holes and (ii) tetrahedral holes of this lattice without disturbing its structure.

- (b) Name the bravais lattice having no element of symmetry? Cite one example.

**Group - C**

**Answer any one questions**

**1×10=10**

8. (a) Give three examples of three different model systems where (i) energy levels are equispaced (ii) energy gap increases with increase in quantum number (iii) energy gap decreases with increase in quantum number.
- (b) Excitation to the first vibrational excited state of  $\text{H}^{35}\text{Cl}$  occurs with infrared radiation of frequency  $2900\text{ cm}^{-1}$ . Calculate the expected position of the same absorption in the case of  $\text{D}^{35}\text{Cl}$ . (Assuming force constant to be same).
- (c) Absorbance is an additive property where as transmittance is a multiplicative property. Explain.
- (d) Comment on IR and Raman activity of the symmetric vibration of  $\text{CO}_2$ . (3+2+3+2)=10

( 5 )

9. (a) A photochemical reaction was carried using a monochromatic radiation (490 nm) of intensity 100 W. When the sample was irradiated for 30 min, 0.3 mole of the reactant was decomposed. Estimate the quantum efficiency assuming 50% absorption.
- (b) Is it possible to determine the coefficient of expansion of a solid by using the Bragg equation?
- (c) Calculate the surface excess of a solute per unit area at  $25^\circ\text{C}$  if the concentration of the solution is  $5 \times 10^{-5}\text{ mol/lit}$  and  $(d\gamma/dc) = -1.35 \times 10^8\text{ dyne cm}^3\text{ mole}^{-1}$ .  
Express your answer in  $\text{mol.m}^{-2}$ . (4+3+3)=10