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**ST—228—2022**

**FACULTY OF SCIENCE**

**M.Sc. (First Year) (First Semester) EXAMINATION**

**MAY/JUNE, 2022**

**(CBCS/New Pattern)**

**PHYSICAL CHEMISTRY**

**Paper-III (CH-413)**

**(Physical Chemistry-I)**

**(Saturday, 2-7-2022)**

**Time : 9.30 a.m. to 1.15 p.m.**

*Time— 3.45 Hours*

*Maximum Marks—75*

*N.B. :— (i) Attempt all questions.*

*(ii) Use of calculator and logarithm table is allowed.*

*(iii) Figures to the right indicate full marks.*

*Given :— (a)  $h = 6.626 \times 10^{-34}$*

*(b) Mass of an  $e^- = m_e = 9.109 \times 10^{-31}$  kg*

*(c)  $C = 3 \times 10^{10}$  cm/sec*

*(d)  $N = 6.023 \times 10^{23}$  molecules*

*(e) Boltzmann constant,  $k = 1.38 \times 10^{-16}$  erg/deg/mole*

*(f)  $R = 82.06$  c.c. atm/deg/mole*

*(g)  $\sigma$  for  $\text{NH}_3 = 3$*

**1. Solve any three :**

**15**

*(a) For the ground state of one dimensional harmonic oscillator, show that a average value of its kinetic and potential energies are equal.*

*(b) Explain Non-stoichiometric defects with their consequences.*

*(c) Write an account on Zeeman splitting.*

*(d) Explain tricomponent system, water-acetone-chloroform.*

*(e) Explain Pauli's exclusion principle.*

*(f) Discuss one partially miscible pairs.*

**P.T.O.**

2. Attempt any *three* :

15

- (a) Derive the relationship between fugacity and activity coefficient for a real gas.
- (b) What is 'Isomorphism' in crystallography ? Explain in detail.
- (c) Derive Lippmann equation for surface excess phenomenon.
- (d) What are partition function ? Derive the expression for vibrational partition function.
- (e) Discuss Eutectic system composed of two solid and a liquid components.
- (f) Set up and solve the Schrodinger's wave equation for the Eigen-values and Eigen function for rigid rotator.

3. Answer the following :

- (a) State and explain Debye-Huckel limiting law. Use it to calculate the activity coefficient of  $\text{Cu}^{+2}$  and  $\text{PO}_4^{-3}$  ions as well as  $\gamma_{\pm}$  of 0.02M solution of  $\text{Cu}_3(\text{PO}_4)_2$ . 8

Or

Describe E.M.F. method for determination of activity and activity coefficient.

- (b) Calculate the rotational partition function for  $\text{NH}_3$  at  $27^\circ\text{C}$ . The three moments of inertia are  $2.78 \times 10^{-47}$ ,  $2.78 \times 10^{-47}$  and  $4.33 \times 10^{-47}$   $\text{kgm}^2$  respectively. 7

Or

- (i) What is Thermodynamics probability ? Explain it.
- (ii) Explain in detail a system, assembly and ensemble.

4. Answer the following :

- (a) "No two electron have same quantum state." Explain it using quantum mechanical approach. 7

Or

What are ordinary angular momentum, generalised angular momentum and Eigen function and Eigen values for angular momentum ? Explain in detail.

- (b) When a particle of mass  $9.1 \times 10^{-18}$  gm in a certain one-dimensional box goes from fifth energy level of first excited state, it emits a photon for frequency  $6.0 \times 10^{14}$  per second. Find the length of the box. 8

Or

- (i) What is Semiconductor ? Explain P type semiconductor.  
(ii) Discuss Born Haber Cycle.

5. Write short notes on (any *three*) : 15

- (a) Cubic close packing  
(b) Gout-Chapman theory of electrical double layer  
(c) Applications of partition functions  
(d) Isomorphism