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**NEPNY—42—2023**

**FACULTY OF SCIENCE**

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

**NOVEMBER/DECEMBER, 2023**

**CHEMISTRY**

**Paper—SCHEC—403**

**(Physical Chemistry—I)**

**(Tuesday, 26-12-2023)**

**Time : 10.00 a.m. to 1.00 p.m.**

*Time—3 Hours*

*Maximum Marks—80*

- N.B. :-**
- (i) Question No. 1 is compulsory.
  - (ii) Solve any *three* questions from Q. No. 2 to Q. No. 6.
  - (iii) Use of log table and calculator is allowed.
  - (iv) Figures to the right indicate full marks.

1. Solve the following : 20
- (a) State and explain any *five* postulates of quantum mechanics.
  - (b) Calculate the mean activity coefficient,  $\sqrt{\pm}$  of –
    - (i) 0.01 m NaCl and
    - (ii) 0.001 m Na<sub>2</sub>SO<sub>4</sub> in aqueous solution at 25°C.
  - (c) Discuss in detail the Debye-Falkenhagen effect as applied to strong electrolytes.

P.T.O.

- (d) What are solid state imperfections ?  
Explain : (i) Schottky defects and (ii) Frenkel defects.
2. Solve the following : 20
- (a) State the Schrödinger's wave equation in polar co-ordinate system and use it to obtain phi-equation, theta-equation and radial equation for hydrogen and hydrogen-like systems.
- (b) Derive the Lippmann equation for surface excess phenomenon.
3. Solve : 20
- (a) What is symmetry number ?  
Calculate the rotational partition function and characteristics rotational temperature for H<sub>2</sub> gas at 2727°C given that  $K = 1.38 \times 10^{-23}$  J/kg,  $h = 6.626 \times 10^{-34}$  JS,  $\sigma = 2$  and  $I = 4.6033 \times 10^{-48}$  kgm<sup>2</sup>.
- (b) What are ternary systems ? Explain the three component system involving two pairs of partially miscible liquids with a suitable phase diagram.
4. Solve the following : 20
- (a) What is meant by Zero-point energy ? Explain its significance.  
An electron in 1D-box of length 10 Å undergo a transition from ground state to second excited state. Calculate the wavelength of photon absorbed. Given that  $h = 6.626 \times 10^{-34}$ Js,  $M_e = 9.109 \times 10^{-31}$  kg and  $C = 3 \times 10^8$  ms<sup>-1</sup>.
- (b) Why  $\lim_{P \rightarrow 0} \frac{F}{P} = 1$  ?

Describe a method for determination of fugacity of a gas at any pressure from P–V–T data.

5. Solve : 20

(a) What is zeta potential ?

Describe Gouy-Chapman theory of electrical double layer.

(b) Define :

(i) ionisation potential and

(ii) lattice energy.

How does the Born-Haber cycle explain the stability of ionic compounds ?

6. Write short notes on the following : 20

(a) Zeeman's splitting a quantum mechanical approach.

(b) EMF method for determination of activity and activity coefficients.

(c) Two solid and a liquid component Eutectic systems.

(d) Relaxation effect and Electrophoretic effect in Debye-Hückel-Onsager theory of strong electrolytes.