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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_2SO_4 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_2 gas at 2727°C given that K = 1.38×10^{-23} J/kg, $h = 6.626 \times 10^{-34}$ JS, $\sigma = 2$ and I = 4.6033×10^{-48} kgm^2.

(*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 $10\,\text{Å}$ 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^{-1}.

(*b*) Why $\lim_{P \to 0} \frac{F}{P} = 1$?

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.