H-2-15-22   Roll No. ....

II Semester Examination, 2022

M.Sc.

CHEMISTRY

Paper III

(Physical Chemistry)

Time : 3 Hours]   [Max. Marks : 80

Note : *All Questions are Compulsory. Question Paper comprises of 3 sections. **Section 'A'** is Objective type/Multiple Choice questions with no internal Choice. **Section 'B'** is Short answer type with internal Choice. **Section 'C'** is Long answer type with internal Choice.*

Section 'A'   1 × 8 = 8

(Objective Type Questions)

Choose the correct answer :

1. All the naturally occuring processes proceed spontaneously in a direction which leads to :

   (a) Decrease in entropy

   (b) Increase in enthalpy

   (c) Decrease in free energy

   (d) Increase in free energy

P.T.O.

2. Which of the following is an example of formation of two pairs of partially miscible liquids :

   (a) Acetic acid-chloroform-water

   (b) Phenol-water-aniline

   (c) Succinic nitrate-water-ether

   (d) Ethanol-ethyl acetate-water

3. The ensemble which is based on open systems where the number of molecules in a unit is not kept constant, while volume (V), temperature (T) and chemical potential (μ) are the same in all the units. Then the ensemble is called as :

   (a) Canonical ensemble

   (b) Micro-canonical ensemble

   (c) Grand canonical ensemble

   (d) Semi-micro canonical ensemble

4. Stirling's theorem is :

   (a) $\ln \lfloor n = n \ln n - n$ (b) $\ln \lfloor n = n - n \ln n$

   (c) $\ln \lfloor n = n \ln n + n$ (d) $\ln \lfloor n = n - 2n \ln n$

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5. Diffusion current (I_d) and time necessary for the formation of one drop of mercury (t) is related in following manner :

(a) $I_d \propto t^{1/4}$ (b) $I_d \propto t^{1/3}$

(c) $I_d \propto t^{2/3}$ (d) $I_d \propto t^{1/6}$

6. In galvanization process, the coating is of :

(a) Sn   (b) Fe

(c) Zn   (d) Cu

7. Which of the following shows laplace equation ?

(a) $\gamma = \dfrac{\rho ghR}{\cos\theta}$ (b) $\gamma = \dfrac{\rho ghR}{2\cos\theta}$

(c) $\gamma = \dfrac{2\rho ghR}{\cos\theta}$ (d) $\gamma = \dfrac{\rho ghR}{\cos\theta}$

8. The temperature below which micelles cannot be formed ?

(a) Neel temperature

(b) Critical temperature

(c) Kelvin temperature

(d) Kraft temperature

Section 'B'   **6 × 4 = 24**

(Short Answer Type Questions)

Note : *Attempt all questions. All questions carry equal marks.*

Unit–I

1. Define chemical potential of any substance and explain its variation with temperature.

Or

Write a note on excess functions for non-ideal solutions ?

UNIT–II

2. Derive the equation for fermi-dirac statistics.

Or

Explain canonical, grand canonical and micro canonical ensembles.

Unit–III

3. Derive Lippman equation.

Or

Explain over-potentials and current density.

Unit–IV

4. Describe the thermodynamics of micellization. What is reverse micelles ?

Or

At 0°C and 1 atm pressure, the volume of nitrogen gas required to cover a sample of silica gel, assuming langmuir adsorption, is found to be 130 cm^3g^{-1} of the gel. Calculate the surface area per gram of silica gel. Given that the area occupied by nitrogen molecule is 0.162 $(nm)^2$.

Section 'C'   **12 × 4 = 48**

(Long Answer Type Questions)

Note : *Attempt all questions. All questions carry equal marks.*

Unit–I

1. (a) What is fugacity ? How can you determine the fugacity of a gas ?

   (b) An aqueous solution of alcohol in which mole fraction of alcohol is 0.05 gave partial pressure of water and alcohol as 23.2 and 10.8 mm respectively. The vapour pressures in the pure state are $P_{alc.}$ = 21.76 mm and P_{water} = 23.8 mm at the same temperature. Calculate the activity and activity coefficient of water and alcohol.

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Or

Define activity and activity coefficient. Describe solubility methods for the determination of activity and activity coefficients ?

Unit–II

2. Write short notes on following :

   (a) Electronic partition function

   (b) Phenomenological laws and Onsager's reciprocity relations.

Or

   (a) Compare Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics.

   (b) Derive the expression for translational partition function.

Unit–III

3. (a) Derive Butler-Volmer equation.

   (b) Explain half wave potential and its significance.

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Or

(a) Discuss Gouy-Chapman theory for the structure of electrified interfaces.

(b) Explain any two prevention methods of corrosion.

Unit–IV

4. (a) Explain the mechanism of electrocatalysis.

(b) What are factors which affects the CMC of surfactants.

Or

(a) Explain the classification of surface-active agents.

(b) Explain BET equation of multimolecular theory of adsorption.

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