AC-233737

M.Sc. (Semester-III)
Examination, Dec.-Jan. (2025-26)

CHEMISTRY

(Catalysis, Solid State and Surface Chemistry)

Time Allowed : Three Hours

Maximum Marks : 70

Note : Question paper is divided into four sections. Attempt questions of all four sections as per direction. Distribution of marks is given in each section.

SECTION-A

(Objective Type Questions)

Note : Attempt any **ten** questions. Each question carries **1** mark.

[10×1=10]

1. (A) **Choose the correct answer :**

(i) According to the third law of thermodynamics the entropy of a perfect crystalline substance at absolute zero is :

(a) Positive

(b) Negative

(c) Zero

(d) Infinite

(ii) An "Alpha effect" in nucleophilicity refers to the enhanced reactivity of a nucleophile due to :

(a) The presence of a lone pair on the atom adjacent to the nucleophilic atom

(b) Its large size

(c) Its high polarizability

(d) Its low basicity

(iii) The HSAB principle classifies a species like the iodide ion (I^-) as a :

(a) Soft base   (b) Hard acid

(c) Hard base   (d) Soft acid

(iv) The primary driving force for the formation of micelles in water is :

(a) Hydrogen bonding

(b) Hydrophobic interaction

(c) Covalent bonding

(d) Ionic repulsion

(v) The presence of F-centers in an alkali halide crystal is responsible for its :

(a) Increased density

(b) Paramagnetic properties

(c) Colour and optical properties

(d) High Electrical conductivity

(vi) In Band theory of semiconductors the energy gap between the valence band and the conduction band is called the :

(a) Fermi gap

(b) Band gap

(c) Defect level

(d) Schottky Barrier

(vii) In a free radical polymerisation mechanism the step where two radical chains combine to terminate the reaction is called :

    (a)   Initiation

    (b)   Propagation

    (c)   Termination by combination

    (d)   Chain transfer

(viii) The process where macromolecules settle under a high centrifugal force is known as :

    (a)   Osmosis

    (b)   Diffusion

    (c)   Sedimentation

    (d)   Viscosity

(B)   **Fill in the blanks :**

(ix) The Nernst heat theorem is related to the formulation of _____ law of thermodynamics.

(x) The increase in the rate of reaction due to the Concentration of reactants in the micellar pseudo phase is known as _____.

(C)   **True / False statement :**

(xi) The concentration at which surfactant molecules spontaneously aggregate to form micelles is called saturation points.   (True / False)

(xii) In Frenkel defect density of a crystal remains unaffected.   (True / False)

SECTION-B

(Very Short Answer Type Questions)

Note: Attempt **any five** questions. Each question carries **2** marks. (word limit : **25-30 words**)   [5×2=10]

(i) State the Nernst heat theorem.

(ii) How electronic effects influence the acidity of an organic acid?

(iii) What is the role of nucleofugacity in substitution reactions?

(iv) What do you mean by Adsorption isotherm?

(v) What is Doping? Give an example.

(vi) Briefly discuss the steps of free radical chain polymerisation with example.

SECTION-C

(Short Answer Type Questions)

Note: Attempt **any five** questions. Each question carries 4 marks. (word limit : **250** words) [5×4=20]

3. (i) Discuss the principle for determining molecular mass using viscometry method.

(ii) Explain the difference between a conductor and a insulator using Band theory.

(iii) What are colour centers (F-centers)? How do they impart colour to crystals?

(iv) Differentiate between the Phase Separation Model and the Mass Action Model for micellization.

(v) What is the Hard and soft acids and bases (HSAB) principle? Give one example of hard-hard interaction.

(vi) What are Onsager's reciprocity relations in the thermodynamics of irreversible process?

SECTION-D

(Long Answer Type Questions)

Note: Attempt **any three** questions. Each question carries **10** marks. (word limit : **500** words) [3×10=30]

4. (i) Explain the third law of thermodynamics. Also explain the thermodynamic principle behind reverse osmosis and its applications.

(ii) Explain the following :

(a) Specific and general acid-base catalysis.

(b) Enzyme catalysis

(iii) What are Surfactants? Classify the surfactants. Also discuss the factors affecting CMC of surfactants.

(iv) Discuss the following :

(a) Number average and weight average molecular masses of polymers.

(b) Metal excess and metal deficiency defects.

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