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M.Sc. (Third Semester)
EXAMINATION, Dec. - Jan., 2021-22
(Paper Third)
CHEMISTRY
(Catalysis, Solid State and Surface Chemistry)

[Time : Three Hours]   *[Maximum Marks : 80]*
[Minimum Pass marks : 16]

Note : Attempt all sections as directed.

Section - A
(Objective/ Multiple Choice Questions)
(1 mark each)

Note : Attempt all questions.

Choose the correct answers:

1. The pK_a of H_2O at 25^0 C is-

   (A)   14.0

   (B)   15.74

   (C)   -1.74

   (D)   7.0

2. For an enzyme catalysed reaction a plot of $\frac{1}{V}$ vs. $\frac{1}{[S]}$ for Lineweaver and Burk equation gives slope and intercept values 0.156 and 2.12 respectively. The Km (Michaclis constant) will be-

   (A)   0.330

   (B)   13.58

   (C)   0.73

   (D)   0.073

3. Which of the following is a soft Lewis acid?

   (A) BH_3

   (B) BF_3

   (C) CO_2

   (D) $B (OR)_3$

4. Which of the following nucleophiles show the $\propto$ - effect

(A) SCN^-

(B) N_3^-

(C) N_2H_4

(D) $P-NO_2C_6H_4O^-$

5. The Nucleophilicity scale can be measured by the following equation :

(A) Swain and Scott

(B) Edward

(C) W.P. Jencks

(D) All of the above

6. Aerosol - OT is _____ surfactant.

(A) Cationic

(B) Anionic

(C) Non - ionic

(D) Gemini

7. What is the main result of adding surfactants into a liquid composed of two immisible phases such as oil and water?-

(A) Reduction in the interfacial tension between the phases

(B) Increase in interfacial tension between the phases

(C) Catalyzation of chemical reaction between the phases

(D) Nothing happens

P.T.O.

8. A surfactant with a HLB (Hydrophile Lipophile Balance) range 13 - 15, is expected to function as a:

(A) Solubilizer

(B) Wetting agent

(C) Detergent

(D) Water - in - oil emulsifier

9. Which of the following statements is incorrect ?

(A) The CMC decreases strongly with increasing alkyl chain length of the surfactant

(B) The CMC of the non - ionics are much higher than for ionics.

(C) The negative free energy of micellization is the result of large positive entropy

(D) The CMC can be ditermined by light scattering method also.

10. The correct form of Laplace equation is:

(A) $P = P^* e^{2\gamma vm}$

(B) $d\gamma = -\Sigma \gamma d\mu_n$

(C) $h = \dfrac{2\gamma}{Pg\pi}$

(D) $Pin = Pout + \dfrac{2\gamma}{r}$

11. Extrinsic point defects are...............

    (A) Defects introduced into a solid as a result of doping

    (B) Defects that occur in the pure substance

    (C) Shear planes that collect defects along certain crystallographic directions -

    (D) None of the above

12. Frenkel defect is not found in the halides of alkali metals because alkali metal have:

    (A) High Electropositivity

    (B) High Reactivity

    (C) High Ionic Radii

    (D) Ability to occupy interstitial sites

13. With which one of the following elements silicon should be doped so as to give p-type semiconductor?

    (A) Germanium

    (B) Arsenic

    (C) Boron

    (D) Selenium

14. In a semiconductor, the energy gap between the valence band and conduction band is about............

    (A) 10 ev (B) 1 ev

    (C) 15 ev (D) 5 ev

15. In an intrinsic semiconductor, the number of free electrons-

    (A) Is greater than the number of holes

    (B) Is less then the number of holes

    (C) Is double then number of holes

    (D) Equals the number of holes

16. Which of the following is not an addition polymer?

    (A) Nylon 66

    (B) PVC

    (C) Polypropylene

    (D) All of the above

17. The unique properties of liquid crystal polymer............

    (A) Thermal Actuation

    (B) Arisotropic Swelling

    (C) Soft Elasticity

    (D) All of the above

18. Polydispersity index is difined as............,where M_w and M_n are the weight average and number average molecular masses respectivity.

   (A) $M_w \times M_n$

   (B) M_n / M_w

   (C) M_w / M_n

   (D) $M_w - M_n$

19. The catalyst used for the synthesis of polymers of 1 - alkenes (alpha olefins)

   (A)   Wilkinsons catalyst

   (B)   Ziegler - Natta catalyst

   (C)   Pd - Catalyst

   (D)   Zeise salt complex

20. The number average molecular weight of polymer can be determined by _____method

   (A)   Osmometry

   (B)   Light Scattering

   (C)   Sedimentation

   (D)   All of the above

Section - B

(Very short answer type question)

(2 marks each)

Note : Attempt all questions. Write answer in 2-3 sentences.

1. What is alpha effect?

2. Define Bronsted catalysis law.

3. What is the difference between reverse micelles and microemulsions?

4. How surfactant classified?

5. Define perfect and imperfect crystals.

6. What is conduction phenomenon in a semiconductor?

7. How is average dimensions of various chain structure calculated? (No derivation)

8. Define crossed linked polymers.

Section - C

(Short Answer Type Questions)

(3 marks each)

Note : Attempt all questions.

1. Calculate the pK_a of H_3O^+ at 25^0 C (Given that $K_w = 1 \times 10^{-14}$)

2. For acid - base catalysis explain the signficance of the following equation.
$$[H^+]_{min} = \left(\frac{k_{0\overline{H}}K_w}{k_{H_+}}\right)^{1/2}$$

3. Define CMC and counter ion binding. How CMC and counterion binding of a surfactent is determined?

4. Explain the pressure across curved surface and write Laplace equation.

5. Explain why crystalline solids are generally more defective as a result of increasing temperature?

6. What is n - p junction? Explain.

7. A polymer sample consists of 9 molecules of MW 30 000 and 5 molecules of MW 50 000. Calculate number average molecular weight.

8. Discuss the importance of electrically conducting polymer with example.
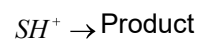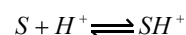
Section - D

(Long Answer Type Questions)

(5 Marks each)

Note : Attempt all questions.

1. Define Hammett acidity function. Derive kinetic equation for the following reaction.

$$S + H^+ \rightleftharpoons SH^+$$

$$SH^+ \rightarrow \text{Product}$$

OR

What are the Characteristics of enzyme catalysed reaction? Discuss the mechanism of competitive inhibition enzyme catalysed reaction.

2. Define surface excess concentration and minimim surface area. Derive the following equation.

$$\Gamma = -\frac{1}{RT}\left(\frac{\partial\gamma}{\partial\ln c}\right)_T$$

γ = Surface Tension

c = Concentration

OR

Define micellization. Discuss Mass action model and phase separation model for the thermodynamics of micellization.

3. Discuss the thermodynamics of Schottky and Frenkel defects.

OR

Explain electronic properties and Band theory of semiconductors.

4. Define relative viscosity, reduced viscosity and intrinsic viscocity as applied to solutions of high polymers. Explain how molecular weight of polymers is determined by viscosity measurements.

OR

Discuss the mechanism of the Kinetics of addition and condensation polymerization.