SURFACE CHEMISTRY

Short Answer Questions:

***1. What is catalysis? How is catalysis classified? Give two examples for each type of catalysis?**

Ans. A catalyst is the substance that increases the rate of chemical reaction to which it is added without itself being consumed in the reaction. This phenomenon is known as catalysis.

Catalysis can be classified into two types. These are -

1. Homogeneous Catalysis: The catalysis in which the catalyst and the reactants are present in the same phase is known as homogeneous catalysis.

Ex: a) conversion of carbon monoxide to Carbon dioxide in presence of NO

$$2CO(g)+O_2(g)\xrightarrow{NO(g)}2CO_2(g)$$

b) Catalytic oxidation of SO_2 to SO_3 in presence of oxides of nitrogen

$$2SO_2(g)+O_2(g)\xrightarrow{NO(g)}2SO_3(g)$$

2. Heterogeneous Catalysis: The catalysis in which the catalyst and the reactants are present in different phases [states] is known as heterogeneous catalysis

Ex: a) in Haber's process iron is used as catalyst

$$N_2(g)+3H_2(g)\xrightarrow{Fe(s)}2NH_3(g)$$

b) In contact process platinum (or) vanadium pentoxide is used as a catalyst

$$2SO_2(g)+O_2(g)\xrightarrow[P_2O_5]{Pt(S)or}2SO_3(g)$$

***2. How are colloids classified on the basis of interaction between dispersed phase and dispersion medium?**

Ans. Basing on the affinity between dispersed phase and dispersion medium, colloidal solution are classified into lyophilic Sols and lyophobic Sols

Lyophilic colloids: i) Colloidal solutions in which a great affinity exists between the dispersed phase and dispersion medium are called as lyophilic sols.

(lyo = liquid, philic = affinity of love).

ii) These are solvent loving colloidal solutions

iii) They are irreversible colloids

iv)They are prepared by direct mixing of dispersed phase and dispersion medium

v) The particles are solvated

Ex: Starch, Protein, Polymer solutions

lyophobic sols: i) Colloidal solution in which little (or) no affinity exists between the dispersed phase and dispersion medium is called lyophobic sols.

(lyo = liquid, phobic = hate)

ii) These are solvent hating colloidal solutions

iii) They are irreversible colloids

iv)They are not prepared by direct mixing of dispersed phase and dispersion medium

v) The particles are not solvated

Ex: Gold sol, metal sols, sols of metal sulphides and oxides etc.

***3. Compare and contrast the phenomenon of physiosorption and chemisorptions?**

Ans. Physical adsorption: The adsorption in which physical or Van der Waals forces exist between adsorbate molecules and adsorbent surface is known as physical adsorption or **physiosorption**

Ex: Adsorption of H_2 or O_2 on charcoal

Chemical adsorption: The adsorption in which chemical forces or chemical bonds exist between adsorbate molecules and adsorbent surface is known as chemical adsorption or chemisorptions

Ex: Adsorption H_2 on 'Pt' metal surface

S. No.	Physisorption	Chemisorption
1.	It occurs due to van der waals' forces	It is formed by the formation of chemical bonds.
2.	It is not specific in nature	It is highly specific in nature.
3.	It is reversible in nature.	It is irreversible.
4.	Enthalpy of adsorption is low (appr. 20 – 40 kJ mol^{-1}).	Enthalpy of adsorption is high (appr. 80 – 240 kJ mol^{-1}).
5.	It depends on the nature of gas. More easily liquefiable gases are adsorbed readily.	It also depends on the nature of gas. Gases which can react with the adsorbent show chemisorption.
6.	Low temperature is favourable for physisorption.	High temperature is favourable for chemisorption.
7.	No appreciable activation energy is required.	High activation energy is sometimes required.
8.	It results into multimolecular layers on the adsorbent surface under high pressured.	It results into unimolecular layer.

***4. What are emulsions? How are they classified? Describe the applications of emulsions?**

Ans. **Emulsions:** i) A dispersion of finely divided liquid droplets in another liquid dispersion medium is emulsion

ii) In emulsions one liquid is 'water' and other liquid is immiscible in water is called 'oil'

Types of emulsions: emulsions are classified in to two types. These are (a) oil in water (o/w) (b) water in oil (w/o)

a) **Oil in water:** In this type of emulsion the dispersed phase is oil (immiscible liquid) and the dispersion medium is water

Ex: Milk, Liquid fat (oil) in water, vanishing cream: fat (oil) in water

b) Water in oil: In this type of emulsion the dispersed phase is water and dispersion medium is oil (immiscible liquid)

Ex: Stiff grease: water in lubrication oil, Cold cream: water in fat

The process of separating the constituents of an emulsion is called deemulsification. Heating and centrifugation are the two techniques used to destroy an emulsion.

Applications of emulsions are

i. A large number of pharmaceuticals are prepared in the form of lotions, creams and ointments

ii. The concentration of sulphide ore by froth floatation process

iii. Emulsifying properties of soaps and detergents are used in washing clothes, crockery etc

iv. Digestion of fats in the intestine is facilitated by emulsification.

5. What are micelles? Discuss the mechanism of micelle formation and cleaning action of soap?

Ans. 'A colloidal sized particle (aggregate) formed in water by the association of simple molecules each having a hydrophobic end and hydrophilic end is known as micelle

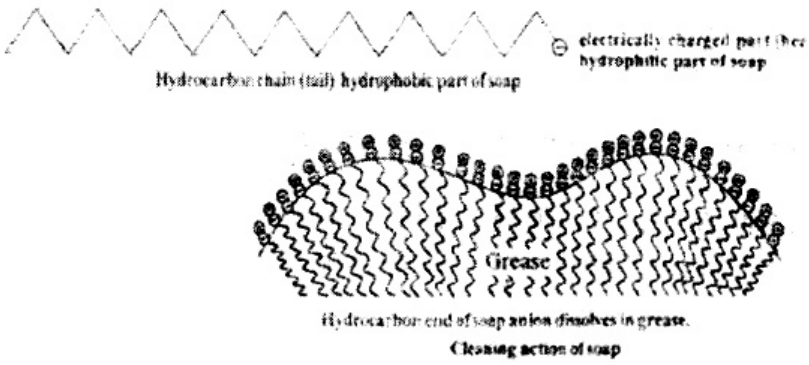
Ex: Concentrated soap solution is an associated colloid

Mechanism:

Cloths contain grease (or) fat. This is known as dirt. Dirt (or) grease forms an emulsion with water used for cleaning but this emulsion is not stable. Soap functions as emulsifying agent for agent for water dirt emulsion in the cleaning process. The main function of soap is to convert the dirt (or) grease on the clothes in to large colloidal particles (micelles).

Soap (sodium stearate) dissolves in water to give Na^+ and stearate ions. The stearate ion contain hydrophobic end (alkyl group end) called 'Tail' and contain a hydrophilic end (carboxylate ion end) called 'head'. The tail part dissolves the grease (or) dirt and forms the micelle. The micelle is then removed by water in the cleaning process

$C_{17}H_{35}COONa \rightarrow C_{17}H_{35}COO^- + Na^+$



Cleaning action of soap

6. What are colloidal solutions? Give example. Compare colloidal and true solutions?

Ans. Colloidal solution: A heterogeneous binary system in which particle size $1m\mu - 1\mu$ of the dispersed phase are distributed in a continuous dispersion medium is called a colloidal solution.

E.g.: 1. milk is a colloidal solution of liquid fat in water. Liquid fat is disperse phase

2. Starch in water is a colloidal solution. Starch is disperse phase

Property	True Solutions	Colloidal solution
Particle size	$<1m\mu$	$1m\mu - 1\mu$
External appearance	Very clear	Opaque
Separation of solute	Not possible	Partially possible
Separation of solute & disperse phase by ultra filtration	Not possible	Possible
Settling of solute (or) dispersed phase	Not possible	Possible by centrifugation
Diffusion particle	Fast	Slow
Tyndall effect	Not shown	Shown

7. State Hardy-schulze rule and Explain the following terms

i. peptization ii). Dialysis iii) Gold number

Ans. Hardy Schulze rule states that "The coagulating power of electrolyte is directly proportional to the magnitude of charge on the active ions".

In coagulating of a negative sol, the coagulating power of captions is in the order $Al^{+3}>Ba^{+2}>Na^{+}$.

In coagulating of a positive sol, the coagulating power of anions is in the order

$[Fe(CN)_6]^{-4}>PO_4^{-3}>SO_4^{-2}>Cl^{-}$

i. peptization: The process of converting a precipitate into colloidal solution by shaking with the dispersion medium in the presence of a small amount of electrolyte is known as peptization and the electrolyte used is called peptizing agent.

ii. Dialysis is the process of removing a dissolved substance from a colloidal solution by means of diffusion through a suitable membrane. It is generally slow and is made faster by applying an emf if the dissolved substance in the impure colloid is an electrolyte (Known as electro dialysis).

iii. **Gold number:** It is the number of milligrams of protective colloid which must be added to 10 ml of given gold sol so that it is just prevented from coagulation by adding 1 ml of 10% NaCl solution. The smaller the gold number, the higher is the protecting power of lyophilic colloids. Gold number of Gelatin is 0.005-0.01, Haemoglobin is 0.03 and potato starch is 25.

8. **Explain the following terms**

i. Electrophoresis ii. Coagulation iii. Tyndall Effect.

Ans. (i) Electrophoresis: The movement of colloidal particles towards oppositely charged electrodes in the presence of an electric field is called electrophoresis. If this movement is towards cathode then is called cataphoresis.

(ii) Coagulation: The formation of aggregates or precipitates of colloidal particles by addition of a suitable electrolyte is called coagulation.

(iii) Tyndall effect: When a beam of light is passed through a colloidal solution and the solution is viewed at right angles to the passage of light, they show a mild to strong opalescence i.e the path of beam of light is illuminated. This phenomenon is called Tyndall effect. It is due to scattering of light by colloidal particles.

9. Name the four positively charged sols and negatively charged sols?

Ans. The colloidal solution in which the dispersed phase particles carry positive charge is called positively charged sol

E.g.: i) Hydrated metallic oxide sols. **E.g.:** $Al_2O_3.xH_2O$, $CrO_3.xH_2O$ and Fe_2O_3, xH_2O , etc

ii) Basic dye stuffs. **E.g.:** methylene blue sol

iii) Haemoglobin (blood)

iv)Oxides. **E.g.:** TiO_2 sol

The colloidal solution in which the dispersed phase particles carry negative change is called negatively charged sol.

E.g.: i) Metal sols. **E.g.:** copper, silver, gold sols

ii) Metallic sulphide sols. **E.g.:** As_2S_3 , Sb_3S_3 , CdS sols

iii) Acid dye stuff sols. **E.g.:** eosin, congo red sols

iv)Sols of starch, gum, gelatin, clay, charcoal, etc

10. **Describe some features of catalysis by zeolites?**

Ans. Zeolites are shape selective catalysts having honey comb like structure. They are microporous aluminosilicates with AlOSi framework and general formula M x/n $[AlO)_{2x}(siO_2)_y/mH_2O$.

The reactions taking place in Zeolites depend upon the size and shape of the reactant and product molecules as well as upon the pores and cavities of the Zeolites. Zeolites are widely used as catalysts

in petrochemical industries for cracking of hydrocarbons and isomerisation. They are also used for removing permanent hardness of water.

E.g.: ZSM-5 is a catalyst used in petroleum industry

$$\text{Alcohols} \xrightarrow[\text{Dehydratin}]{\text{ZMS}-5} \text{Gasoline (Petrol)}$$

Very Short Answer Questions

1. **What is collodion?**

Ans. 4% solution of nitrocellulose in a mixture of alcohol and ether is called collodion.

2. What causes brownian movement in colloidal dispersion?

Ans. Unbalanced bombardment of the particles of dispersed phase by molecules of dispersion medium causes. Brownian motion. This stabilizes the sol.

3. How do emulsifying agents stabilize the emulsion?

Ans. These agents stabilize the emulsion by forming an interfacial layer between suspended particles and the dispersion medium.

4. Why are some medicines more effective in the colloidal form?

Ans. Because they have large surface area so easily assimilated in the body.

5. Why do we add alum to purify water?

Ans. Alum coagulates the colloidal impurities present in water, so that these get settle down and remove by decantation or filtration.

6. What are the factors that influence the adsorption of a gas on a solid?

Ans. The factors that influence the adsorption of a gas on a solid are

i) The nature of the gas (ii) Surface area of adsorbent (iii) Pressure (IV) Temperature

(v) Activation of adsorbent.

7. Explain the terms aerosol and hydrosol with example?

Ans. A colloidal solution in which dispersion medium is a gas is called an Aerosol.

E.g.: Fog, mist, cloud.

A colloidal solution in which dispersion medium is water is called a hydrosol

E.g.; Starch sol, gold sol.