**(i)** Enzyme catalysed reactions are highly specific, i.e., one enzyme for one reaction.

**(ii)** Enzyme catalysed reactions are normally hydrolytic in nature.

**(iii)** Enzyme catalysed reactions take place with evolution of gases.

**(iv)** The rate of reaction depends upon enzyme concentration.

## MASTERJEE CONCEPTS

Enzyme catalysed reactions are highly susceptible to pH of medium. Favorable range of pH is 5 to 7. The optimum temperature for enzyme catalysed reaction is nearly 30°C. Enzymes being colloidal in nature and thus, their action is ruined by electrolytes.

**Mredul Sharda (JEE 2013, AIR)**

**(f)** **Induced Catalysis:** The phenomenon in which one reaction influences the rate of other reaction which does not occur under ordinary condition. e.g. Sodium arsenite solution is not oxidized by air. However, if air is passed through a mixture of solution of sodium arsenite and sodium sulphite, both of them undergo simultaneous oxidation. Oxidation of $Na_2SO_3$ induces the oxidation of $Na_3AsO_3$.

**(g)** **Shape Selective Catalysis by Zeolites:** Zeolites are microporous alumino-silicates of the general formula $Mn[(AlO_2)_x(SiO_2)_y].mH_2O$

Where n is the valency of cation $M^{n+}$. They may be considered as open structures of silica in which a fraction x/(x + y) of the tetrahedral sites have been substituted by aluminum. The net negative charge on the aluminosilicate framework is neutralized by exchangeable cations M of valency n. Zeolites have high porosity due to the presence of one, two or three dimensional network of interconnected channels and cavities of molecular dimensions. Other elements such as Ba, Mg, B, Ga and P can take the place of Si and Al in the zeolitic frame work. Shape selectivity of a catalyst depend upon the pore structure of the catalyst. The pore size of zeolites generally varies between 260 pm and 740 pm. Depending on the size of the reactant and product molecules when compound to the size of cages or pores of the zeolite, reactions proceed in a specific manner.

## PROBLEM-SOLVING TACTICS

When free energy change is given and extent of adsorbent has to find out, use the following equation.

$$G° = -2.303\ RT\ \log \frac{x}{m} \quad \text{or}$$

It can be written as in terms of enthalpy and Entropy.

$$\frac{x}{m} = 10^{\frac{-\Delta G°}{2.303RT}} = 10^{-\left[\frac{\Delta H° - T\Delta S°}{2.303RT}\right]}$$

$$K_{eq.} = \frac{x}{m} = \left[10^{\frac{+\Delta S°}{2.303R}}\right] \times \left[10^{\frac{-\Delta H°}{2.303RT}}\right]; \qquad K_{eq.} = \frac{x}{m} = \left[e^{\frac{\Delta S°}{R}}\right] \times \left[e^{\frac{-\Delta H°}{RT}}\right]$$

Also we can have $\ln\frac{K_{eq1}}{K_{eq2}} = \frac{\Delta H}{R} x \frac{(T_2 - T_1)}{T_1 T_2}$

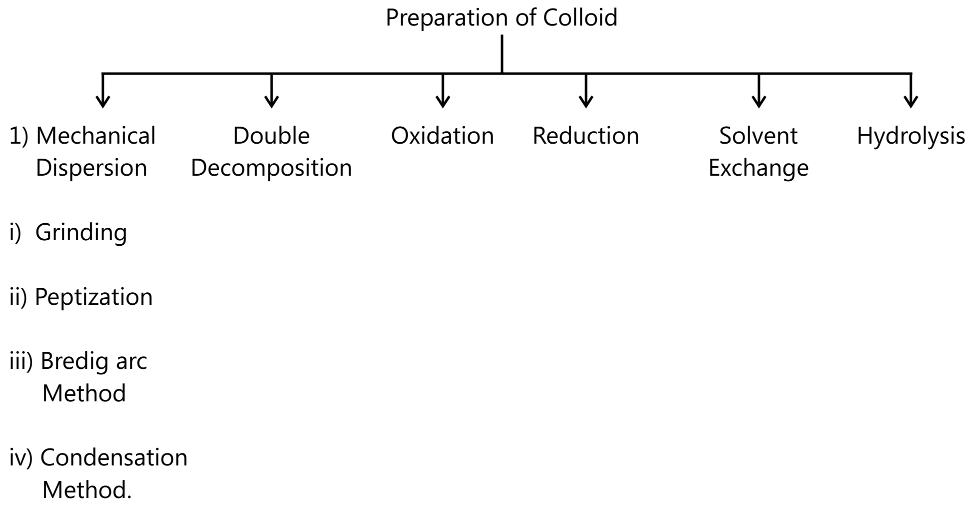
When rate of adsorption or desorption is given use the following equation, $2.303 \log\frac{r_2}{r_1} = \frac{Ea}{R}\frac{[T_2 - T_1]}{T_1 T_2}$

# POINTS TO REMEMBER

## COLLOIDS

### Characteristics of Colloidal State

- It is a particular state, Heterogeneous in nature, number of phases = 2. i.e Dispersed phase and Dispersion medium.
- The one phase dispersed in other is known as dispersed phase (or D.P.) or internal phase or discontinuous phase whereas, the other in which dispersions are made is known as dispersion medium (D.M) or external phase or continuous phase.



Preparation of Colloid

1) Mechanical Dispersion
   - i) Grinding
   - ii) Peptization
   - iii) Bredig arc Method
   - iv) Condensation Method.

Double Decomposition

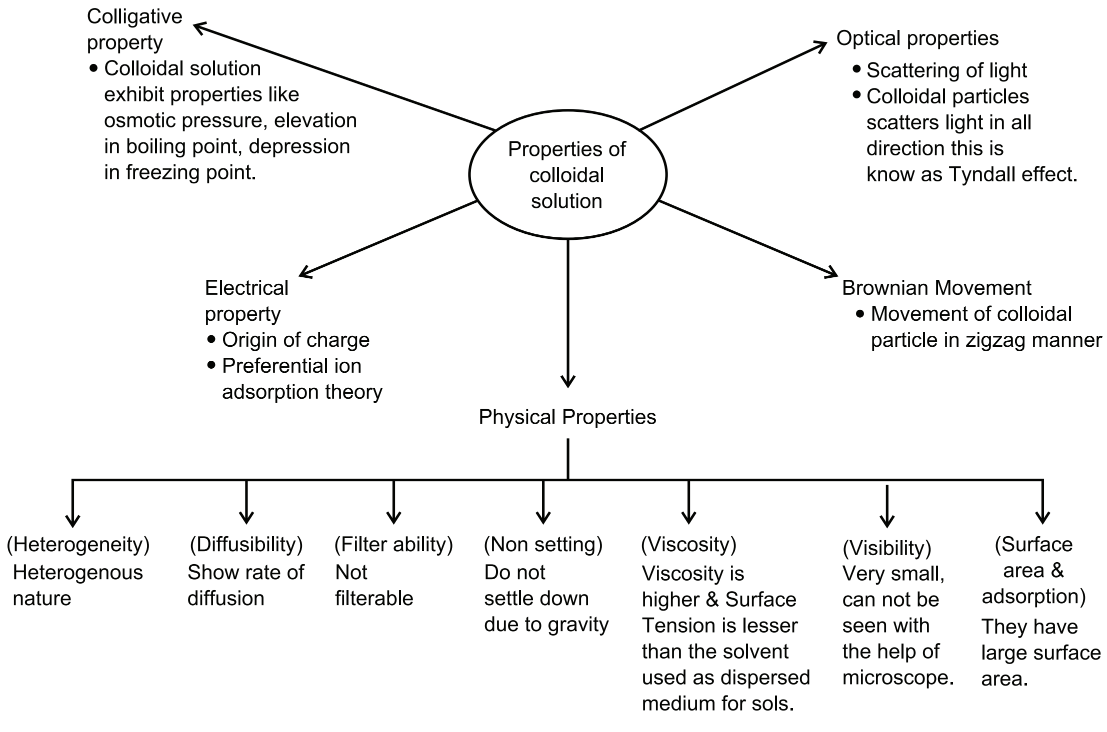
Oxidation

Reduction

Solvent Exchange

Hydrolysis

### Properties of Colloids



Properties of colloidal solution

Colligative property
- Colloidal solution exhibit properties like osmotic pressure, elevation in boiling point, depression in freezing point.

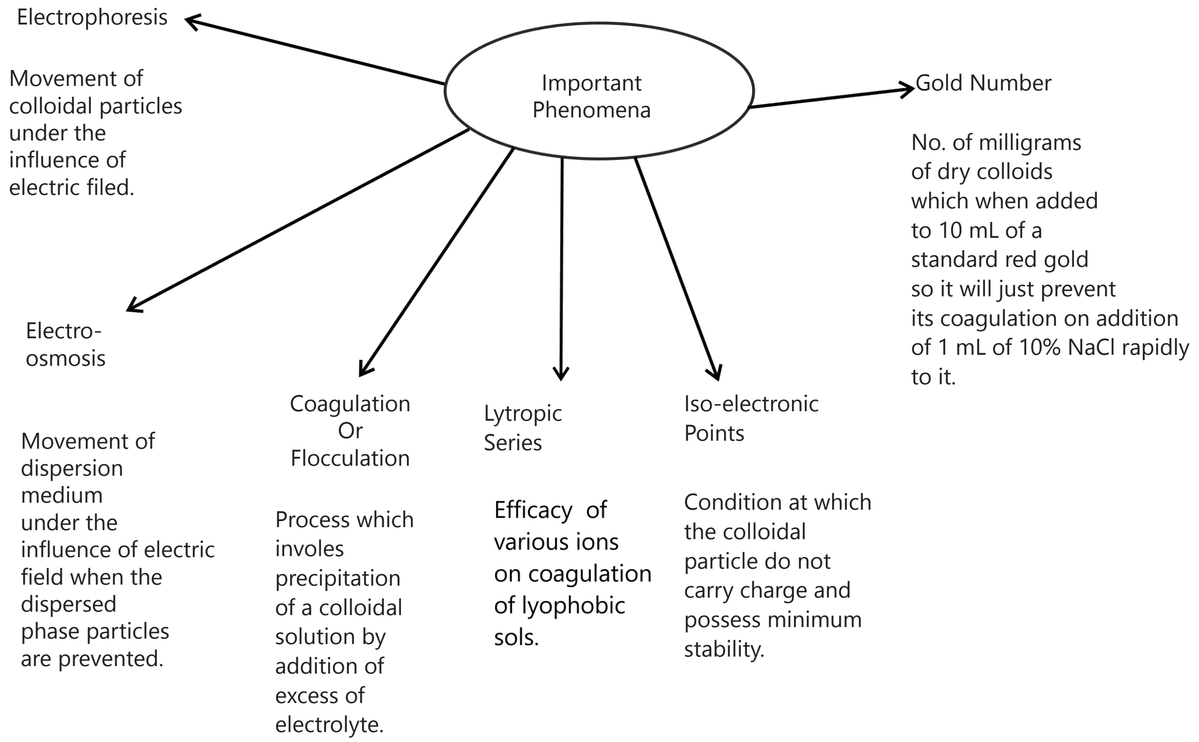
Optical properties
- Scattering of light
- Colloidal particles scatters light in all direction this is know as Tyndall effect.

Electrical property
- Origin of charge
- Preferential ion adsorption theory

Brownian Movement
- Movement of colloidal particle in zigzag manner

Physical Properties
- (Heterogeneity) Heterogenous nature
- (Diffusibility) Show rate of diffusion
- (Filter ability) Not filterable
- (Non setting) Do not settle down due to gravity
- (Viscosity) Viscosity is higher & Surface Tension is lesser than the solvent used as dispersed medium for sols.
- (Visibility) Very small, can not be seen with the help of microscope.
- (Surface area & adsorption) They have large surface area.

### Important Phenomena:



Electrophoresis

Movement of colloidal particles under the influence of electric filed.

Electro-osmosis

Movement of dispersion medium under the influence of electric field when the dispersed phase particles are prevented.

Coagulation Or Flocculation

Process which involes precipitation of a colloidal solution by addition of excess of electrolyte.

Lytropic Series

Efficacy of various ions on coagulation of lyophobic sols.

Iso-electronic Points

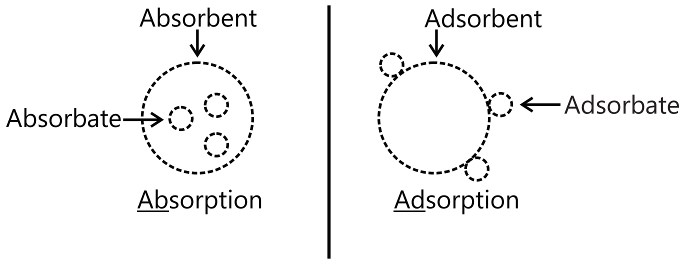
Condition at which the colloidal particle do not carry charge and possess minimum stability.

Gold Number

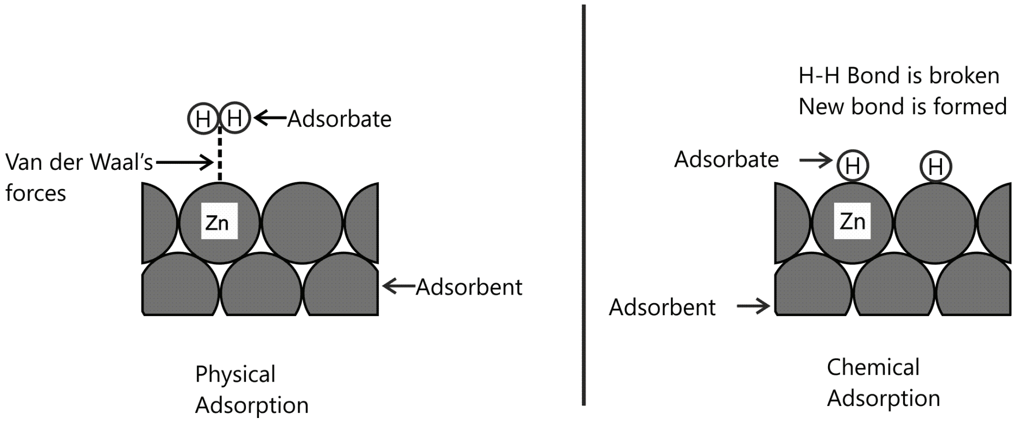
No. of milligrams of dry colloids which when added to 10 mL of a standard red gold so it will just prevent its coagulation on addition of 1 mL of 10% NaCl rapidly to it.

## ADSORPTION

### Absorption and Adsorption process:



### Physical Adsorption and Chemical Adsorption



### Freundlich Adsorption Isotherm

Extent of adsorption (x/m) increases with pressure.

**1.** At low pressure extent of pressure is directly proportional to pressure.

$$\frac{x}{m} \propto p \text{ or } \frac{x}{m} = kp$$

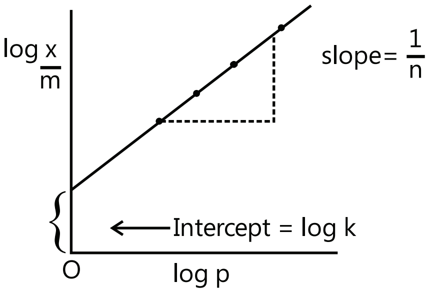
**2.** At high pressure extent of adsorption is independent of pressure.

$$\frac{x}{m} = \text{constant} \text{ or } \frac{x}{m} \propto p^0$$

**3.** In the intermediate range of pressure, x/m will depend upon the power of pressure which lies between 0 and 1 i.e., fractional power of pressure.

This may be expressed as $\frac{x}{m} \propto p^{1/n}; \frac{x}{m} = kp^{1/n}$ Calculation of k and n of adsorption isotherm:

$$\log\frac{x}{m} = \log k + \frac{1}{n}\log p$$



(3)

### Langmuir Adsorption Isotherm

$$\theta = \frac{K_1 P}{1 - K_1}\left(\text{where } K_1 = \frac{K_a}{K_d}\right)$$

$\theta$= Fraction of area occupied.

$K_a$= Rate of adsorption

$K_b$= Rate of desorption.

The Langmuir adsorption isotherm is thus, represented as

$$\frac{x}{m} = \frac{aP}{1+bP}$$ (Where a and b are two Langmuir parameters)

At very high pressure, the above isotherm acquires the limiting form:

$$\frac{x}{m} = \frac{a}{b} \quad (K_1P >>> 1 \text{ } bP >>> 1)$$ ... (v)

And at very low pressure, it is reduced to

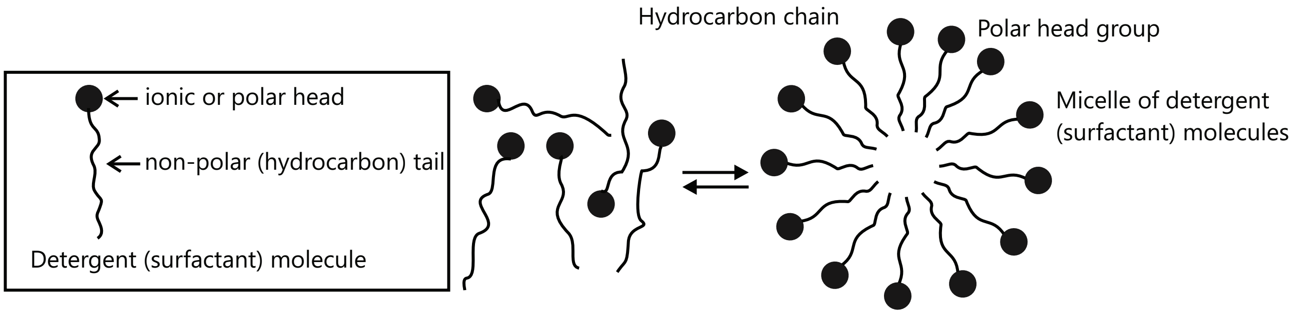
$$\frac{x}{m} = aP \quad (K_1P <<< 1 \therefore bP <<< 1)$$

### Soap and Detergent:

- Saponification of fats and oil yields soap and glycerol as a byproduct.
- Detergents are surface active agents having cleaning properties they are also known as surfactants (Surface active agents).This cleaning properties is due to their characteristic structure.

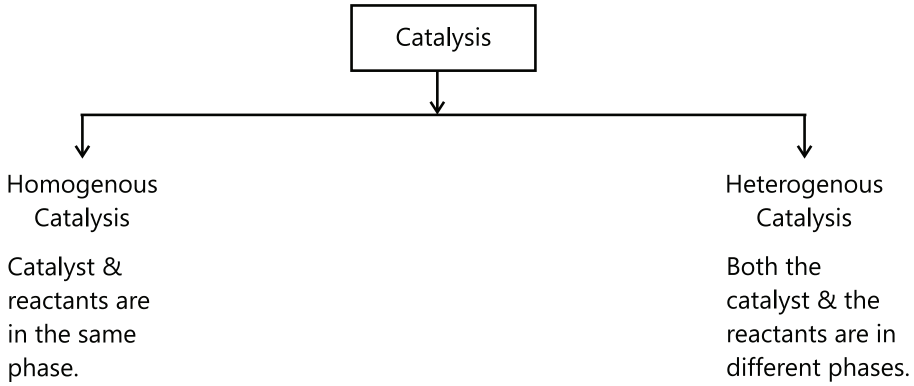
- They have polar head group and long hydrocarbon chain tail which is apolar.
- The concentration at which the surfactants molecule aggregates and micelle formation takes place is known as critical micellar concentration.
- Though their hydrocarbon chain they interact with the dirt particle (say oil or grease)
- Forming and emulsion and imparting cleansing property.

**Micelle Formation:**



## CATALYSIS

### Type of Catalysis


Catalysis

Homogenous Catalysis

Catalyst & reactants are in the same phase.

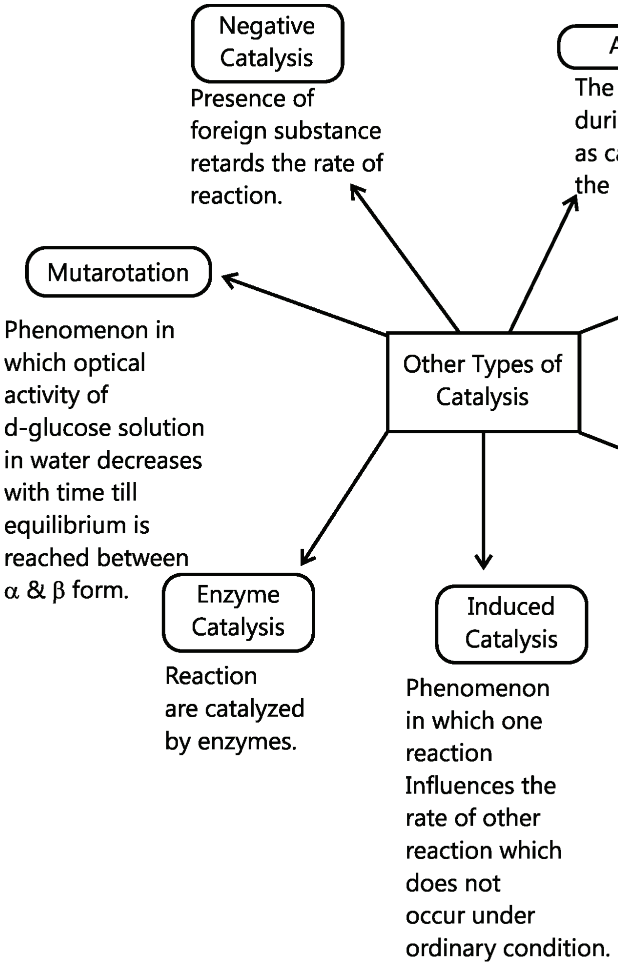
Heterogenous Catalysis

Both the catalyst & the reactants are in different phases.

### Theories of Catalysis

1. Intermediate Compound Formation theory.
2. Adsorption Theory.
3. The Modern Theory.

## Other Catalysis



**Other Types of Catalysis**

**Negative Catalysis**
Presence of foreign substance retards the rate of reaction.

**Autocatalysis**
The product formed during reaction acts as catalyst for the reaction.

**Mutarotation**
Phenomenon in which optical activity of d-glucose solution in water decreases with time till equilibrium is reached between α & β form.

**Acid-Base Catalysis**
Reaction is catalyzed by acid & base simultaneously.

**Enzyme Catalysis**
Reaction are catalyzed by enzymes.

**Induced Catalysis**
Phenomenon in which one reaction Influences the rate of other reaction which does not occur under ordinary condition.

**Catalysis by Zeolite**
1) Zeolite have cage like structure.
2) Host-guest interaction between zeolite & reactant.