

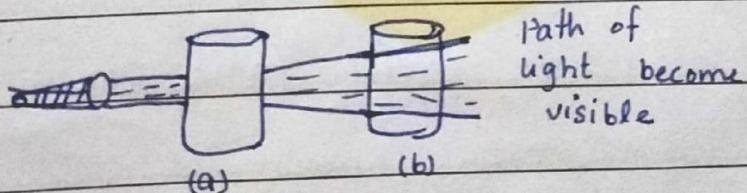
: SHORT ANSWERS:-

(3)

Tyndall effect:

Tyndall effect is observed only when,

- (i) The diameter of the dispersed particles is not much smaller than the wavelength of the light used.
- (ii) The refractive indices of the dispersed phase and dispersion medium differ in magnitude.
- (iii) Tyndall effect can also be observed when a fine beam of light enters a room through a hole. This happens due to the scattering of light by the particles of the dust and smoke in air.

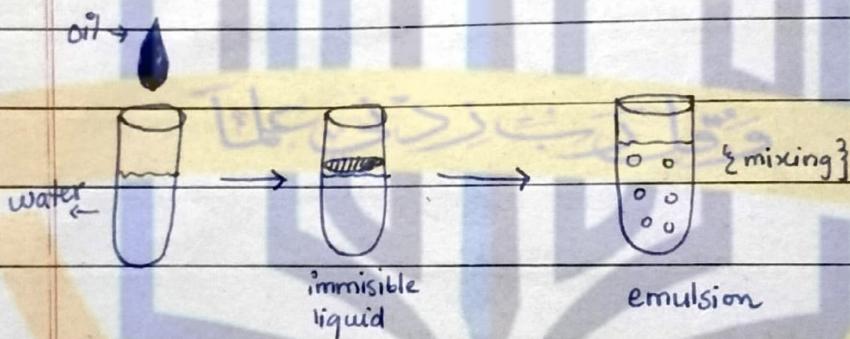


- (a) soln. of copper sulphate does not show tyndall effect.
- (b) Mixture of water & milk show tyndall effect.

Emulsification:

The dispersal of a liquid in the form of an emulsion is called emulsification.

It is a process of mixing of two immiscible liquids into a mixture. It is the process of creating phases in a liquid-liquid mixture that results in a creation of emulsions.



(1)

Enzyme inhibition:

Enzyme inhibition refers to a process where a substance, known as "inhibitor" interferes with the activity of an enzyme.

This happens in different ways

such as by blocking the active-sites of enzymes or altering its structure.

The inhibitors may be

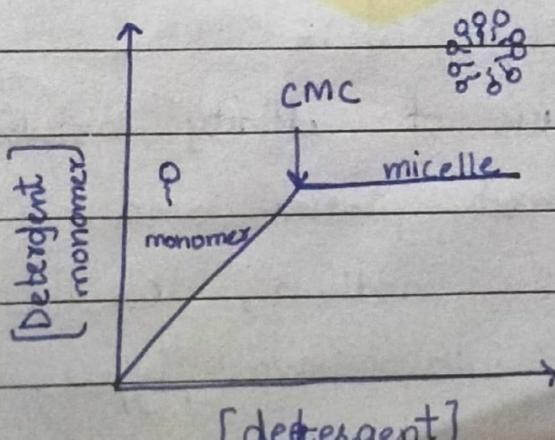
- (i) competitive inhibitor
- (ii) non-competitive inhibitors -

(2)

Critical micelle Concentration (CMC):

Critical micelle concentration (CMC) is defined as the surfactant concentration at which micelle formation is first seen in the solution.

The lowest concentration at which micelle first appear is called the critical concentration for micelle formation -



(vi)

Colloids

(i) In a ^{colloid} sol, the particles are larger typically b/w 1 and 1000 nanometers.

(ii) Colloids are broader category of mixtures where particles are dispersed in medium.

(iii) Colloids encompass a wider range of dispersions including sols, gels, foams & emulsions.

Sols

In a sol, particles are smaller in size range of nanometers. (1 to 100 nm).

They are usually individuals atoms, molecules or small aggregates.

Sols are specific type of colloidal dispersion where solid particles are dispersed in a liquid medium.

(v)

Types of sols:-

On the basis of affinity between the dispersed phase and dispersion medium, sols can be divided into two types,

- (i) Lyophilic sols
- (ii) Lyophobic sols.

Lyophilic sols:

1. These are very stable and are not easily coagulated by electrolytes.
2. These are highly viscous

Examples:

Gums, starch, proteins.

Lyophobic sols:

1. They are generally unstable \Rightarrow get easily coagulated on adding electrolyte.
2. Viscosity of the colloidal dispersion is same as solvent

Example:

Gold, As_2S_3 in water.

(6)

Electrophoresis

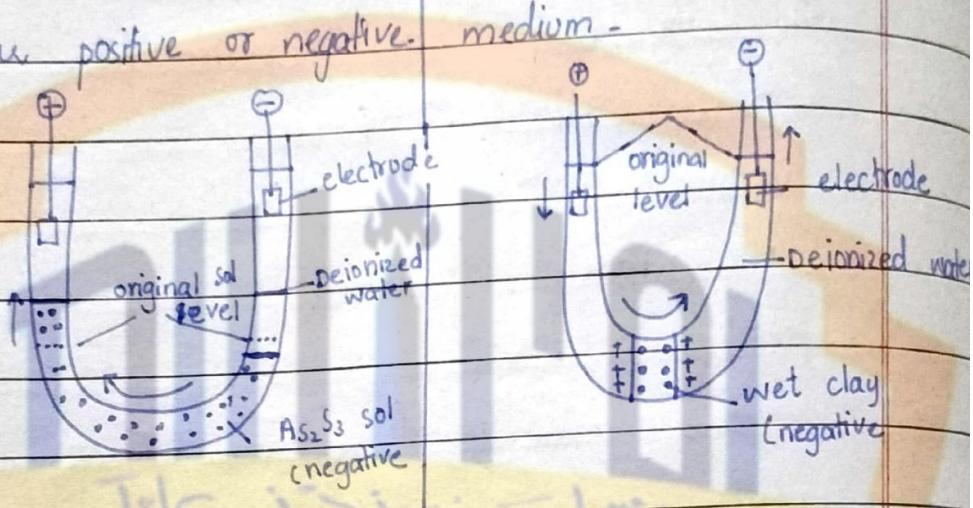
1. The movement of sol particles under an applied electric potential is called electrophoresis.

Electroosmosis

- The movement of dispersion medium under influence of applied potential is known as electro-osmosis.

2. By noting the direction of movement of sol particles, we can determine whether they are positive or negative.
- It is a direct consequence of existence of zeta-potential between sol and the medium.

3.



(7)

Autocatalysis:

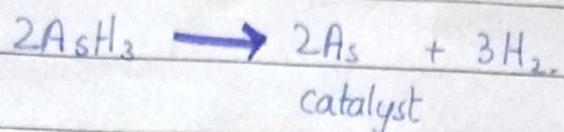
When one of the products of the reaction itself acts as a catalyst for that reaction, the phenomenon is called autocatalysis."

Example:

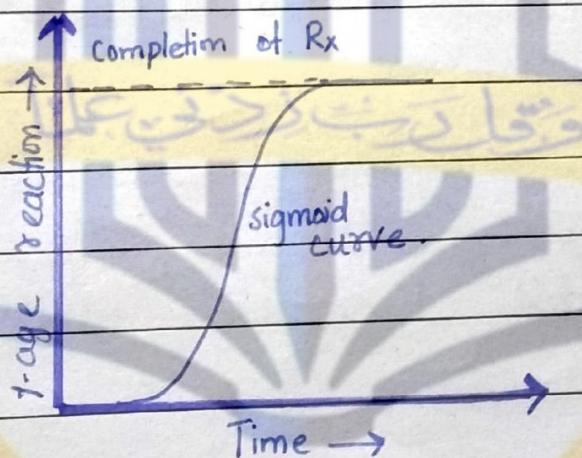
Decomposition of Arsine:

The free arsenic produced by the

decomposition of arsine (AsH_3) autocatalyses the reaction.



⇒ In autocatalysis the initial rate of the reaction rises as the catalytic product is formed, instead of decreasing steadily - the curve plotted b/w reaction & time shows a maximum when the reaction is complete.



(8)

Enzyme catalysis

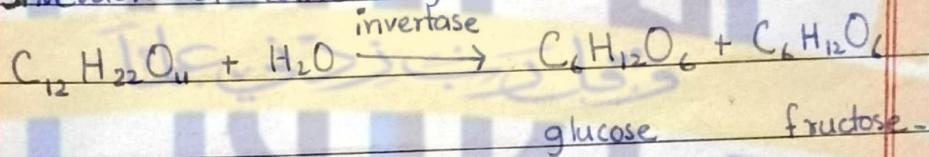
"The catalysis"

brought about by enzymes is known as Enzyme catalysis."

- Enzymes are protein molecules which act as catalyst to speed up organic reactions in living cells.
- Each enzyme is produced in a particular living cell to catalyse the reaction occurring in the cell.
- The first enzyme as prepared by synthesis in the laboratory in 1969.

Example:

Inversion of cane sugar:



(9)

Colloidal dispersion:

• The colloidal solution or colloidal dispersions are intermediate between true solutions or suspensions.

- When the diameter of the particles of a substance dispersed in a solvent ranges from about 10 \AA to 2000 \AA , the system is termed as colloidal dispersion, colloidal solution, or simply

Examples:

The colloidal particles are not necessarily corpuscular in shape. They may be rod-like, disc-like, thin films or long filaments.

Common examples are:

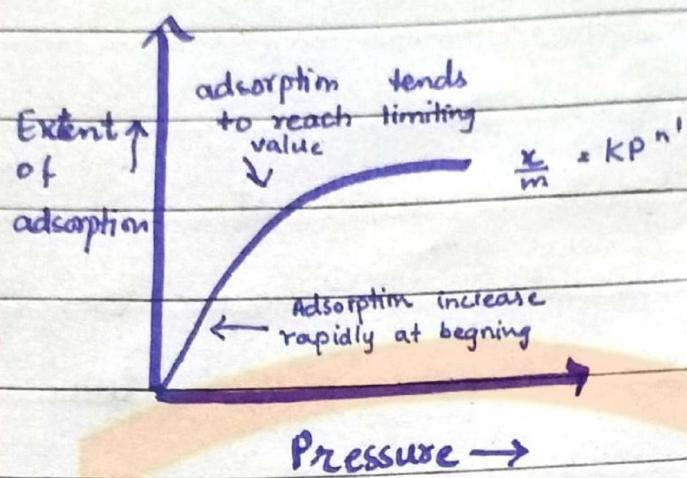
Fog, ice-cream, soap bubbles,
Aerosol etc.

(20)

Effect of surface area on adsorption.

The effect of surface area on adsorption is that a larger surface area provides more sites for molecules to bind to, increasing the overall absorption capacity.

This is because a larger surface area allows for more interactions between the adsorbent and adsorbate. So, in simple words, more surface area means more adsorption.



(11)

Thixotropy phenomenon:

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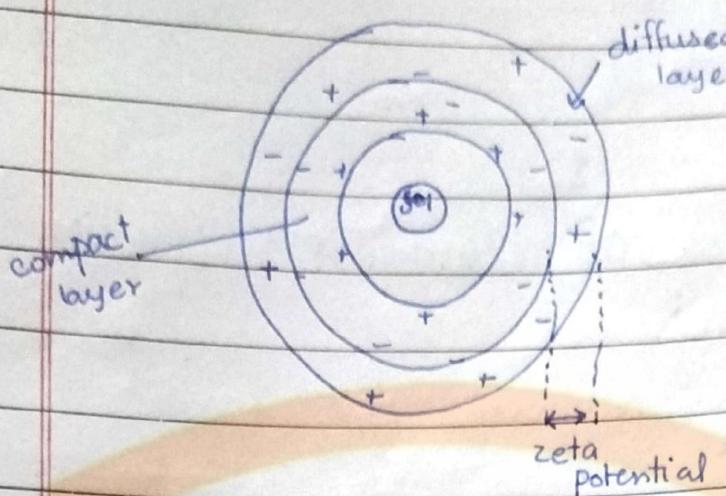
(12)
Postulates of Langmuir adsorption isotherm:

- (i) Each adsorbent has specific equivalent sites for adsorption.
- (ii) Adsorbate molecules attach to these sites.
- (iii) One molecule of adsorbate can absorb on one site of adsorbent.

(13)
Zeta Potential:

The potential difference between the compact layer and the bulk of liquid across the diffused layer is termed as electrokinetics or zeta potential.

⇒ Zeta potential measurements can be used to find the stability of charged colloidal particles.



(14)

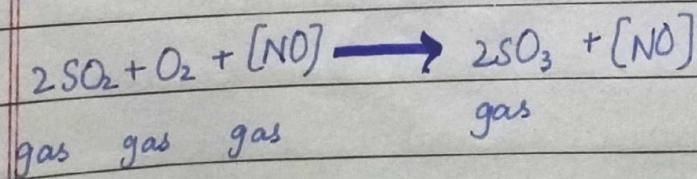
Homogeneous catalysis:

In homogeneous catalysis, the catalyst is in the same phase as the reactants and is evenly distributed throughout.

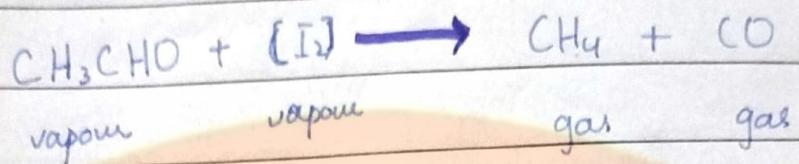
⇒ This type of catalysis can occur in gas phase or the liquid (soln) phase.

Examples:

Oxidation of sulphur dioxide (SO_2) to sulphur trioxide (SO_3) with nitric acid (NO) as catalyst -



(2) Decomposition of acetaldehyde (CH_3CHO) with iodine (I_2) as catalyst.



(15)

Enzymes as catalysts:

Enzymes are specific in nature

when it comes to catalysis.

They have a unique three-dimensional structure that allows them to interact with specific substrates.

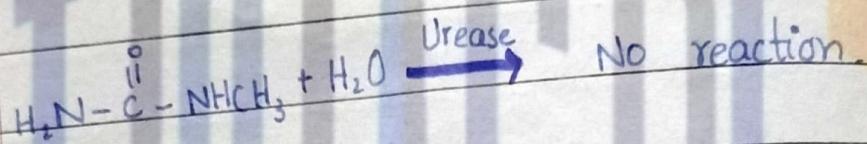
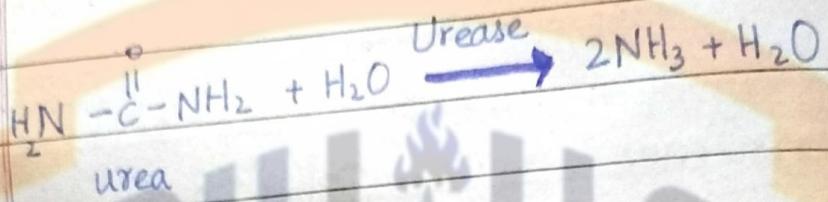
This specificity is due to active site of enzymes, which is perfectly shaped to accommodate and bind to a specific substrate.

The lock and key mechanism ensures that enzymes only catalyze

specific reactions, enhancing their efficiency and preventing unwanted reactions.

Example :

Urease catalysis the hydrolysis of urea and no other amide, not even methylurea.



: LONG QUESTIONS:-

QUESTION NO : 03

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(a)

Discuss preparation and purification of sols.

-: Preparations of sols :-

Lyophilic sols may be prepared

by simply warming the solids with the liquid dispersion medium e.g., starch with water.

On the other hand, Lyophilic sols have to be prepared by special methods.

These methods falls into two categories:

(ii) Dispersion method in which larger macro-sized particles are broken down to colloidal size.

(iii) Aggregation Methods in which colloidal size particles are built up by aggregating single ions or molecules.

∴ Dispersion Methods:-

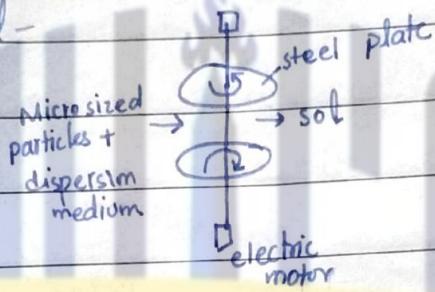
(1) Mechanical dispersion using colloid mills:

Many substances can be disintegrated into particles size in a colloidal mill. The colloidal mill consist of two steel disc each rotating in opposite direction at speed of about 7000 rpm.

The solid particles are ground down to colloidal size and are then dispersed in a liquid to give a sol.

Example:

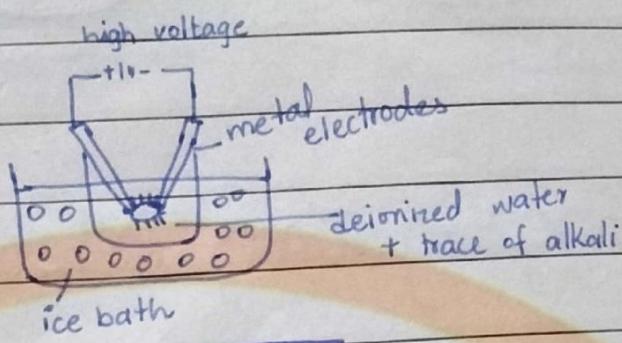
colloidal graphite (lubricant) and printing inks are made by this method -



2. Bredig's Arc Method:

It is used for preparing hydrosols of metals e.g. silver, gold & platinum. An arc is struck b/w two metal electrodes held close together beneath de-ionized water. The water is kept cold and trace of alkali (KOH) is added. The intense heat of spark across the electrodes vapourizes some of metal and vapour condense under water. The vapour particles aggregates to form colloidal particles in water.

Since the metal has been ultimately converted into sol particle (via metal vapors).



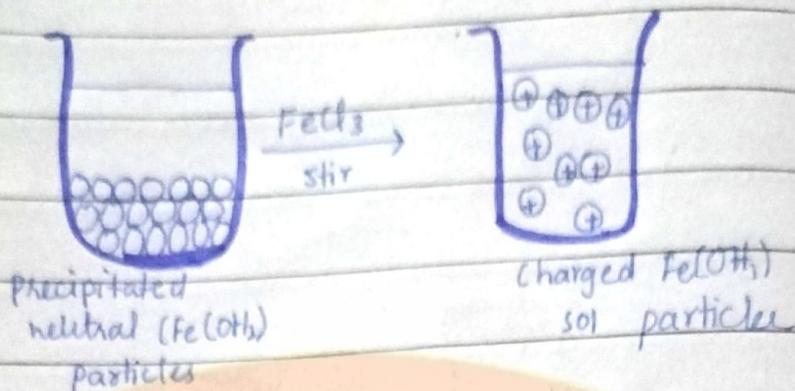
3) By Peptization:

Some precipitated ionic solids are dispersed into colloidal soln in water by addition of small quantities of electrolytes, particularly those containing common ions. The precipitate adsorb the common ions & electrically charged particles then splits from ppt as colloidal particles.

PUACP Examples:

(i) Silver-chloride: $\text{Ag}^+ \text{Cl}^-$, can converted into sol by adding hydrochloric acid (Cl^- - being common ion).

(ii) Ferric hydroxide Fe(OH)_3 yields a sol by adding ferric chloride (Fe^{3+} as common ion).



→ Aggregation Methods:-

These methods consists of chemical reactions or change of solvents whereby the atoms or molecules of dispersed phase appearing first, aggregate to form colloidal particles.

The important methods for preparation of hydrophobic sols are

- (i) Double decomposition
- (ii) Reduction
- (iii) Oxidation
- (iv) Hydrolysis
- (v) change of solvent

Purification of Sols:-

In the methods of preparation, the resulting sol frequently contains besides colloidal particles appreciable amounts of electrolytes. To obtain pure sol, these electrolytes have to be removed.

This is accomplished by following methods:

- (i) Dialysis
- (ii) Electrodialysis
- (iii) Ultrafiltration

Details of two are here:-

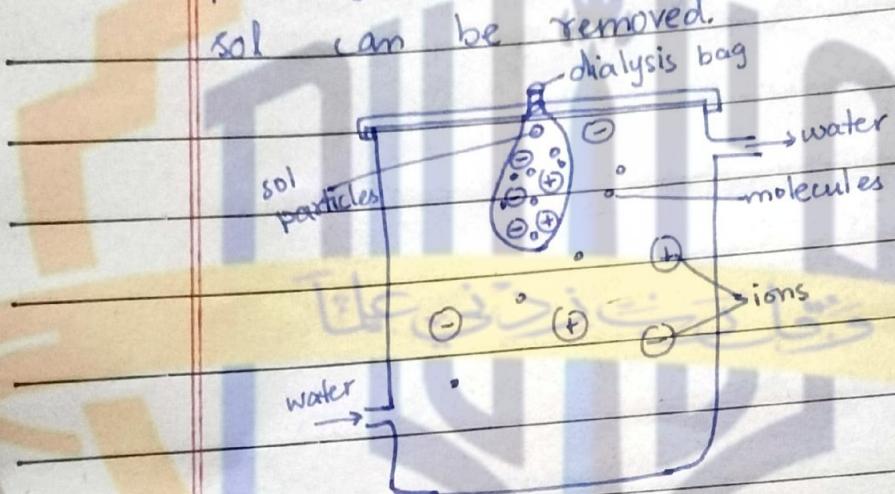
-: Dialysis :-



The process of removing ions from a sol by diffusion through a permeable membrane is called Dialysis."

When a sol containing dissolved ions (molecules) are placed in a bag of permeable membrane

dipping in pure water, the ions diffuse through the membrane. By continuous flow of water, the conc of electrolyte outside the membrane tends to be zero. In this way, partially all the electrolyte present in sol can be removed.



(2)

-: Ultrafiltration :-
-: Ultrafiltration :-

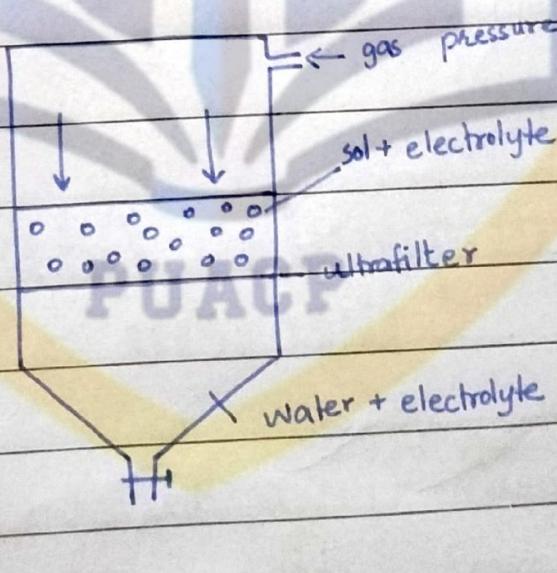
The separation of sol particles from liquid medium and electrolytes by filtration through a ultrafilter is called ultrafiltration."

⇒ If the filter paper is impregnated with colloids or regenerated cellulose such as cellophane or visking, the pore size is reduced - Such modified filter paper is an ultrafilter.

⇒ It is a slow process. Gas pressure has to be applied to speed up-

The colloidal particles are left on ultrafilter in the form of slime.

The slime stirred into fresh medium to get back the pure sol-



(b)

-:- Adsorption :-

(c)

The phenomenon of concentration of molecules of a gas or liquid at a solid surface is called adsorption!



The substance that deposits on the surface is called Adsorbate.

The solid on whose surface the deposition occurs is called adsorbent.

-:- Langmuir Adsorption theorem :-

Langmuir (1916) derived a simple adsorption isotherm based on theoretical consideration -

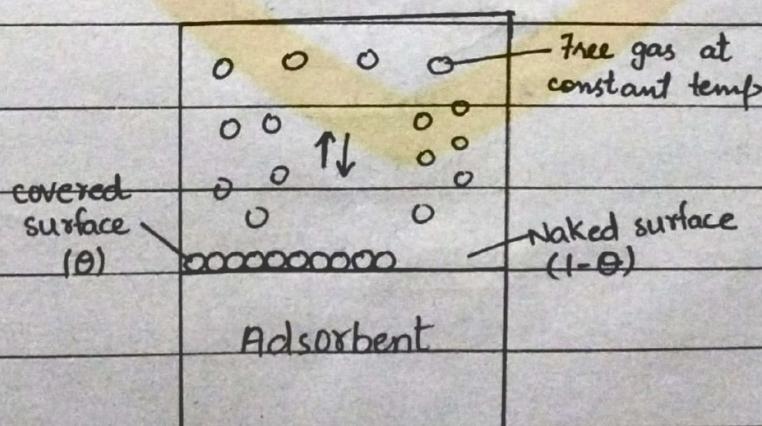
Assumptions:

- The layer of a gas adsorbed on the adsorbent is one-molecule thick.
- The adsorbed layer is uniform all over the adsorbent.
- There is no interaction between the adjacent adsorbed molecules.

Derivation:

Langmuir considered that the gas molecule strike a solid surface and are thus adsorbed. Some of these molecules evaporates or desorbed. A dynamic equilibrium is eventually established b/w the two opposing processes, Adsorption and desorption.

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Dynamic equilibrium

If Θ is the fraction of the total surface covered by the adsorbed molecules, the fraction naked area is $(1-\Theta)$.

The rate of desorption (R_d) is proportional to the covered surface Θ . Therefore,

$$R_d = K_d \Theta$$

where K_d is rate constant for desorption process.

The rate of adsorption (R_a) is proportional to the available naked surface $(1-\Theta)$ and the pressure (P) of a gas.

$$R_a = K_a (1-\Theta) P$$

where K_a is rate constant for adsorption.

At Equilibrium the rate of desorption is equals to rate of adsorption,

$$K_d \Theta = K_a (1-\Theta) P$$

$$\Theta = \frac{K_a P}{K_a + K_d P}$$

$$\Theta = \frac{(K_a / K_d) P}{1 + (K_a / K_d) P}$$

$$\Theta = \frac{K P}{1 + K P}$$

Where K is equilibrium constant and is referred as adsorption coefficient.

The amount of gas adsorbed per gram of the adsorbent x is proportional to θ .

$$x \propto \frac{KP}{1+KP}$$

$$x = \frac{k' KP}{1+KP} \quad \dots \dots (1)$$

Equation (1) gives the relationship between amount of gas adsorbed to the pressure of a gas at constant temperature and is known as Langmuir Adsorption isotherm

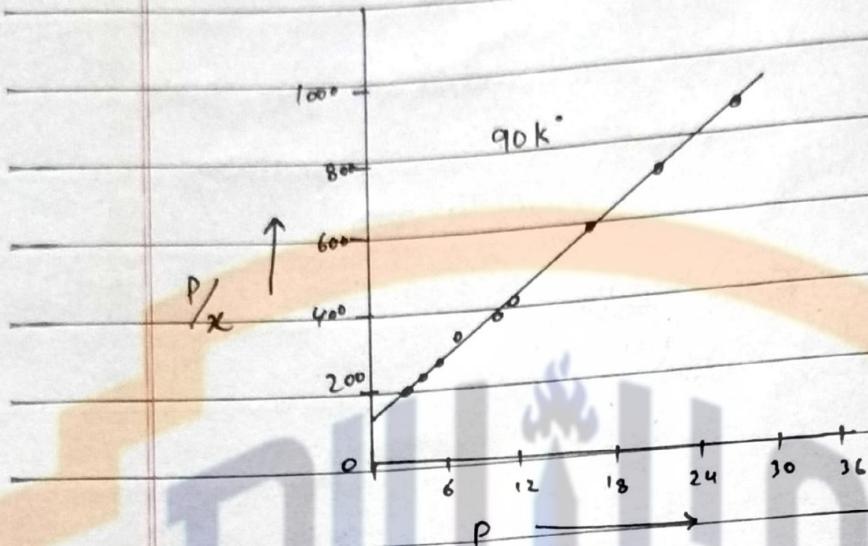
In order to test this isotherm, eq (1) is rearranged so that,

$$\frac{P}{x} = \frac{1}{k'} + \frac{P}{k''} \quad \dots \dots (2)$$

where k'' constant = k'/k

Equation (2) gives straight line if P/x is plotted against P , we should get straight line with slope

$1/k''$ and intercept $1/k'$.



verification of Langmuir isotherm for adsorption

of N_2 on mica at 90K.

QUESTION No: 03

(a)

what are colloids, kinetics properties of sols?

-:- Colloids :-

"A colloid is a substance microscopic-ally dispersed throughout another substance" -

- o) The word colloid comes from a Greek word "Kolla" which means glue like thus colloidal particles are glue like substances.
- o) These particles pass through a filter paper but not through a semipermeable membrane -

(e) The colloidal solutions are the intermediate b/w true solution and suspension. "

⇒ when the diameter of particles dispersed in a solution ranges from about 10 \AA to 2000 \AA , the system is termed as colloid or colloidal solution -

Examples:

Milk, blood, fog, ice-cream -

-: Kinetic Properties of Sols :-

Brownian Movement

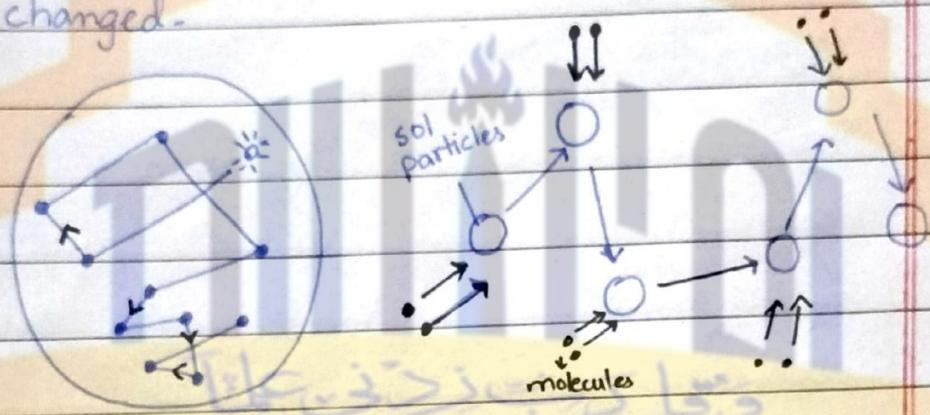
"The continuous zig-zag rapid movement executed by a colloidal particle in the dispersion medium is called brownian movement."

Explanation:

The explanation of Brownian movement was advanced by Albert Einstein around 1955 by mathematical considerations based on kinetic molecular theory.

According to him, at any instant a colloidal particle was being struck by several molecules of dispersion medium. The movement of the particle was caused by unequal

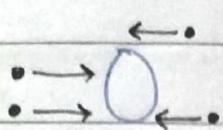
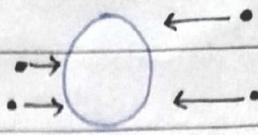
number of molecules of the medium striking it from opposite direction. When more molecules struck the particles on one side other than on others the direction of the movement changed.



Brownian movement (Bombardment on sides of colloidal particles by molecules)-

⇒ In the suspension, the suspended particles being very large, the probability of unequal bombardment diminished.

The force of the molecules hitting the particles on one side is cancelled by the force of collision occurring on other side. Hence they do not exhibit brownian movement.

Sol
particleCoarse suspension
particle

- Brownian movement vanishes in coarse suspensions -

Advantages:-

- ⇒ The phenomenon of Brownian movement is an excellent proof of existence of molecules and their ceaseless motion in liquids -
- ⇒ It also explains how the action of gravity, which would ordinarily cause the setting of colloidal particles, is counteracted -
- ⇒ The constant pushing of particles by the molecules of dispersion medium has a stirring effect which does not permit the particles to settle -

(b)

Michaelis - Menton mechanism for enzyme catalysis.

Enzymes Catalysis

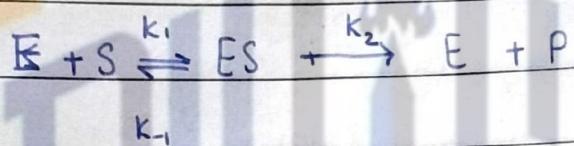
"The catalysis brought about by enzymes are known as enzymes catalysis."

Enzymes : The reactions being slow remarkably catalysed by organic compounds called enzymes. Enzymes have been found to be complex protein molecules.

Michaelis - Menton Mechanism

Michaelis - Menton mechanism of enzyme catalysis obey lock and key model of enzyme functioning - An enzyme has specific site for adsorption of a particular substance -

⇒ According to this model, substrate can form a complex with enzyme by a reversible process, then substrate-enzyme complex is converted into product with regeneration of enzyme by irreversible process.



According to above equation, rate of Rx is:

$$u = k_2 [ES]$$

Net rate formation of enzyme-substrate complex can be written as,

$$\frac{d[ES]}{dt} = k_1 [E][S] - k_1 [ES] - k_2 [ES].$$

Applying steady-state approximation, because ES complex is formed and used during reaction and it is unstable so, $\frac{d[ES]}{dt} = 0$

$$0 = k_1 [E][S] - k_1 [ES] - k_2 [ES]$$

$$k_1 [ES] + k_2 [ES] = k_1 [E][S].$$

$$[ES] \{ k_1 + k_2 \} = k_1 [E][S].$$

$$\frac{[ES]}{k_1 + k_2} = \frac{k_1 [E][S]}{k_1 + k_2}$$

(1)

Enzyme is present in vessel in free form as well as in ES complex form so,

$$[E]_0 = [E] + [ES]$$

where $[E]_0$ is initial conc. of enzyme.

$[E]$ is available conc. of free enzyme.

and $[ES]$ is conc. of enzyme-substrate complex.

$$[E] = [E]_0 - [ES]$$

putting above eq in eq (1)

$$[ES] = \frac{k_1 \{ [E]_0 - [ES] \}}{k_1 + k_2} [S]$$

$$[ES] = \frac{\{ [E]_0 - [ES] \}}{k_1 + k_2} [S]$$

$$\frac{k_1}{k_1 + k_2}$$

$$K_M = \frac{k_1 + k_2}{k_1}$$

$$[ES] = \frac{\{ [E]_0 - [ES] \}}{K_M} [S]$$

K_M = Michaelis-Menton constant.

$$[ES] = \frac{[E]_0 [S]}{K_M} - \frac{[ES] [S]}{K_M}$$

$$\frac{[ES] + [ES] [S]}{K_M} = \frac{[E]_0 [S]}{K_M}$$

$$[ES] = \frac{[E_0][S]}{K_m + [S]}$$

putting value of $[ES]$ in eq. (a)

$$u = k_2 \frac{[E_0][S]}{K_m + [S]}$$

Result deduced are as follows:

(i)

Rate of reaction is the function of concentration of substrate.

(ii)

Rate of reaction is directly proportional to $[S]$ but upto certain limits only.

(iii)

When $[S]$ is low, then $K_m + [S] \approx K_m$, So,

$$u = k_2 \frac{[E_0][S]}{K_m}$$

$$u = \text{constant} \times [S]$$

$$u \propto [S]$$

so, rate of reaction is directly proportional to concentration of substrate.

(iv)

when $[s]$ is very high then

$$k_m + [s] \approx [s], \text{ so,}$$

$$u = k_2 \frac{[E_0][s]}{[s]}$$

$$u = k_2 [E]_0 = u_{\max}$$

u_{\max} is independant.

QUESTION NO: 01

(a)

Explain Langmuir-Hinshelwood mechanism to study organic and inorganic reactions.

Langmuir-Hinshelwood Mechanism

Langmuir-Hinshelwood mechanism involves the following steps:

- (i) Diffusion of reactant gases towards solid surface of catalyst
- (ii) Interaction of adsorbed reactant gases on catalyst surface.
- (iii) Product formed after interaction of reactants