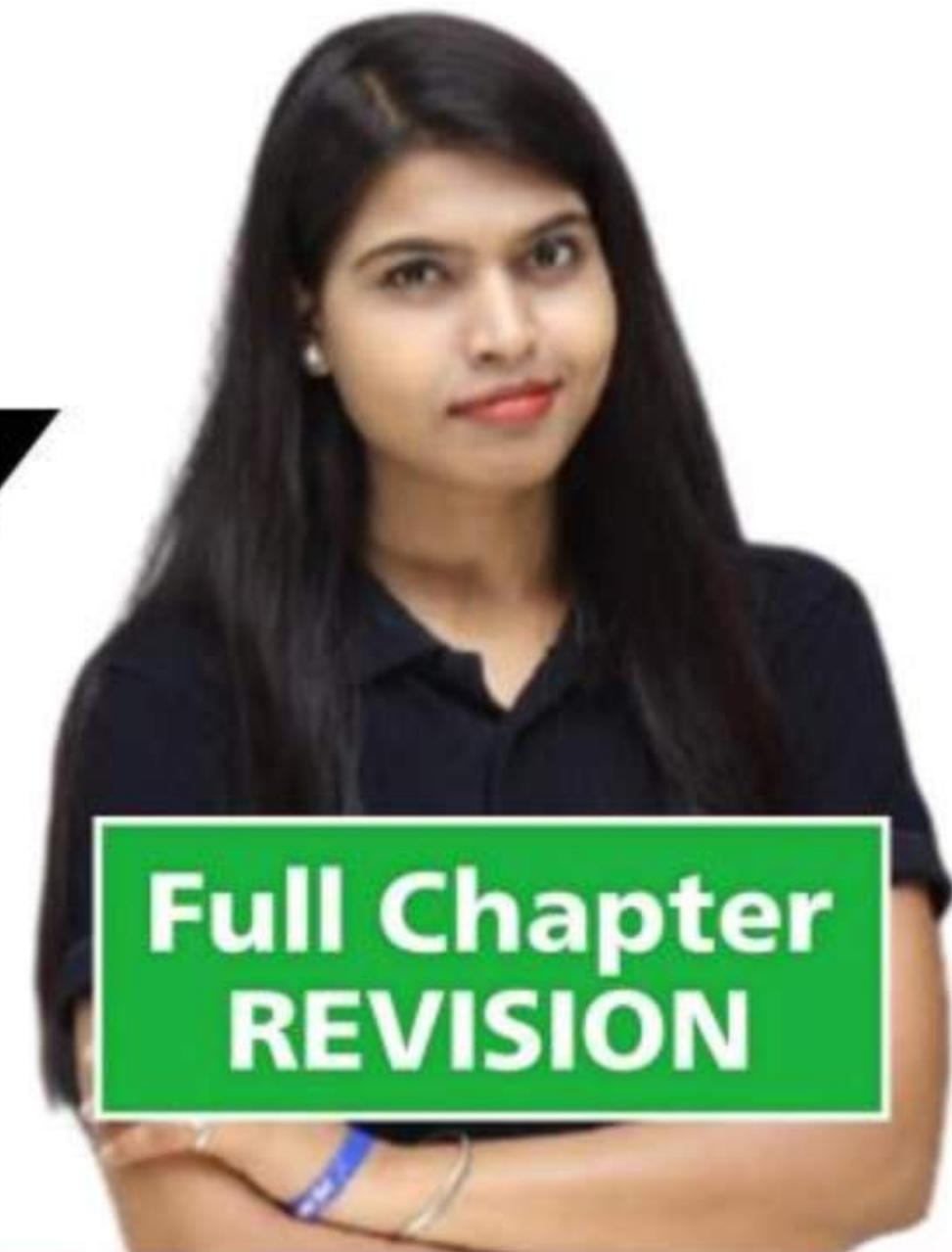


PHYSICAL CHEMISTRY CRASH COURSE

SURFACE CHEMISTRY **IN 1 SHOT**



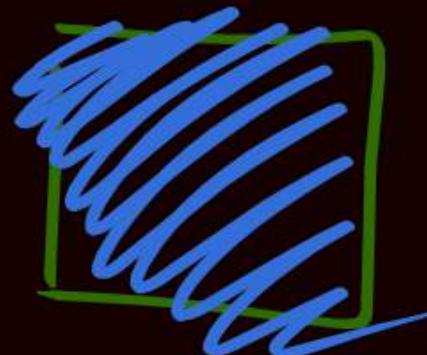
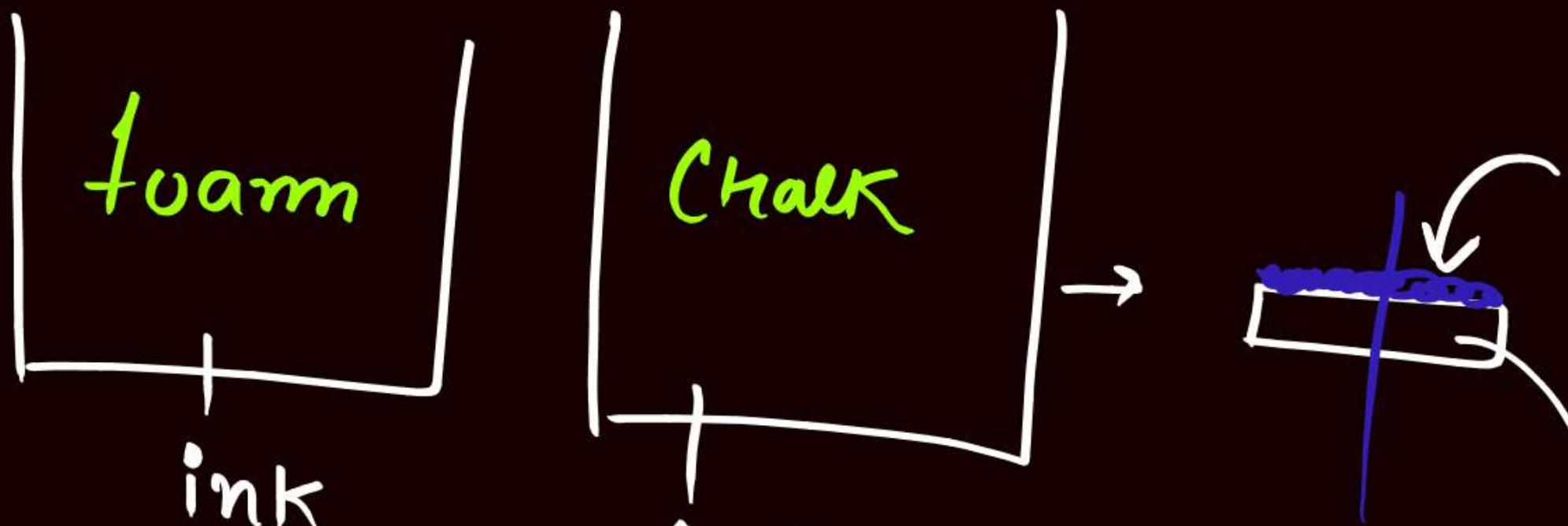
JEE Main Manzil Sprint

Practice Sheet on PW App



ADSORPTION

COLLOIDS



ABSORPTION

ink. ADSORPTION

GENERAL TERMS

ADSORPTION: The accumulation of molecular species at the surface rather than in the bulk of the solid or liquid is termed as **ADSORPTION**.

ADSORBATE: The substance **(ink)** which get accumulated over the surface is called **ADSORBATE**.

ADSORBENT: The substance on the surface of which **(chalk)** adsorption takes place.
Adsorption is essentially a surface phenomenon.



GENERAL TERMS

DESORPTION: The process of removing an adsorbate from surface of adsorbent is called **DESORPTION.**

ABSORPTION: Substance is distributed uniformly through the bulk.

SORPTION: Process in which adsorption and absorption takes place simultaneously.

FACTORS AFFECTING ADSORPTION OF GASES ON SOLIDS

1. **NATURE AND SURFACE AREA OF THE ADSORBENT:** Greater the surface area of the adsorbent, greater is the volume of the gas absorbed, therefore silica and charcoal are good adsorbing agents.
2. **NATURE OF THE GAS BEING ADSORBED:** A gas which is more easily liquefiable or is more soluble in water is more readily adsorbed.
3. **TEMPERATURE:** On increasing temperature, adsorption of gas decreases because adsorption is exothermic process.
4. **PRESSURE:** Adsorption \propto Pressure

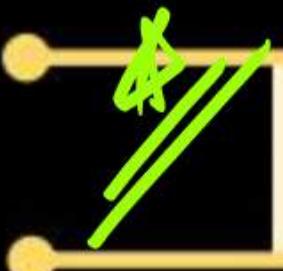
TYPES OF ADSORPTION

Physisorption

- It arises because of Van der Waals forces.
- It is not specific in nature.
- It is reversible in nature.
- It depends on the nature of gas. More easily liquefiable gases are adsorbed readily.
- Enthalpy of adsorption is low (20-40 kJ mol⁻¹)
- Favourable at low temperature. It decreases with increase of temperature.
- No appreciable activation energy is needed.
- It increases with increase of surface area of adsorbent.
- It results into multi molecular layers on adsorbent surface under high pressure.

Chemisorption

- It is caused by chemical bond formation.
- It is highly specific in nature.
- It is irreversible.
- It also depends on the nature of gas. Gases which can react with adsorbent show chemisorption.
- Enthalpy of adsorption is high (80-240 kJ mol⁻¹)
- Favourable at high temperature. It increases with increase of temperature.
- High activation energy is sometimes needed.
- It too increases with an increase of surface area of adsorbent.
- It results into uni-molecular layer on adsorbent surface.

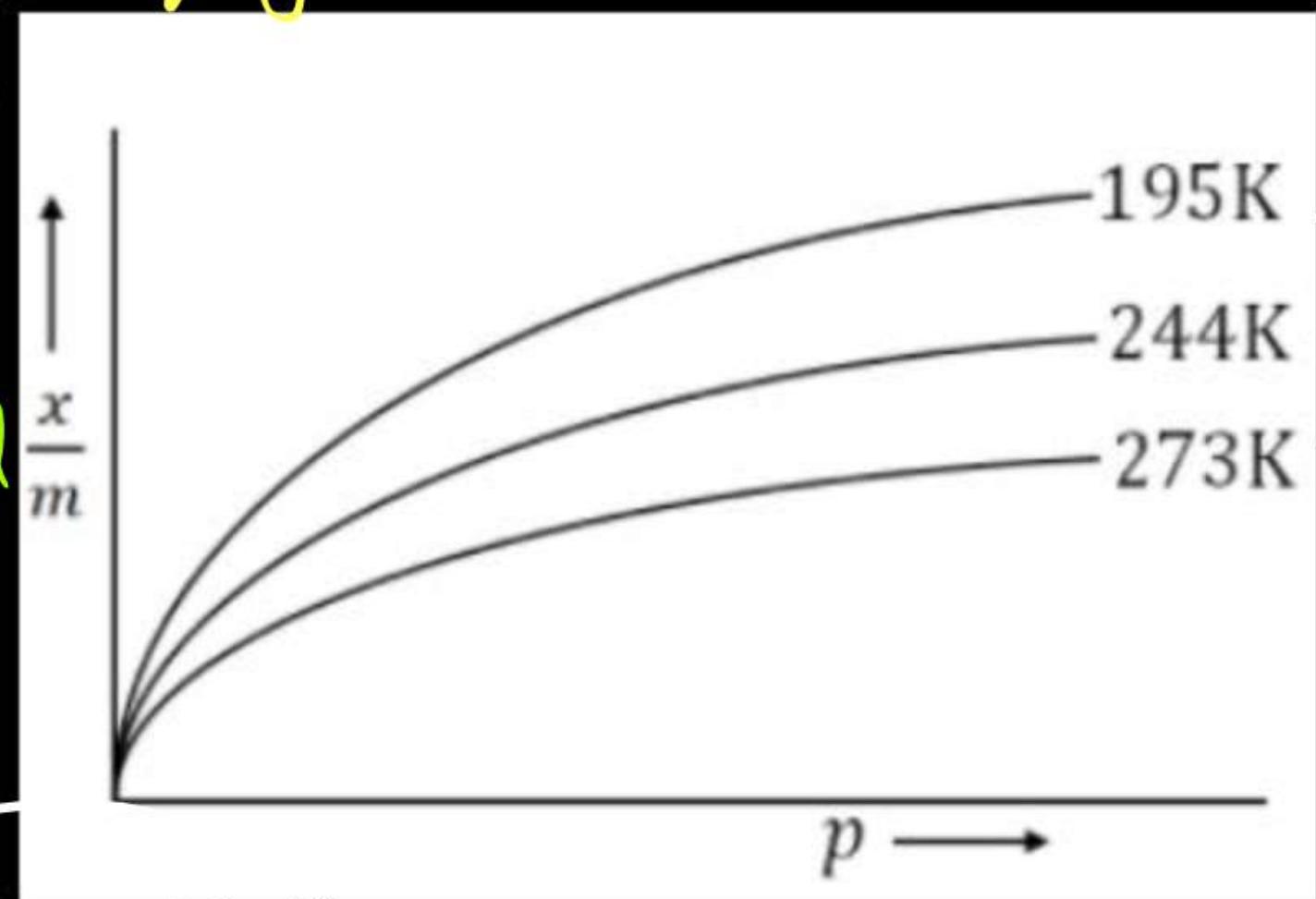
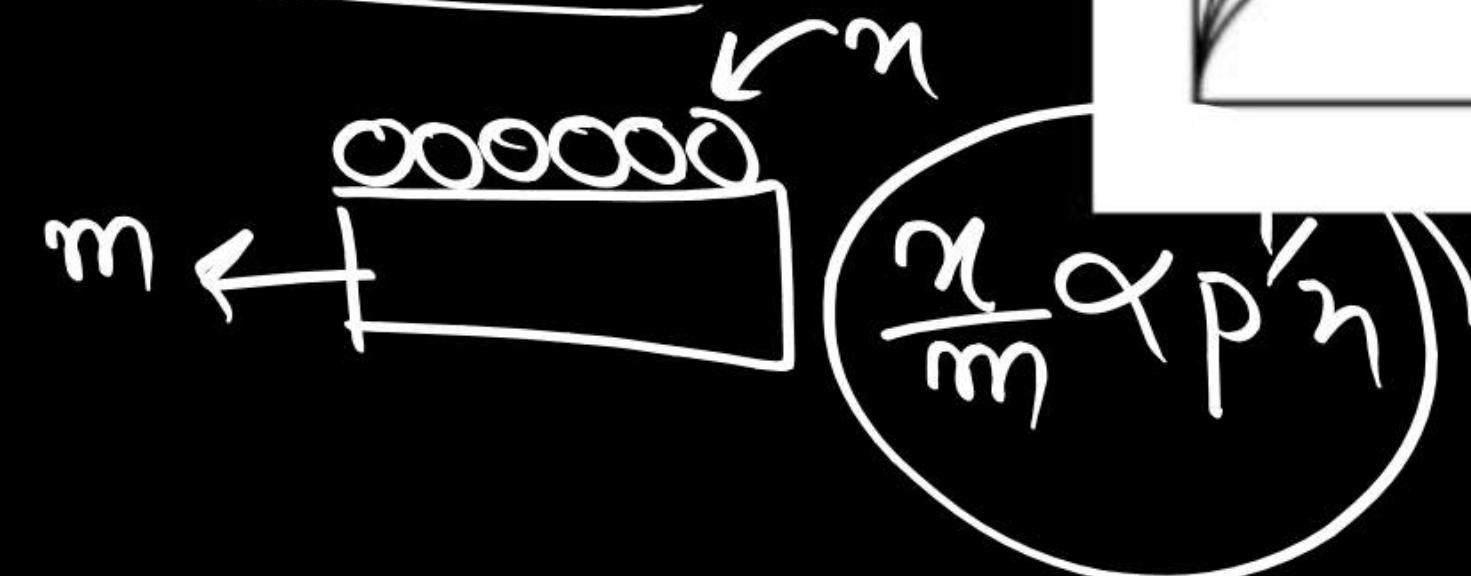


ADSORPTION ISOTHERMS



→ These are the plot for the adsorption of gas over solid.

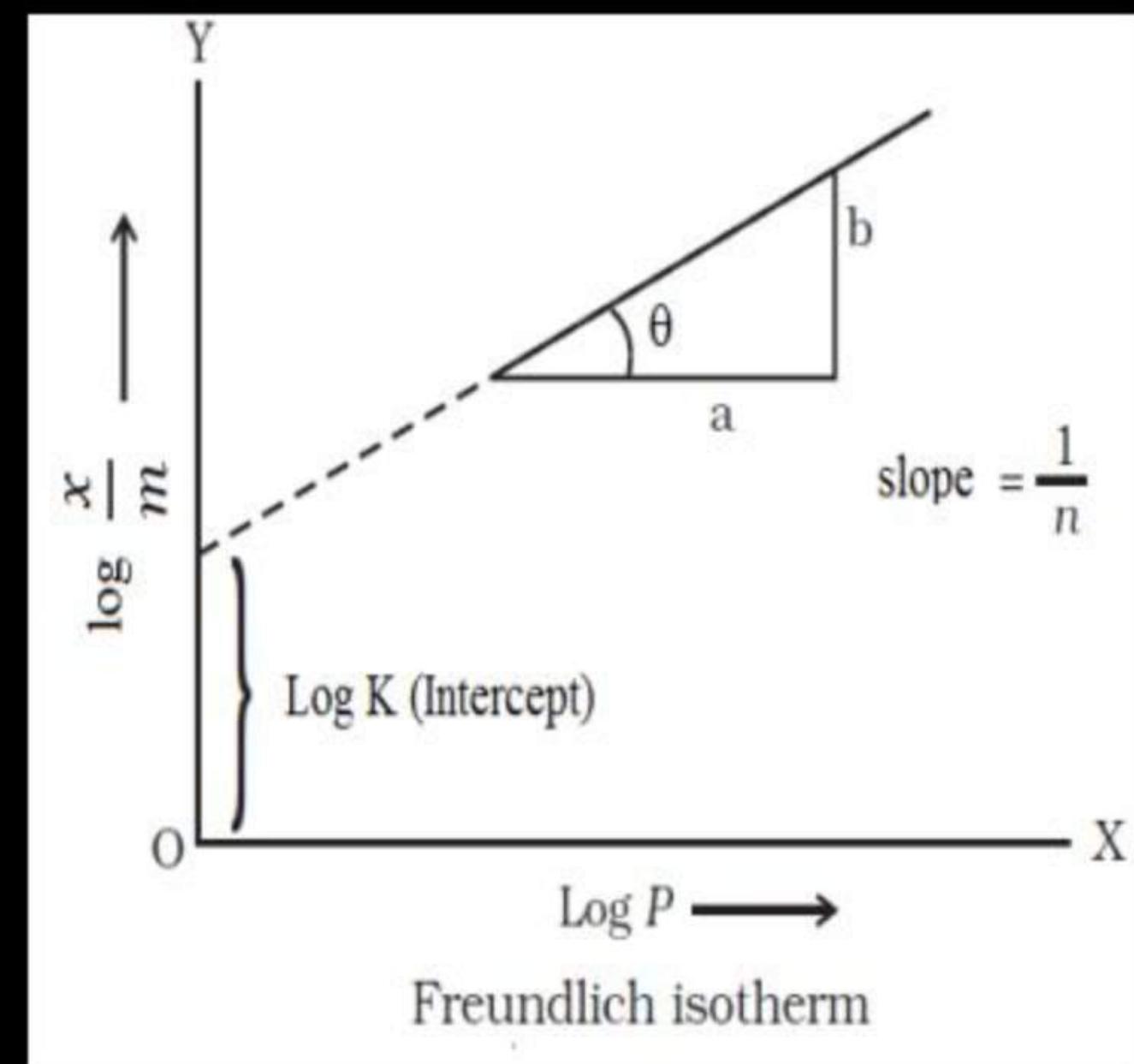
→ The variation in the amount of gas adsorbed by the adsorbent with pressure at constant temp. is termed as Adsorption Isotherm



Freundlich's adsorption equation for gas

Relation between amount of gas adsorbed by a given mass of solid adsorbent & pressure.

$$\frac{n}{m} = K P^{\frac{1}{n}}$$



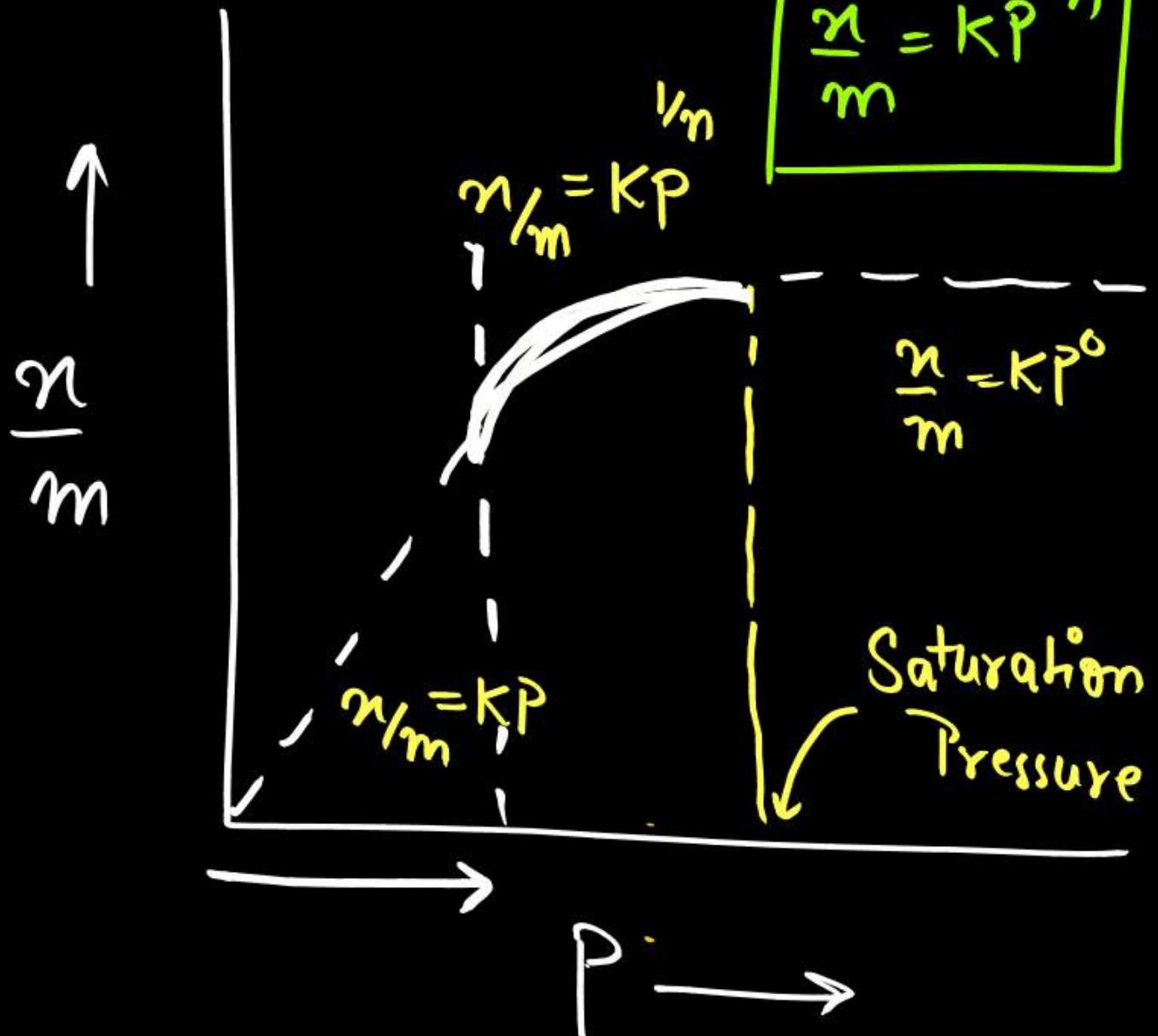
Freundlich's adsorption equation for gas

$$\Rightarrow \frac{n}{m} = K P^{\frac{1}{n}}$$

$$\Rightarrow \log \left(\frac{n}{m} \right) = \log K + \frac{1}{n} \log P$$

$$Y = C + m X$$

Slope = $\frac{1}{n}$



$\Rightarrow n$ is constant which depends on the nature of adsorbate

as well as adsorbent.

\rightarrow Only applicable at moderate pressure

$$0 < \frac{1}{n} < 1$$

\Rightarrow (i) At low Pressure :- when $\frac{1}{n} = 1$

$$\frac{n}{m} = KP \text{ i.e. } \frac{n}{m} \propto P$$

follows first order kinetics

(ii) At high Pressure :- When $\frac{1}{n} = 0$ $\frac{n}{m} = \text{constant}$, which means that
adsorption is independent of Pressure.

$$\frac{n}{m} = KP^0$$
$$\frac{n}{m} = \text{constant}$$

(iii) At intermediate Range of Pressure $\Rightarrow \alpha_m = K P^m$

* $\Rightarrow \alpha_m$ will depend on power of pressure which lies b/w 0 and 1.

APPLICATION OF ADSORPTION

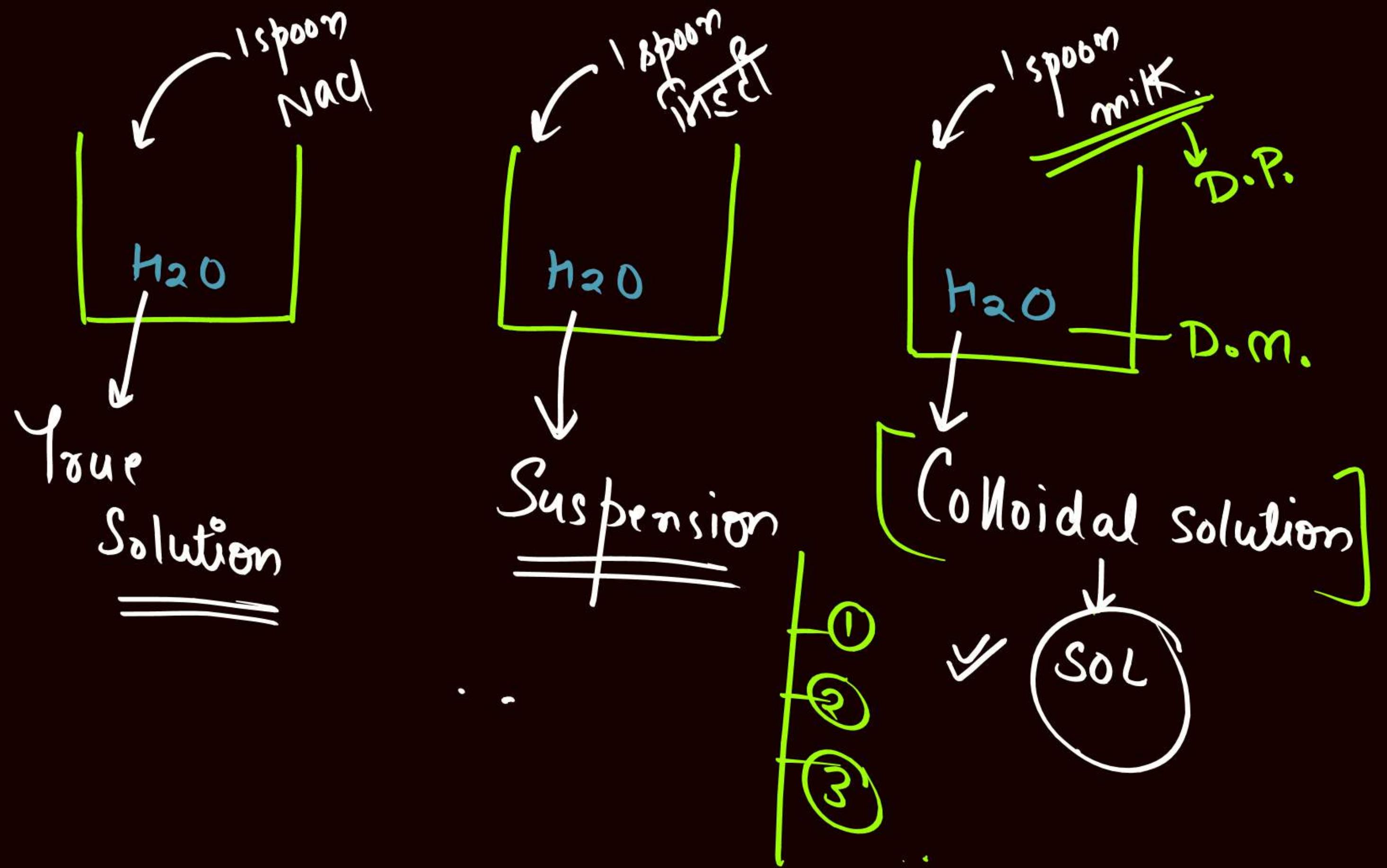
- **REMOVAL OF UNWANTED GASES OR VAPOURS:** Many times, poisonous vapours are present in air. These can be adsorbed by a suitable adsorbent. In fermentation industry the excess of carbon dioxide can make the product unpalatable, which is removed by adsorption on charcoal.
- **REMOVAL OF COLOURING MATTER:** In the production of sugar, vinegar, etc there are a number of colouring impurities. These are removed by absorbents like charcoal, fuller's earth, etc.
- **CATALYSIS:** in heterogeneous catalysis, adsorption of the reactants and desorption of the products are very important process.

➤ **LUBRICATION:** Graphite acts as a lubricant due to adsorption of gases. At high altitudes it loses its lubricating properties because the pressure of the gases is very much reduced leading to the removal of adsorbed gases from the surface of graphite.

➤ **CHROMATOGRAPHIC ANALYSIS:** All types of chromatographic techniques are based upon selective adsorption of different types of substance on a given adsorbent.

➤ **CREATION OF HIGH VACUUM:** Charcoal adsorbs all gases at low temperature. Thus if a vessel is first evacuated by conventional techniques and then connected to charcoal at low temperature, the residual gases will be adsorbed by it and ultra high vacuum in the vessel will be obtained.

- **RECOVERY OF PRODUCTS:** Some valuable products are lost in effluent liquids. These are adsorbed on suitable adsorbents and later recovered by shaking them with suitable solvents.
- **MEDICINE:** Many drugs are adsorbed by the various body tissues. Their effectiveness can be controlled by their selective adsorption of different types of substance on a given adsorbent.



COLLOIDS

On the basis of size of particles of solute, solutions have been classified into three types

True solutions	Colloidal solutions	Suspensions
Less than 10^{-9} m or 1nm i.e. $< 10\text{\AA}$	Between 10^{-9} and 10^{-6} m or 1 nm to 1000nm i.e. $10\text{\AA} - 10000\text{\AA}$	More than 10^{-6} m or 1000nm i.e. $>10000\text{\AA}$

→ Colloidal particles can pass through filter paper but not through animal or vegetable membrane. A colloid is a heterogeneous system in which one substance is dispersed as very fine particles in another substance called dispersion medium.

TYPES OF COLLOIDS BASED ON

①

Physical state of dispersed phase and dispersion medium

②

Nature of interaction between dispersed phase and dispersed medium

③

Type of particles of the dispersed phase

- LYOPHILIC ✓
- LYOPHOBIC ✗

- ✓ • MULTI MOLECULAR
- ✓ • MACRO MOLECULAR
- ✓ • ASSOCIATED

Classification based on physical state of dispersed phase and dispersion medium

Colloids have been classified into eight types:

Dispersed phase	Dispersion medium	Type of colloid	Examples
Solid	Solid	Solid sol	Some coloured glasses and gem stones
Solid	Liquid	Sol	Paints, cell fluids
Solid	Gas	Aerosol	Smoke, dust
Liquid	Solid	Gel	Cheese, butter, jellies
Liquid	Liquid	Emulsion	Milk, hair cream
Liquid	Gas	Aerosol	Fog, mist, cloud, insecticide sprays
Gas	Solid	Solid sol	Pumice stone, foam rubber
Gas	Liquid	Foam	Froth, whipped cream, soap lather

Classification based on the nature of interaction between dispersed phase and dispersed medium

Property	Lyophilic sols ✓	✗ Lyophobic sols
1 Ease of preparation	By directly mixing with the liquid dispersion medium	Prepared by special method only
2 Stability	Quite stable and are not easily precipitated or coagulated	Easily precipitated by addition of a small amount of suitable electrolyte
3 Reversible and irreversible nature	Reversible in nature ✓	Irreversible in nature
4 Hydration	Highly hydrated ✓	Not must hydrated ✓
5 Nature of substances	Organic substances like starch, gum, etc	Usually inorganic substances
6 Viscosity	Much higher than medium	Almost same as that of medium
7 Surface tension	Usually lower than that of medium	Nearly same as that of medium

Classification of colloids based on type of particles of the dispersed phase

✓ MULTI-MOLECULAR COLLOIDS

On dissolution, a large number of atoms or smaller molecules of a substance aggregate together to form species having size in the colloidal range (diameter < 1 nm). For example, gold sol, Sulphur sol

✓ MACROMOLECULES COLLOIDS

Macromolecules in suitable solvents form solutions in which the size of the macromolecules may be in the colloidal range. Such systems are called macromolecular colloids. These colloids are quite stable and resemble true solutions in many respects. Examples are starch, cellulose, proteins, enzymes, polythene, nylon, polystyrene, synthetic rubber, etc.

ASSOCIATED COLLOIDS (MICELLES)

There are some substances which at low concentrations behave as normal strong electrolytes, but at higher concentrations exhibit colloidal behaviour due to the formation of aggregates. The aggregated particles thus formed are called **micelles**. These are also known as **associated colloids**.

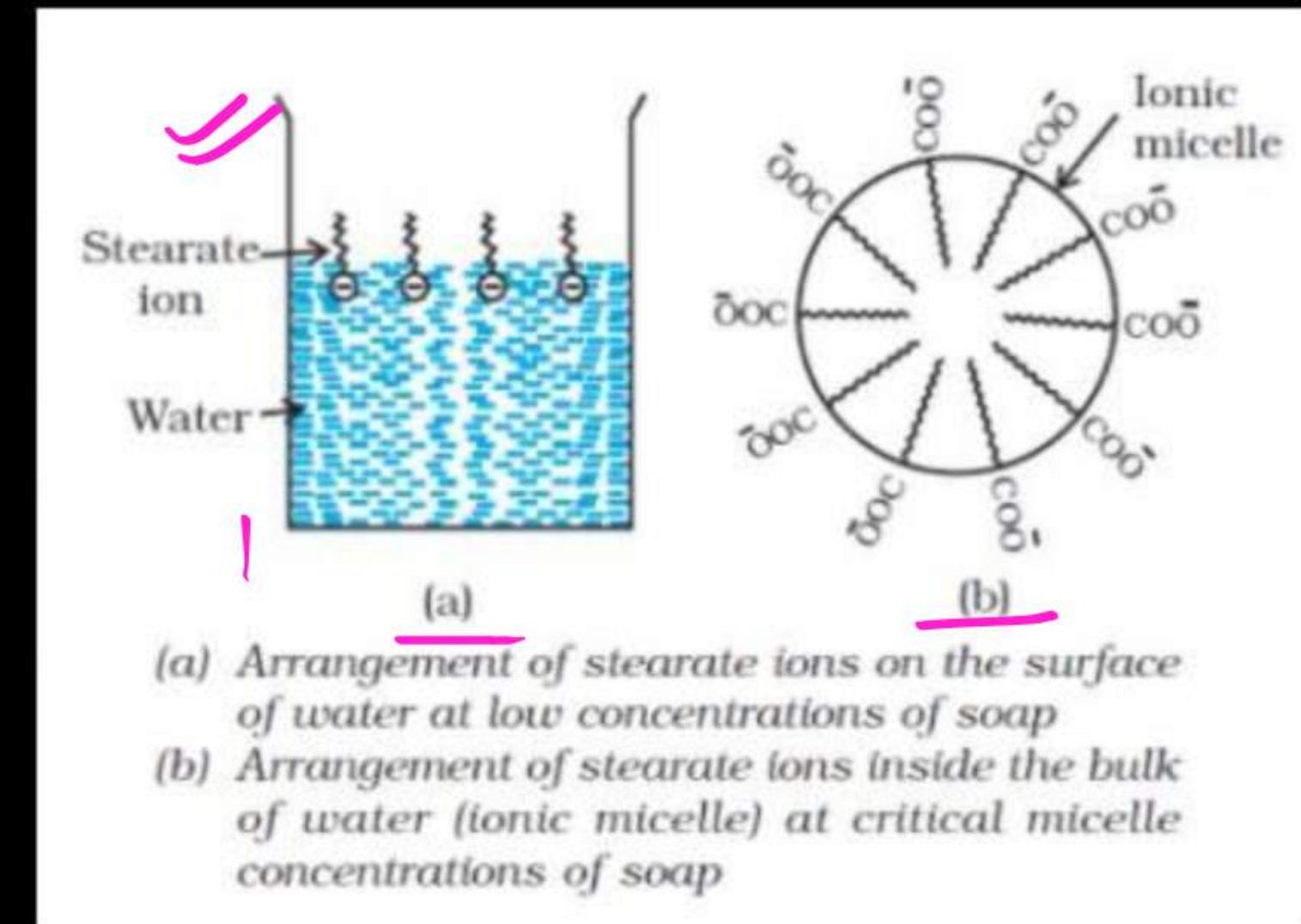
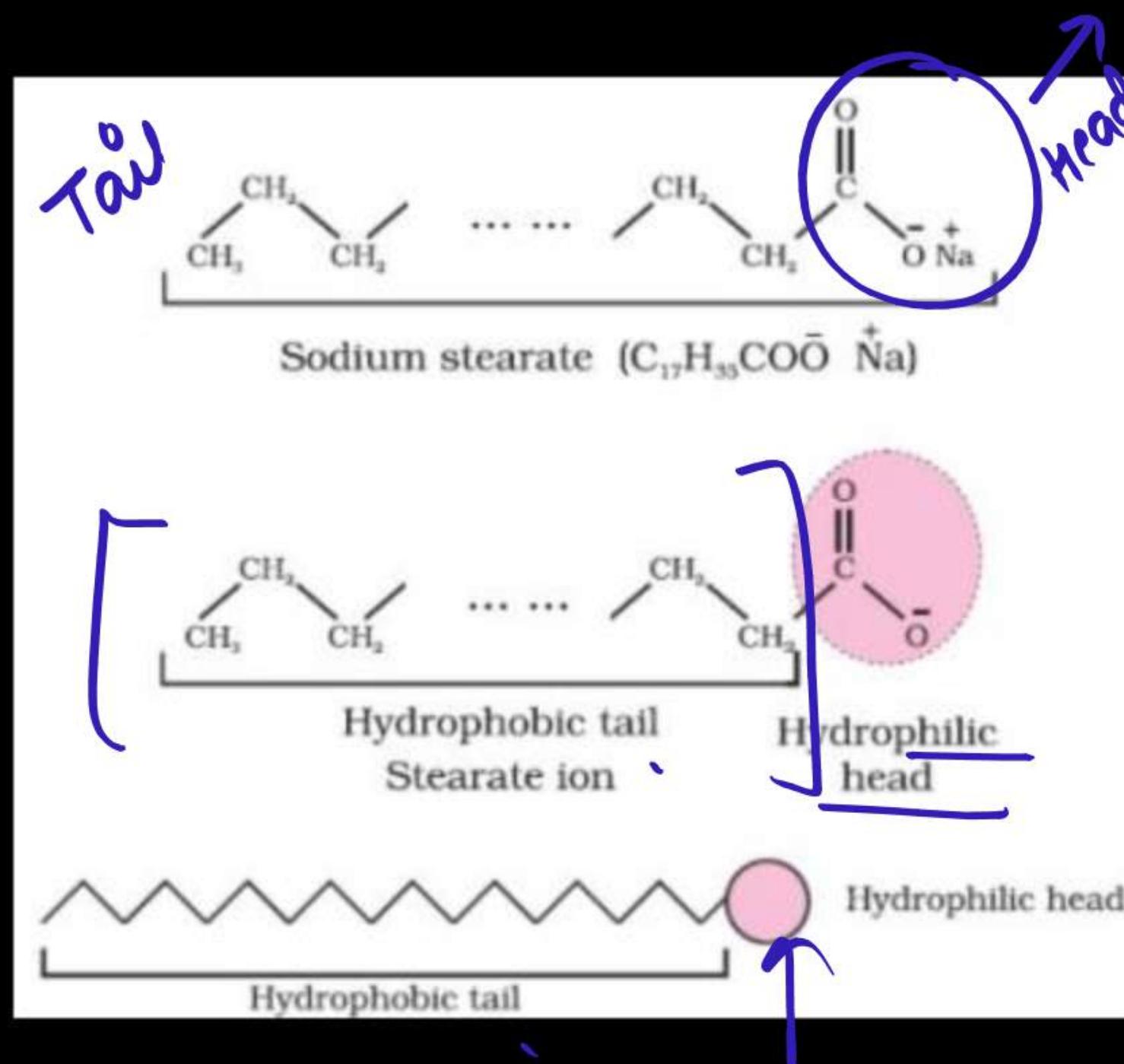
- The formation of micelles takes place only above a particular temperature called **Kraft temperature (T_k)** and above a particular concentration called **critical micelle concentration (CMC)**.

$\downarrow 10^{-3}$ or 10^{-4} mol/L

Mechanism of micelle formation

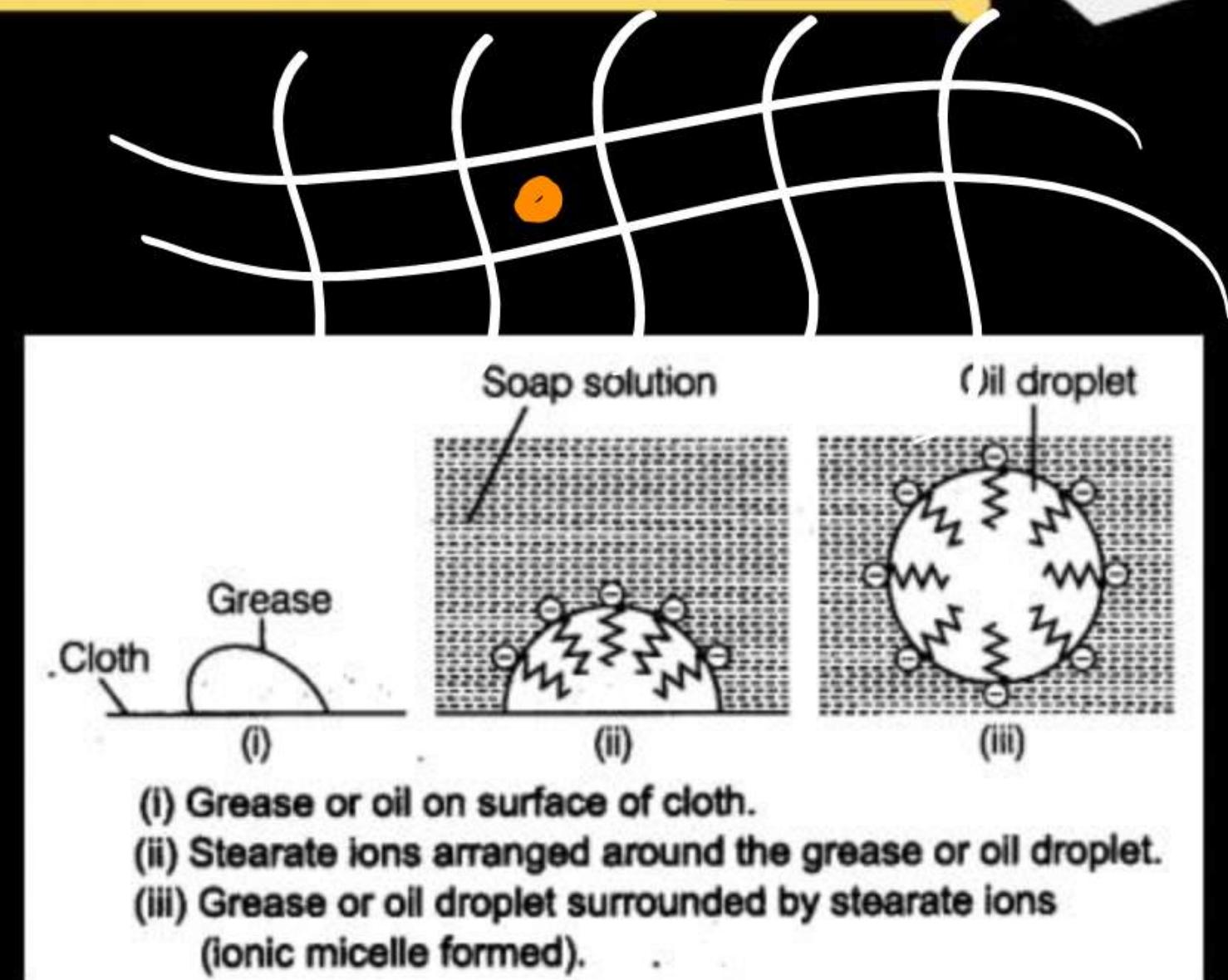
Soap is sodium or potassium salt of a higher fatty acid and may be represented as RCOO^-Na^+ (e.g., sodium stearate $\text{CH}_3(\text{CH}_2)_{16}\text{COO}^-\text{Na}^+$, which is a major component of many bar soaps). When dissolved in water, it dissociates into RCOO^- and Na^+ ions. The RCOO^- ions, however, consist of two parts — a long hydrocarbon chain R (also called non-polar 'tail') which is hydrophobic (water repelling), and a polar group COO^- (also called polar-ionic 'head'), which is hydrophilic (water loving).

Condition for Micelles Formation: Substances which contain polar head and non-polar tail form micelles.



Cleansing action of soaps

The cleansing action of soap is due to the fact that soap molecules form micelle around the oil droplet in such a way that hydrophobic part of the stearate ions is in the oil droplet and hydrophilic part projects out of the grease droplet like the bristles. Since the polar groups can interact with water, the oil droplet surrounded by stearate ions is now pulled in water and removed from the dirty surface. Thus soap helps in emulsification and washing away of oils and fats. The negatively charged sheath around the globules prevents them from coming together and forming aggregates.

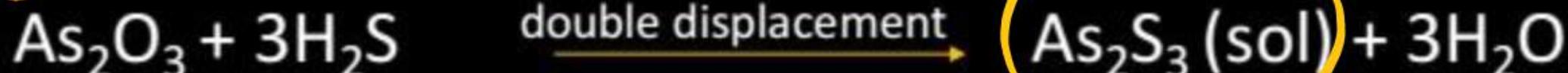




Preparation of colloids

a) **CHEMICAL METHODS:** Colloidal solutions can be prepared by chemical reactions which form molecules by double displacement, oxidation, reduction or hydrolysis. These molecules then aggregate to form sols.

①



②



③



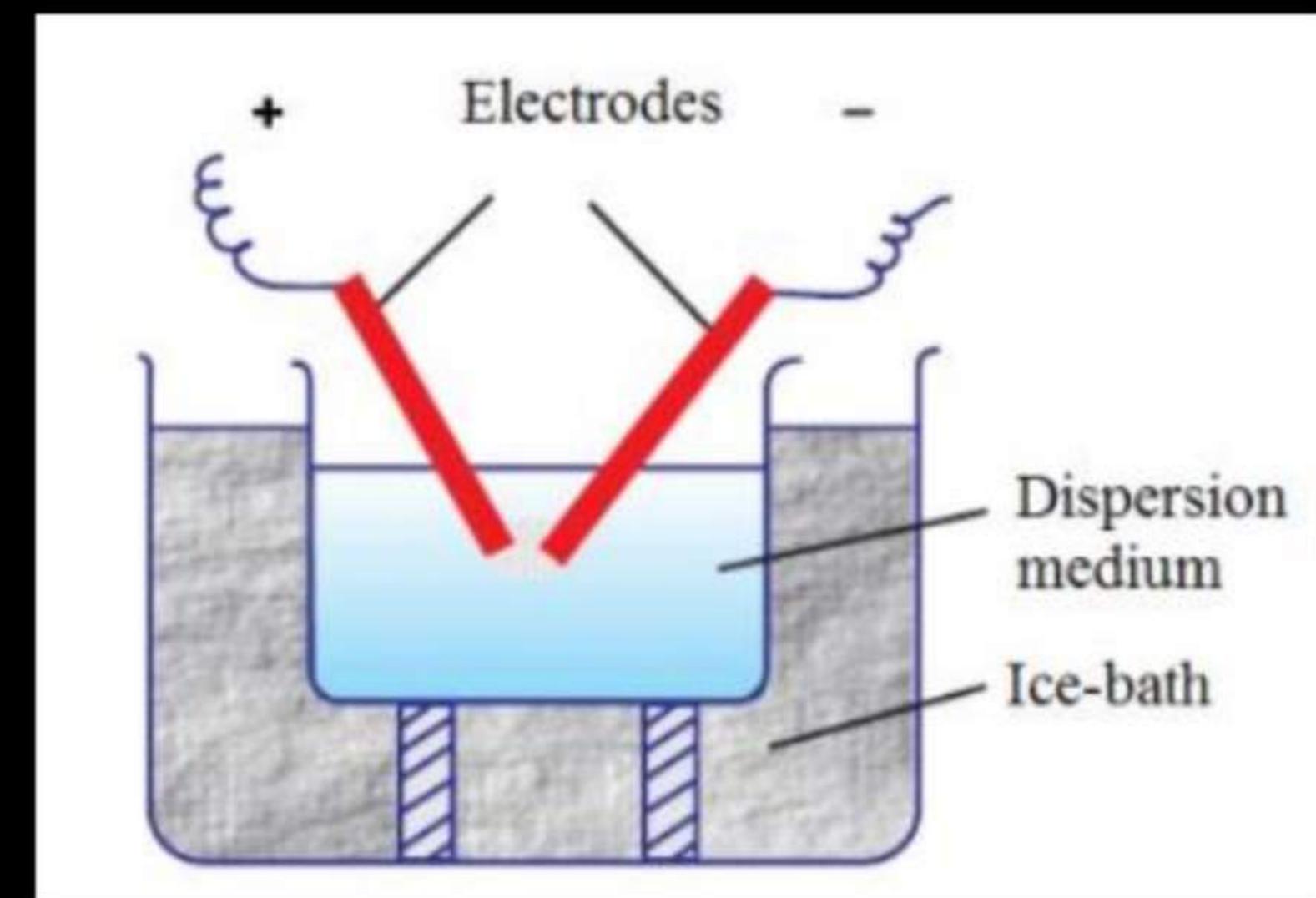
⚡



Preparation of colloids

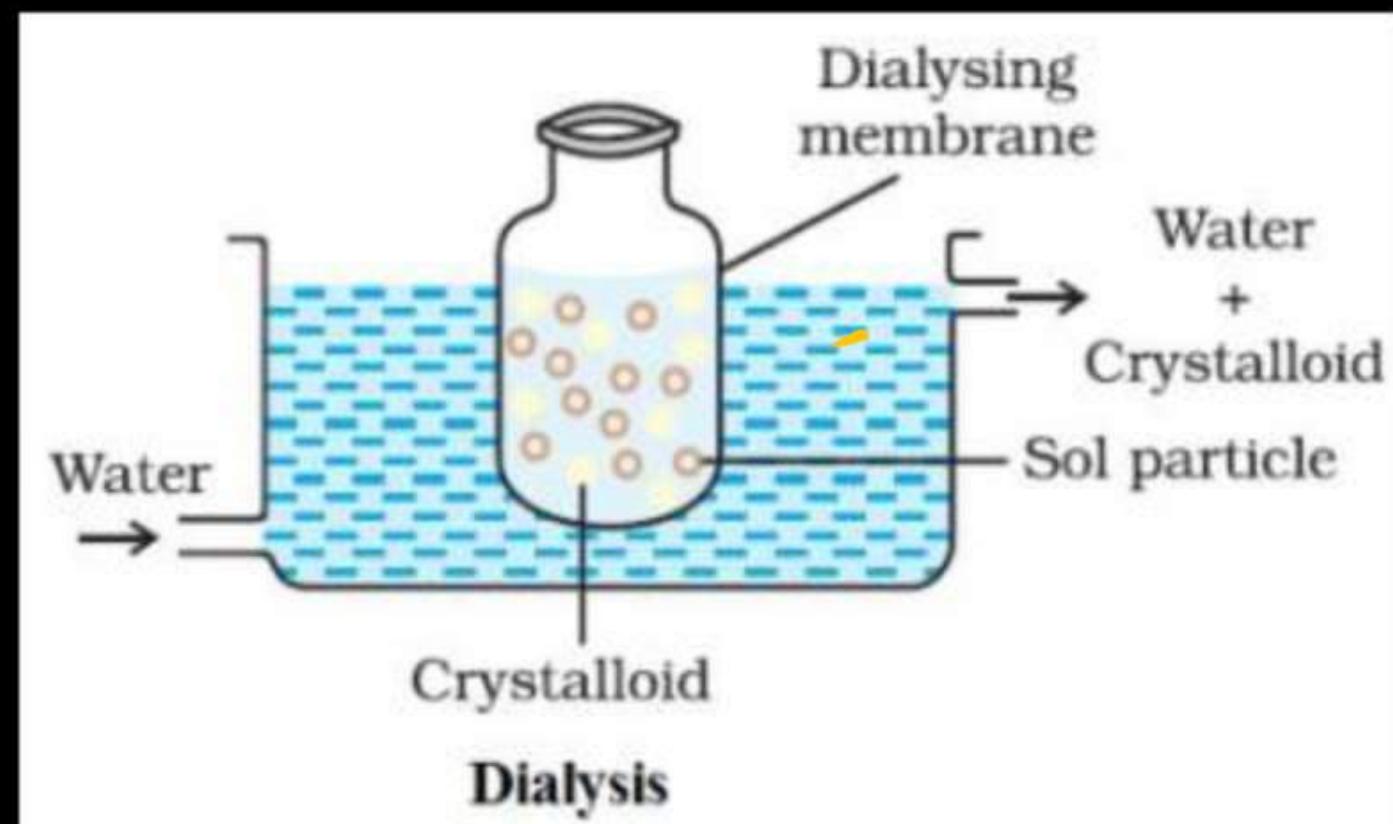
b) PEPTIZATION: Peptization is defined as the **process of converting a precipitate into colloidal sol by shaking it with dispersion medium in the presence of a small amount of electrolyte.** The electrolyte used for this purpose is called **peptizing agent**. During peptization, the **precipitate adsorbs one of the ions of the electrolyte** on its surface. This causes the **development of positive or negative charge on precipitates**, which ultimately **break up** into smaller particles of the size of a colloid.

c) ELECTRICAL DISINTEGRATION OR BREDIG'S ARC METHOD: This process involves dispersion as well as condensation. Colloidal sols of metals such as gold, silver, platinum, etc., can be prepared by this method. In this method, electric arc is struck between electrodes of the metal immersed in the dispersion medium. The intense heat produced vapourises the metal, which then condenses to form particles of colloidal size.

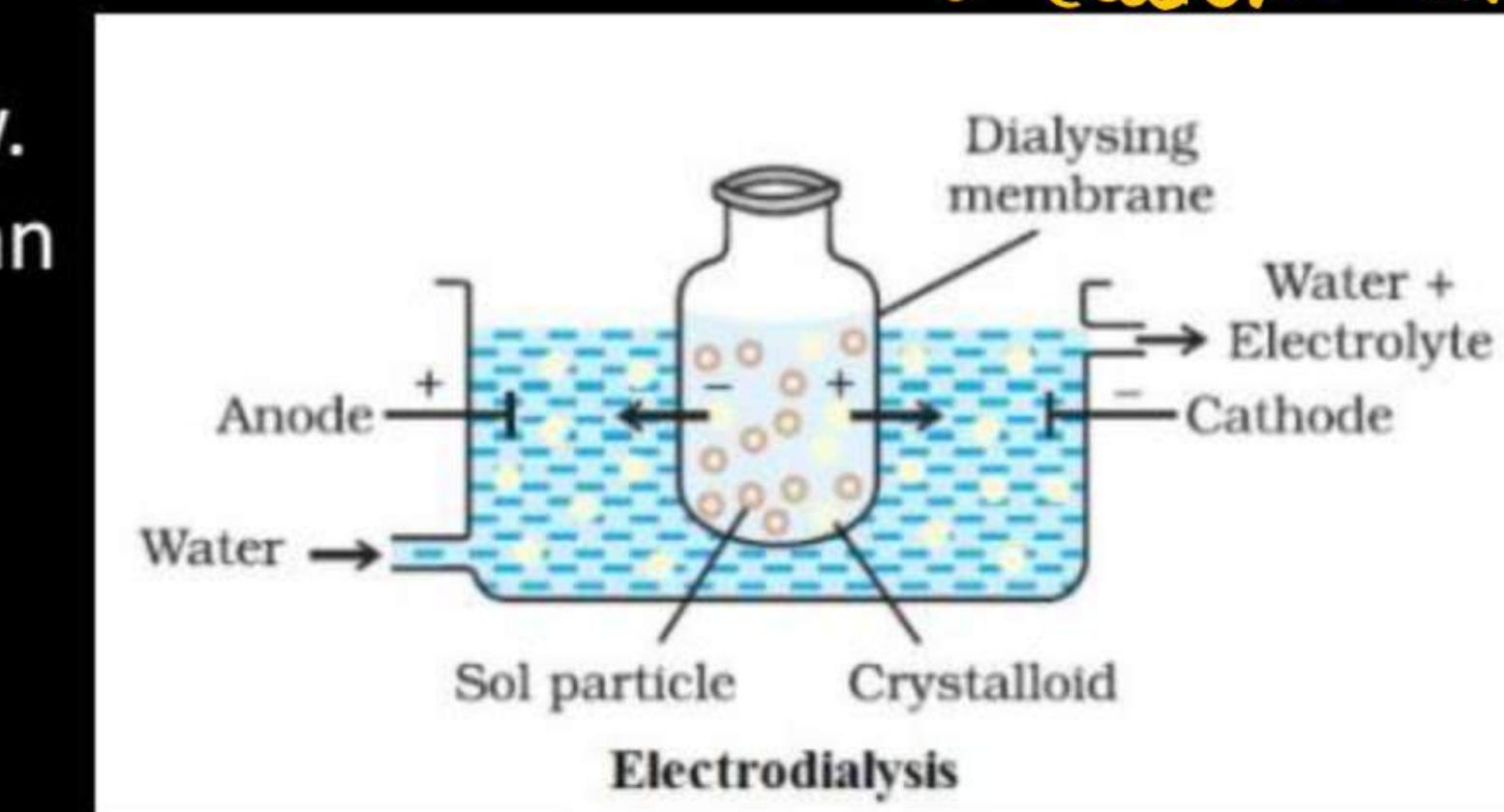
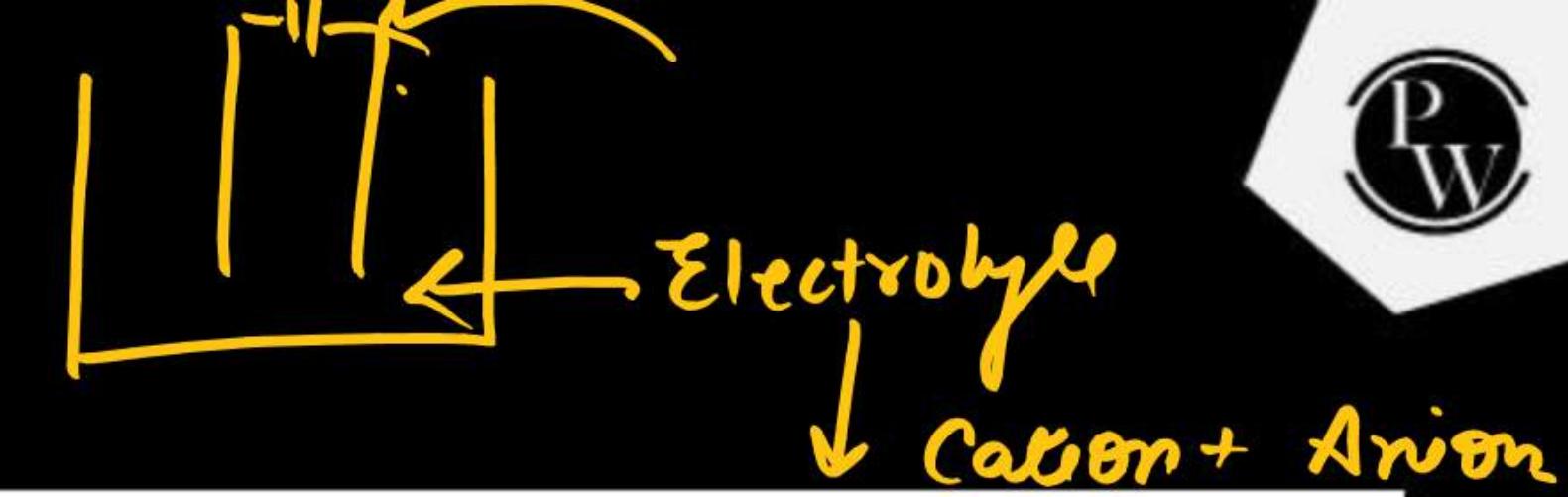


PURIFICATION OF COLLOIDAL SOLUTIONS

1) **DIALYSIS:** It is a process of removing dissolved substance from a colloidal solution by means of diffusion through a suitable membrane. The apparatus used for this process is called dialyser. A bag of suitable membrane containing the colloidal solution is suspended in a vessel through which fresh water is continuously flowing. The molecules/ions diffuse through membrane into outer water and pure colloidal solution is left behind.



2) ELECTRO-DIALYSIS: Ordinarily, the process of dialysis is quite slow. It can be made faster by applying an electric field if the dissolved substance in the impure colloidal solution is only an electrolyte. The process is then named electrodialysis.

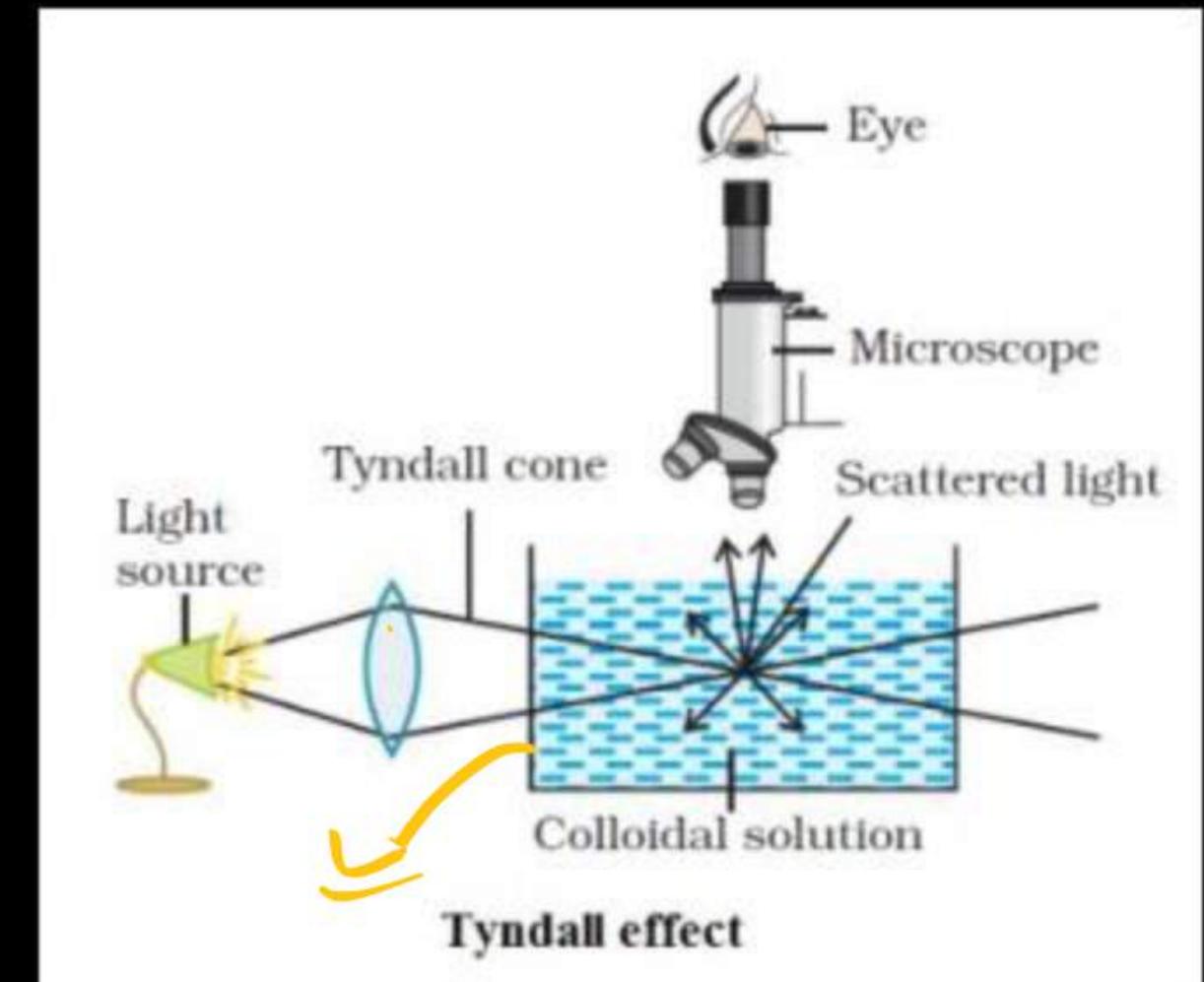


3) ULTRAFILTRATION: An ultrafilter paper may be prepared by soaking the filter paper in a colloidion solution (4% solution of nitro cellulose in a mixture of alcohol and ether) hardening by formaldehyde and then finally drying. Ultra filter paper allows to pass electrolyte particles present as impurity but not allow to pass colloidal particles. Ultrafiltration is a slow process, to speed up the process, pressure or suction is applied. The colloidal particles on strring with fresh dispersion medium to get pure colloidal solution.

PROPERTIES OF COLLOIDAL SOLUTIONS

1) **Colligative properties:** The values of colligative properties of colloidal particles are small because they are bigger in size so lesser in numbers.

2) **Tyndall effect:** When a beam of light strikes the surface of colloidal particles then path of beam get illuminated due to scattering of light by colloidal particles, this phenomenon is called Tyndall effect.



PROPERTIES OF COLLOIDAL SOLUTIONS

Tyndall effect is observed only when,

- a. The diameter of the dispersed particles is not much smaller than the wavelength of the light used; and
- b. The refractive indices of the dispersed phase and the dispersion medium differ greatly in magnitude.

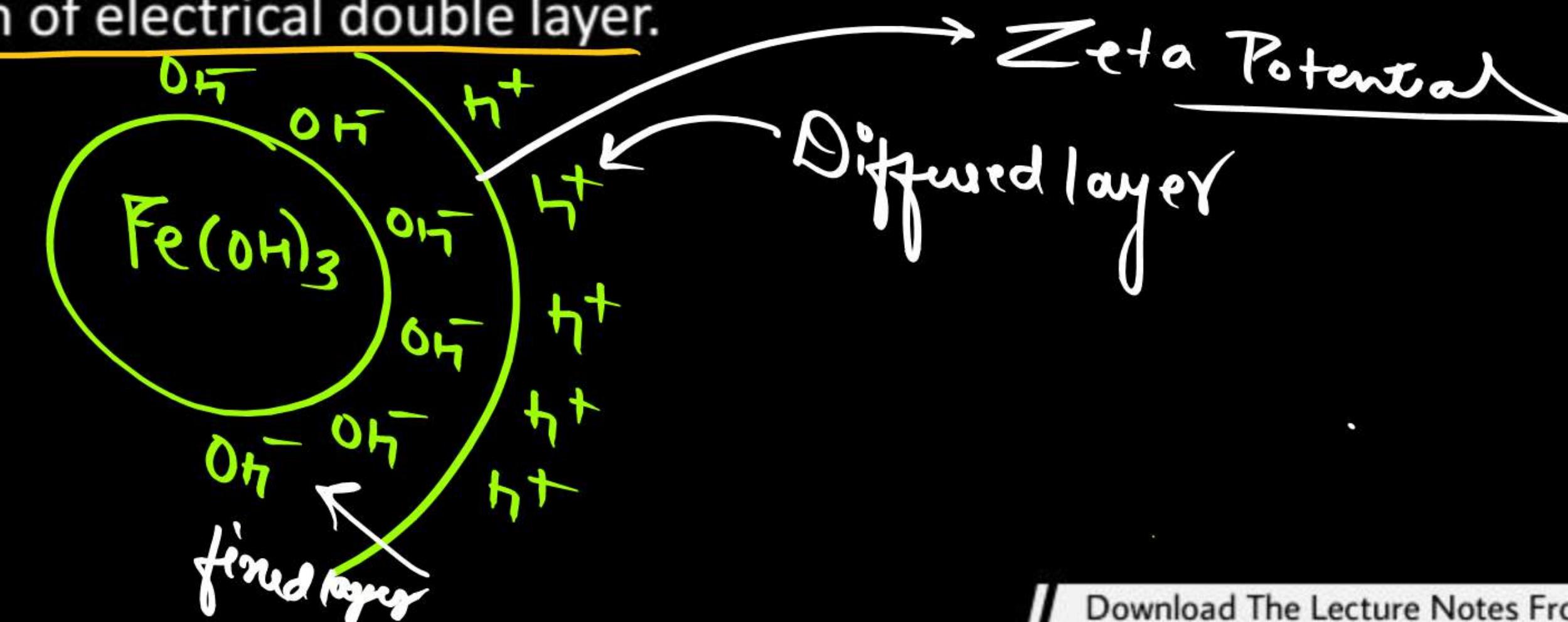
Tyndall effect is not shown by true solution. Zsigmondy, in 1903, used tyndall effect to set up an apparatus known as ultramicroscope. Ultramicroscope does not provide any information about the size and shape of colloid particle

3) **Colour:** The colour of colloidal solution depends on the wavelength of light scattered by the dispersed particles, size and nature of the particles and the manner which the observer receives the light.

For example, a mixture of milk and water appears blue when viewed by the reflected light and red when viewed by the transmitted light.

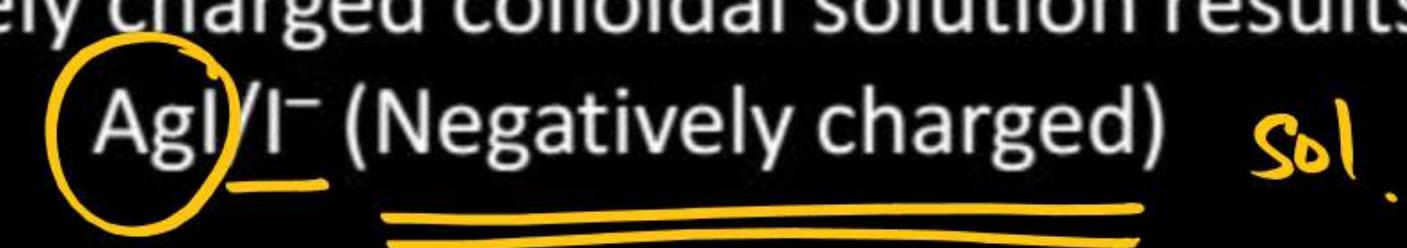
4) **Brownian movement:** British Botanist Robert Brown observed that colloidal particles are in continuous zig zag motion when viewed under a powerful ultramicroscope called Brownian movement. This motion is independent of the nature of colloids but depends on the size of particles and viscosity of the solution. Smaller the size lesser the viscosity, faster is the motion.

5) Charge on colloidal particles: Colloidal particles always carry an electric charge. The nature of this charge is the same on all the particles in a given colloidal solution and may be either positive or negative. The charge on the sol particles is due to one or more reasons, viz., due to electron capture by sol particles during electro-dispersion of metals, due to preferential adsorption of ions from solution and/or due to formulation of electrical double layer.



Example 1:

When **silver nitrate** solution is added to **potassium iodide** solution, the precipitated silver iodide adsorbs iodide ions from the dispersion medium and negatively charged colloidal solution results.



However when KI solution is added to **AgNO₃** solution, positively charged sol results due to adsorption of Ag⁺ ions from dispersion medium.



Example 2:

→ If FeCl_3 is added to excess of hot water, a positively charged sol of **hydrated ferric oxide** is formed due to adsorption of Fe^{3+} ions. But when **ferric chloride** is added to **NaOH** a negatively charged sol is obtained with adsorption of OH^- ions.



→ The charged colloid sol attracts counter ions from the medium forming a second layer, e.g.,



Combination of the two layers of opposite charges around the colloidal particle is called **Helmholtz electrical double layer**.

TYPES OF SOLS

Positively charged sols

Hydrated metallic oxides,
e.g., $\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O}$, $\text{CrO}_3 \cdot x\text{H}_2\text{O}$ and
 $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$, etc.

Basic dye stuffs, e.g.,
methylene blue sol.

Haemoglobin (blood)

Oxides, e.g., TiO_2 sol.

Negatively charged sols

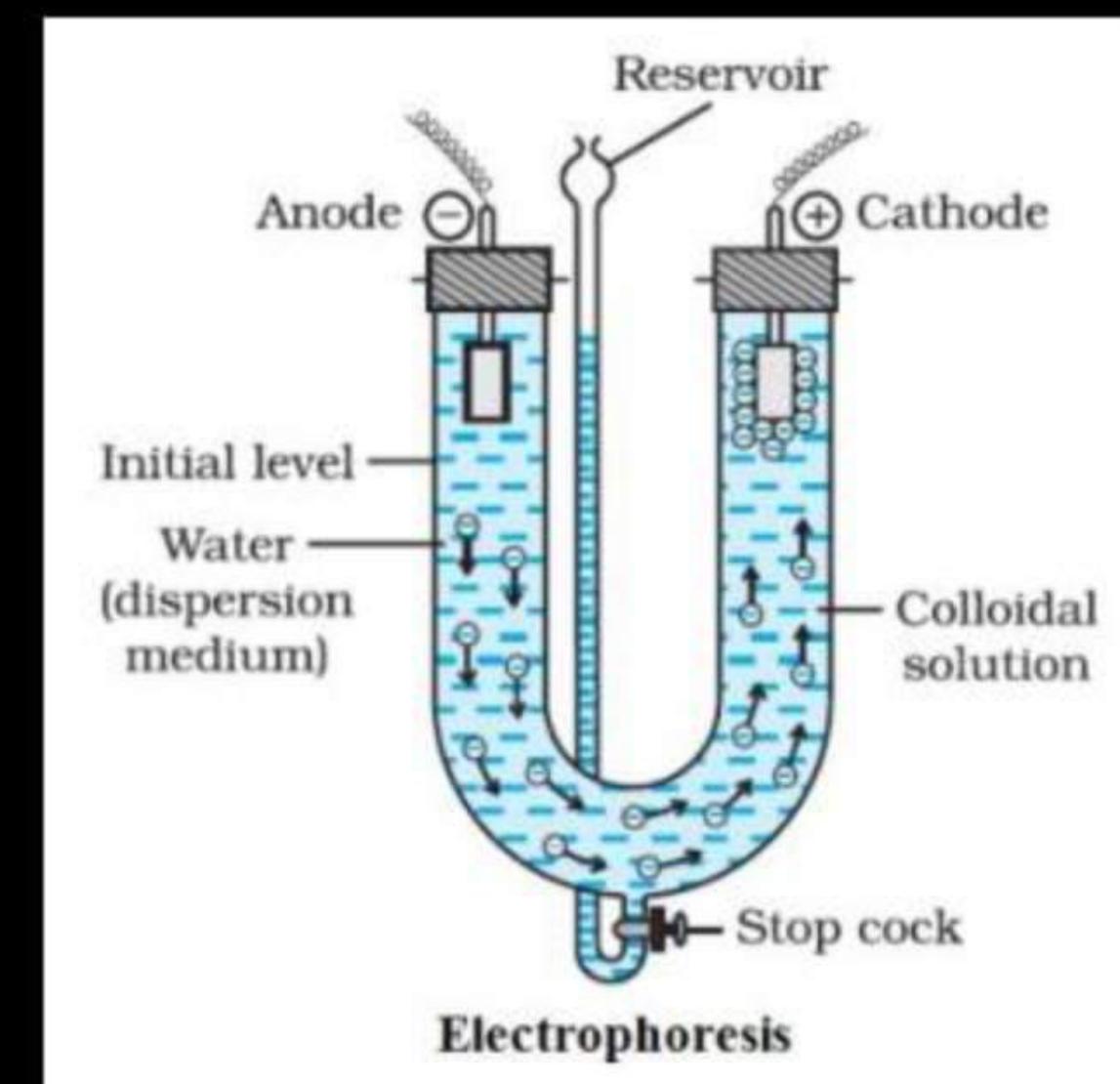
Metals, e.g., copper, silver,
gold sols.

Metallic sulphides, e.g., As_2S_3 ,
 Sb_2S_3 , CdS sols.

Acid dye stuffs, e.g., eosin,
congo red sols.

Sols of starch, gum, gelatin,
clay, charcoal, etc.

6) **Electrophoresis:** The phenomenon of movement of colloidal particles under an applied electric field is called electrophoresis. Positively charged particles move towards the cathode while negatively charged particles move towards the anode when electric potential is applied across two platinum electrodes dipping in a colloidal solution.



7) **Coagulation or precipitation:** The coagulation of colloids is due to neutralisation of charge due to which the particles come nearer to each other to form aggregates and settle down under the force of gravity. The process of setting of colloidal particles is called coagulation of the sol. The coagulation of lyophobic sols can be carried out in the following ways:

1. By electrophoresis ✓
2. By mixing two oppositely charged sols ✓
3. By boiling ✓
4. By persistent dialysis ✓
5. By addition of electrolytes ✓

Hardy schulze rule: higher the valency of the active ion or flocculating ion, greater will be its coagulating power

For example, Coagulating power for negatively charged solution: $\text{Al}^{3+} > \text{Mg}^{2+} > \text{Na}^+$.

Similarly, coagulation power for positively charged solution: $[\text{Fe}(\text{CN})_6]^{4-} > \text{PO}_4^{3-} > \text{SO}_4^{2-} > \text{Cl}^-$

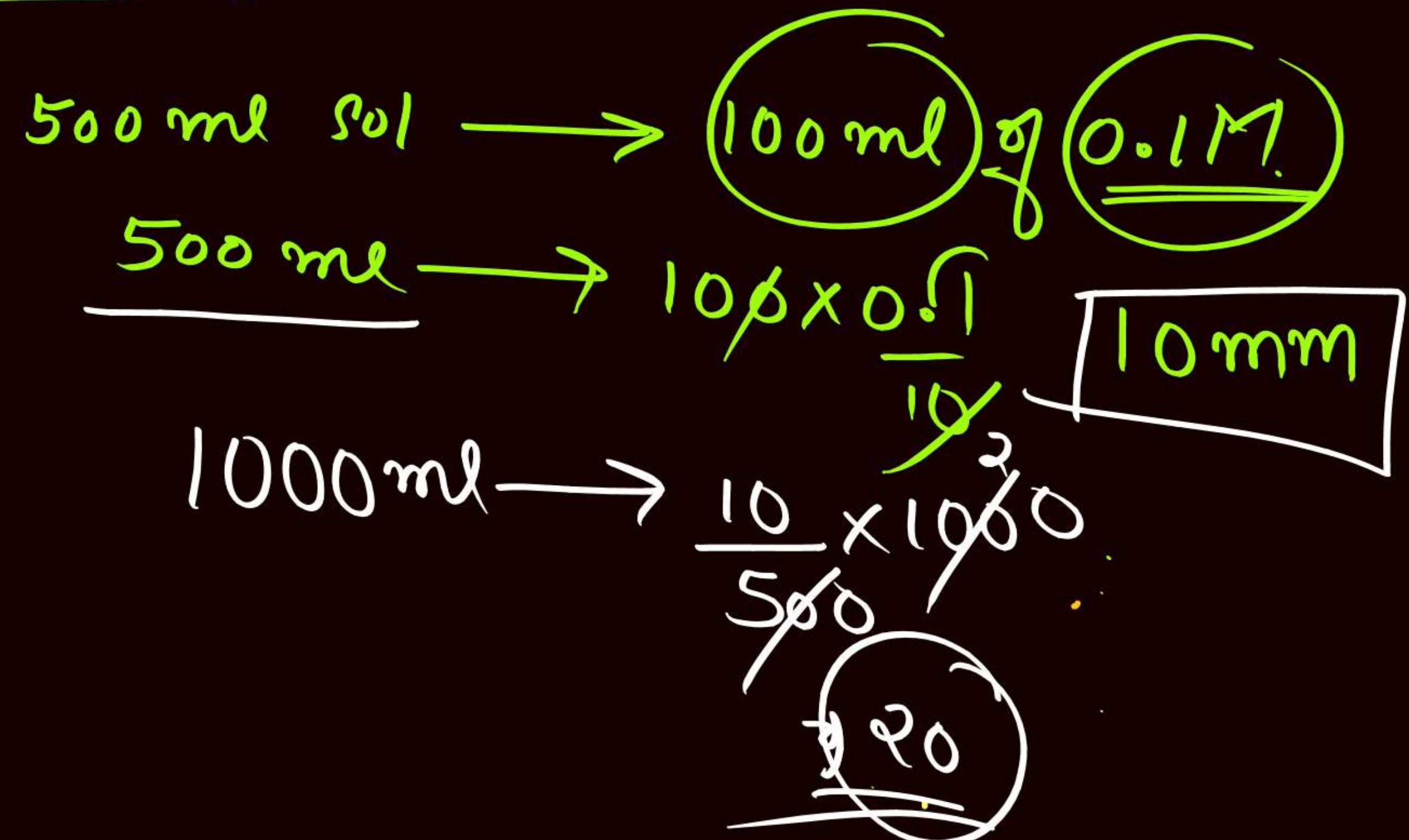
Coagulating Value \rightarrow It is defined as the millimoles of Coagulating agent required to coagulate per litre of Solution.

1L \rightarrow mm
?

$$\text{Coagulating Power} \propto \frac{1}{\text{Coagulating Value}}$$

Q. 100 ml of 0.1 M Electrolyte is required for 500 ml of Solution
Coagulating Value ?

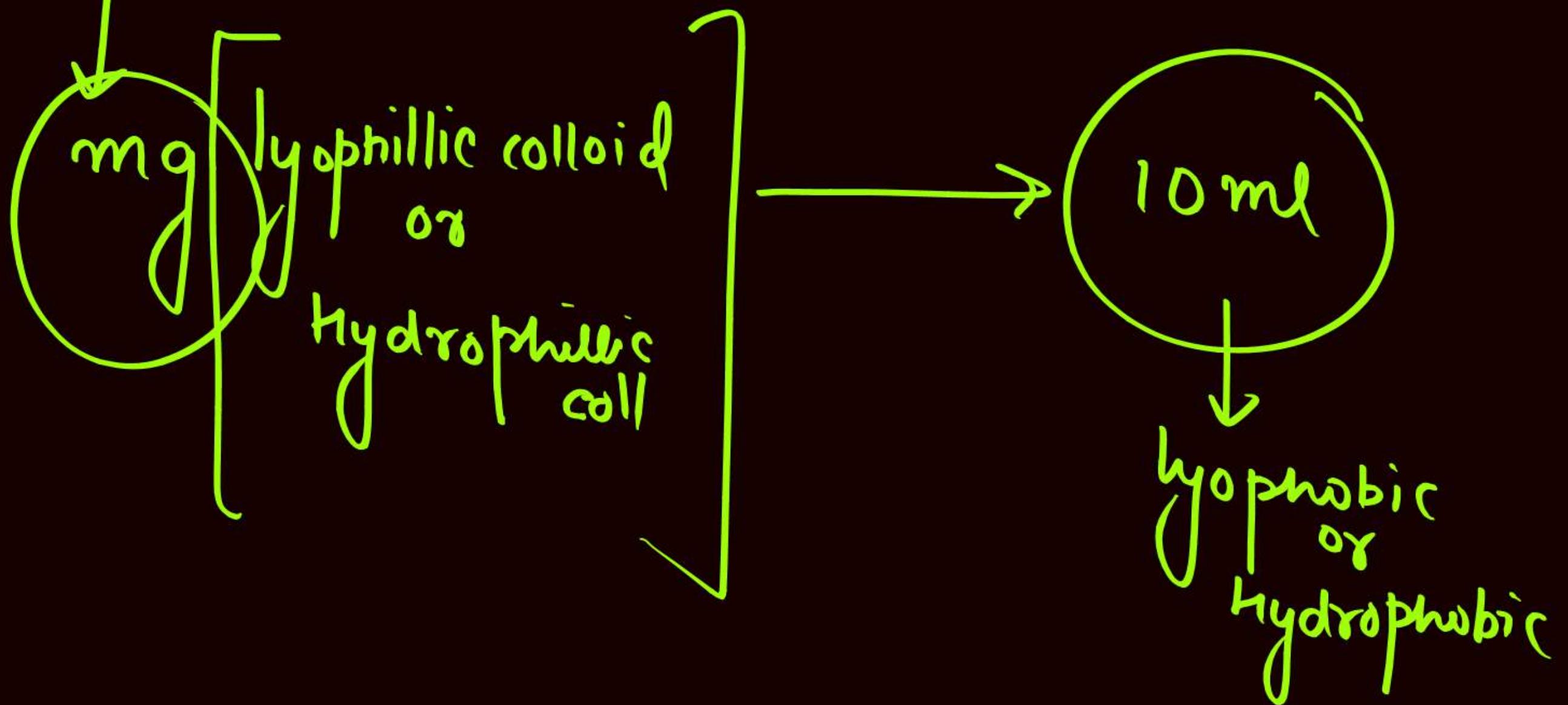
$$M = \frac{m}{V(l)}$$



PROTECTIVE Sols :- Some hydrophilic sols may act as protective sol for some hydrophobic sols and protect them by forming a hydrophilic layer around the colloidal particles.

✓ GOLD Number :- It is defined as the amount of protective sol in milligrams to prevent the coagulation of 10 ml of red gold sol. by adding 1 ml of 10% NaCl solution.

Gold no



\Rightarrow Protective Power $\propto \frac{1}{\text{Gold no.}}$

To prevent Coagulation of a gold sol. by adding $\frac{100}{10}$ ml of
 $\underline{\text{10% Brine}}$ $\underline{\text{Solution}}$, $\boxed{0.025 \text{ gm}}$ gelatin is required

Calculate the gold no. of Protective sol.

$$100 \text{ ml} \rightarrow 0.025 \text{ g}$$

$$10 \text{ ml} \rightarrow \frac{0.025 \times 10}{100 \times 1000} \times \frac{1}{10^3} = 2.5$$

Q \geq 0.25 gm lyophilic colloid is required for protection of
100 ml of red gold sol. Gold number = ?

$$100 \text{ ml} \rightarrow 0.25 \text{ g}$$

$$10 \text{ ml} \rightarrow \frac{0.25}{100 \times 10^{-3}} \text{ g} \times 10^6$$

$\frac{0.25}{100 \times 10^{-3}}$

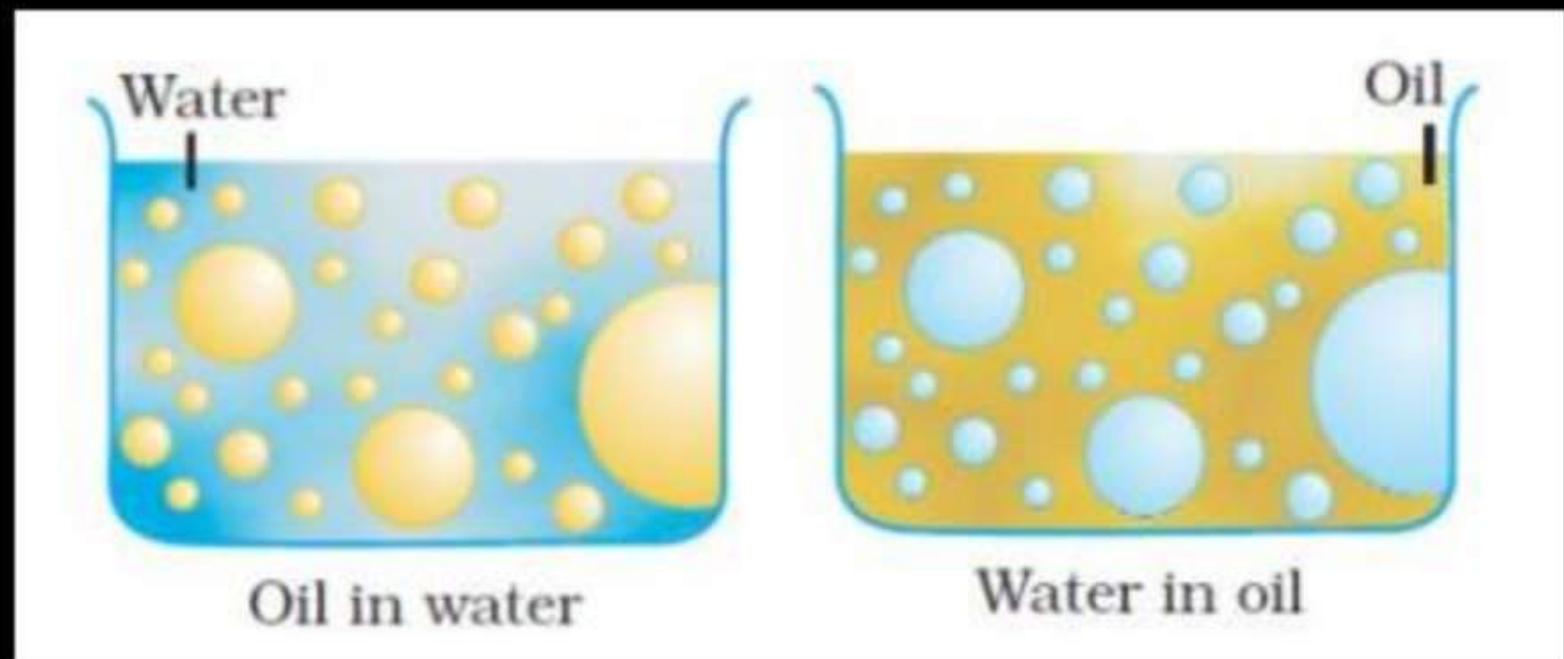
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EMULSIONS

There are two types of emulsions:

- 1) Oil dispersed in water (O/W type) example, milk and vanishing cream ✓
- 2) Water dispersed in oil (W/O type) example, butter and cream ✓



COLLOIDS AROUND US

Many substances we use in our daily life are colloids i.e. meal we eat, the cloths we wear, the wooden furniture, the house we live in etc. are largely composed of colloids.

Following are examples of colloids

- ✓ 1. Blue colour of sky
- ✓ 2. Fog, mist and rain
- ✓ 3. Food articles like milk, butter, ice-cream and halwa etc.
- ✓ 4. Blood: It is a colloidal solution of albuminoid substance. The styptic action of alum and FeCl₃ solution is due to coagulation in blood forming a clot which stop further bleeding.

COLLOIDS AROUND US



5. Soils: due to colloidal nature of soils, they absorb moisture and nourishing materials.
6. Formation of delta: It is colloidal solution of clay and sea water containing a number of electrolytes. When river water meets the sea water, the electrolytes present in the sea water, coagulate the colloidal solution of clay resulting in its deposition with formation of delta.

Applications of colloids

- **Electrical precipitation of smoke:** Smoke is a colloidal solution of solid particles such as carbon, arsenic compounds, dust, etc., in air. The smoke, before it comes out from the chimney, is led through a chamber containing plates having a charge opposite to that carried by smoke particles. The particles on coming in contact with these plates lose their charge and get precipitated. The particles thus settle down on the floor of the chamber. The precipitator is called Cottrell precipitator.
- **Medicines:** Colloidal antimony is used in curing kalaazar. Colloidal gold is used for intramuscular injection. Milk of magnesia, an emulsion, is used for stomach disorders.

Applications of colloids

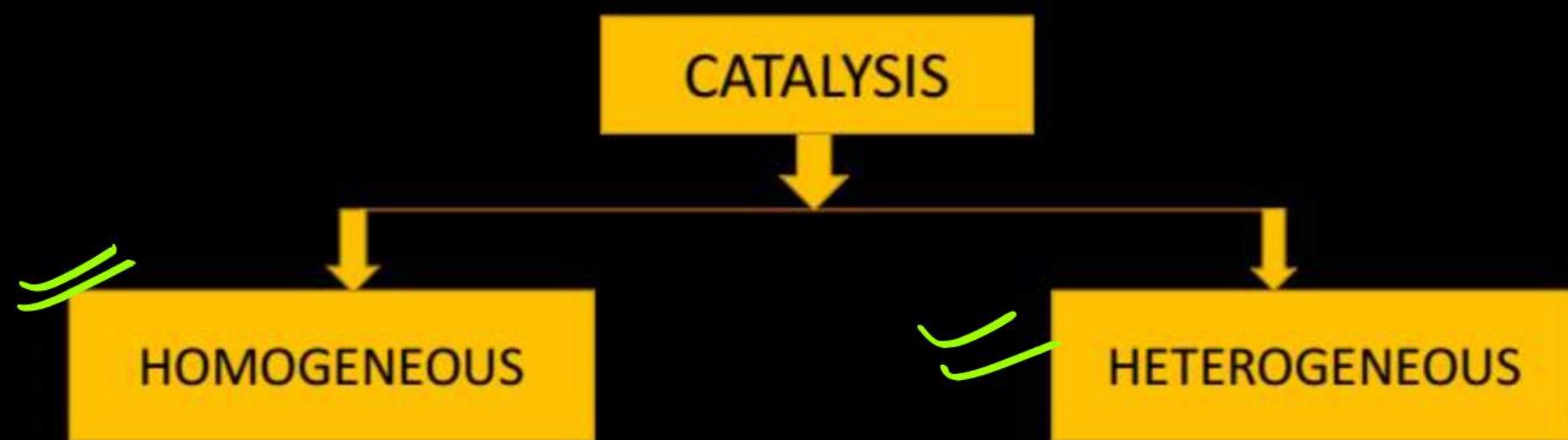
- ✓ **Cleansing action of soaps and detergents:** As already discussed.
- ✓ **Photographic plates and films:** Photographic plates or films are prepared by coating an emulsion of the light sensitive silver bromide in gelatin over glass plates or celluloid films.
- ✓ **Tanning:** Animal hides are colloidal in nature. When a hide, which has positively charged particles, is soaked in tannin, which contains negatively charged colloidal particles, mutual coagulation takes place. This results in the hardening of leather. This process is termed as tanning. Chromium salts are also used in place of tannin.

Applications of colloids

- **Rubber industry:** Latex is a colloidal solution of rubber particles which are negatively charged. Rubber is obtained by coagulation of latex.
- ✓ **Industrial products:** Paints, inks, synthetic plastics, rubber, graphite lubricants, cement, etc., are all colloidal solutions.
- ✓ **Purification of drinking water:** Alum is added to water to coagulate the suspended impurities and make it fit for drinking purposes.

CATALYSIS

A catalysis may increase or decrease the rate of reaction.



Reactant and catalyst
are in same phase

Reactant and catalyst are in
different phase

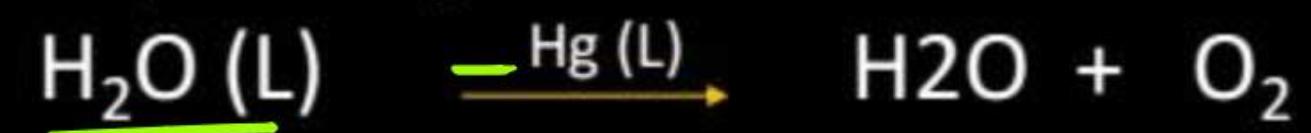
EXAMPLES

method

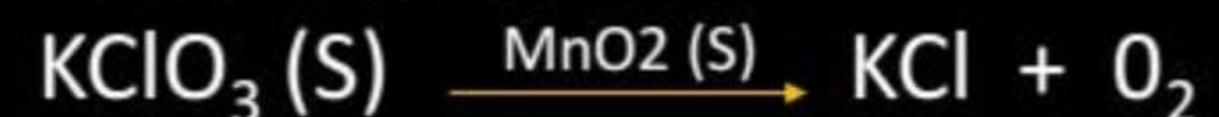
Solid - liquid

*method*

Liquid - liquid

*method*

Solid - solid

*method*

Solid - gas



CATALYST



AUTO-CATALYSIS

One of the product acts as a catalyst

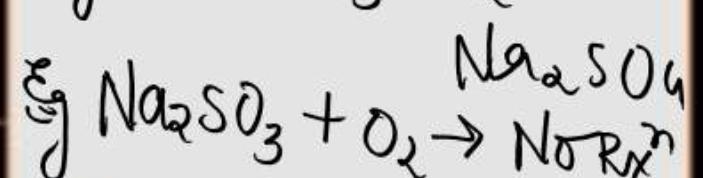


E.g. hydrolysis of ester in acidic medium,



INDUCED CATALYSIS

One reaction is non-spontaneous but in presence of spontaneous reaction it becomes spontaneous



PROMOTOR AND INHIBITOR/POISON



PROMOTORS : Increase the activity of catalyst



INHIBITOR/ POISON : Decreases the activity of catalyst

In contact process: formation of H_2SO_4

Poison $\rightarrow \text{As}_2\text{O}_3$

Catalyst $\rightarrow \text{V}_2\text{O}_5, \text{ Pt}$

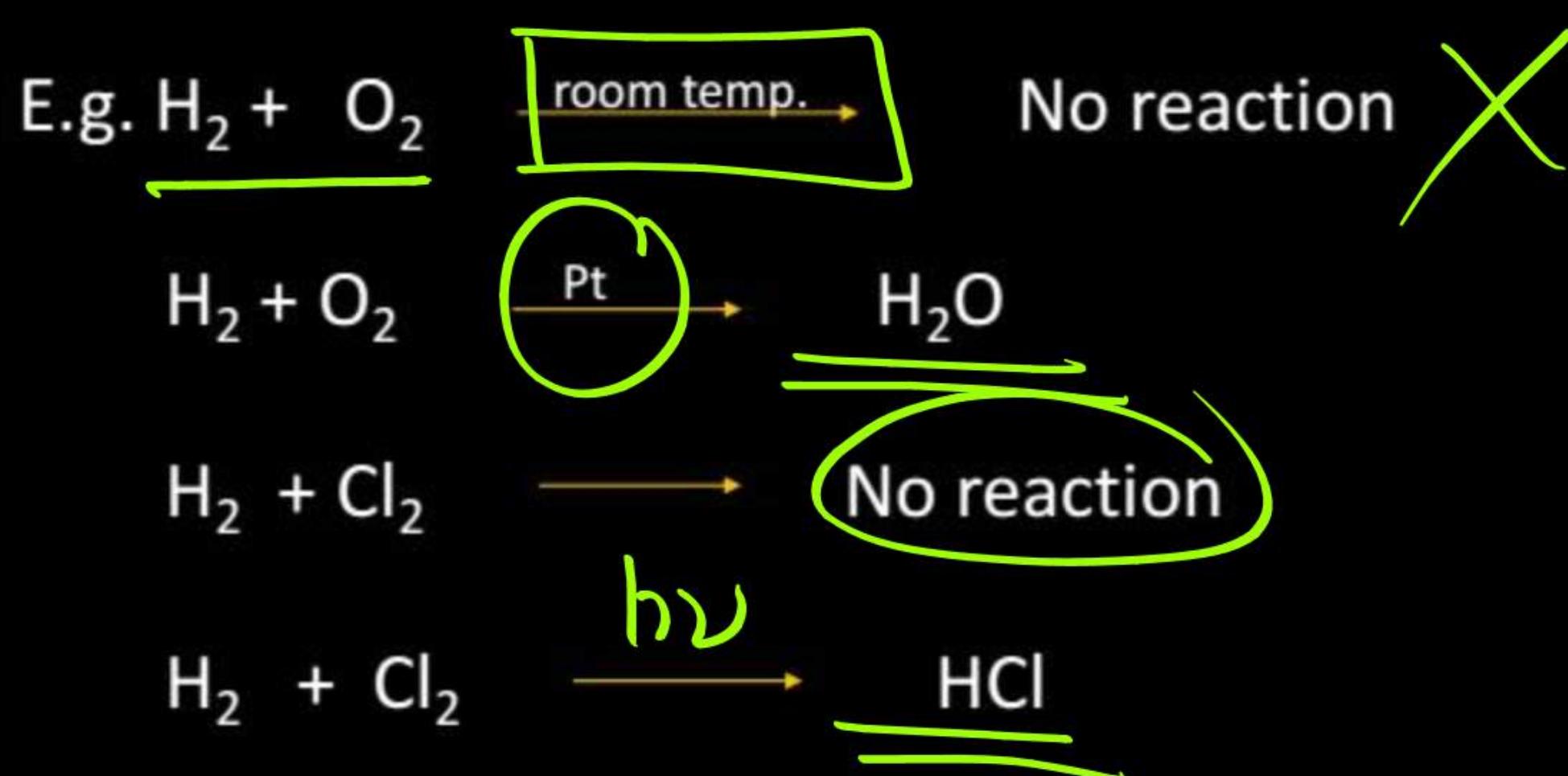


ROSENMUND REACTION: $\text{CO} + \text{H}_2 \longrightarrow \text{CO}_2 + \text{H}_2$

CHARACTERISTICS OF A CATALYST

Total mass of catalyst remains unaffected but its physical state may change.

Generally, a catalyst can not initiate a reaction but not always.



SHAPE SELECTIVE CATALYST BY ZEOLITES

The catalytic reaction that depends upon the pore structure of the catalyst and size of reactant and product and molecules is called shape selective catalysis. Zeolites are a good shape-selective catalyst because they have honeycomb like structure.

Zeolites are microporous aluminosilicates with three dimensional network of silicates in which some silicon atoms are replaced by aluminium. The size of pores varies between 260 pm and 740 pm. Thus only those molecules can be adsorbed in these pores whose size is small enough to enter these cavities and also leave easily. It will not adsorb those molecules which are too big to enter.

SHAPE SELECTIVE CATALYST BY ZEOLITES

Zeolites are being very widely used as catalyst in petrochemical industries for cracking of hydrocarbons and isomerization. An important zeolite catalyst used in petroleum industry is ZSM-5 (Zeolite of sieve Molecular Porosity 5) It converts alcohol directly into gasoline by dehydrating them to give a mixture of hydrocarbons

Examples of enzymatic reactions

SOME INDUSTRIAL CATALYTIC PROCESSES

Process	Catalyst
Haber's process for the manufacture of ammonia $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$	Finely divided iron, molybdenum as promoter; conditions: 200 bar pressure and 723-773K temperature.
Ostwald's process for the manufacture of nitric acid. $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$ $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$ $4NO_2(g) + 2H_2O(l) + O_2(g) \rightarrow 4HNO_3(aq)$	Platinised asbestos; temperature 573K.
Contact process for the manufacture of sulphuric acid. $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$ $SO_3(g) + H_2SO_4(aq) \rightarrow \underbrace{H_2S_2O_7(l)}_{\text{Oleum}}$ $H_2S_2O_7(l) + H_2O(l) \rightarrow 2H_2SO_4(aq)$	Platinised asbestos or vanadium pentoxide (V_2O_5); temperature 673-723K.

Q. Which of the following statements is incorrect regarding physisorptions?

[AIEEE-2012]

- A. Under high pressure it results into multi molecular layer on adsorbent surface
- ~~B. Enthalpy of adsorption ($\Delta H_{\text{adsorption}}$) is low and positive~~
- C. It occurs because of Van der Waal's forces
- D. More easily liquefiable gases are adsorbed readily



Q. According to Freundlich adsorption isotherm, which of the following is correct ?

[AIEEE-2012]

A. $\frac{x}{m} \propto p^0$

B. $\frac{x}{m} \propto p^1$

C. $\frac{x}{m} \propto p^{1/n}$

D. All the above are correct for different ranges of pressure

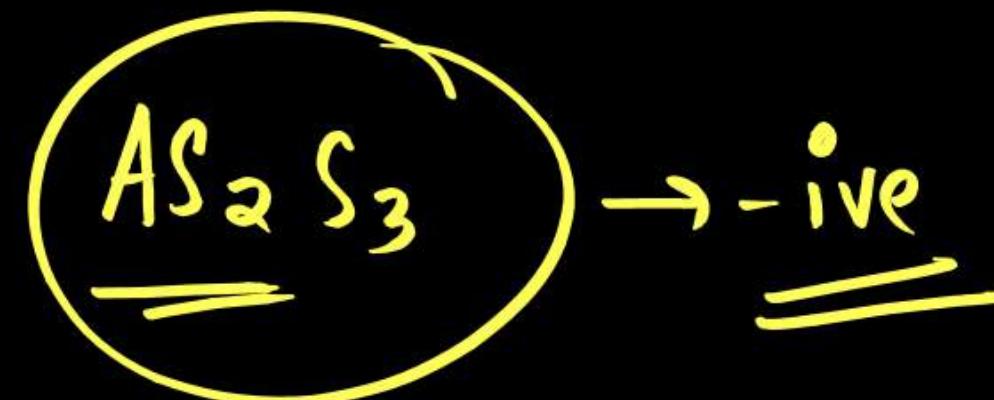
$$\frac{x}{m} = K P^{1/n}$$

$$0 < 1/n < 1$$



Q. The coagulation power of electrolytes having Na^+ , Al^{3+} and Ba^{2+} for arsenic sulphide sol increases in the order: [JEE- Main-2013]

- A. $\text{Al}^{3+} < \text{Ba}^{2+} < \text{Na}^+$
- B. $\text{Na}^+ < \text{Ba}^{2+} < \text{Al}^{3+}$
- C. $\text{Ba}^{2+} < \text{Na}^+ < \text{Al}^{3+}$
- D. $\text{Al}^{3+} < \text{Na}^+ < \text{Ba}^{2+}$



Hardy-Schulze Rule
-ive sol \propto +ive charge



Q. A particular adsorption process has the following characteristics :

- (i) It arises due to van der waals forces and
(ii) It is reversible.

[J-Main-2015]

Identify the correct statement that describes the above adsorption process:

- A. Enthalpy of adsorption is greater than 100 kJ mol⁻¹
~~B. Energy of activation is low.~~
C. Adsorption is monolayer
D. Adsorption increases with increase in temperature

Physisorption



Q. For a linear plot of $\log(x/m)$ versus $\log p$ in a Freundlich adsorption isotherm, which of the following statements is correct ? (k and n are constants) [JEE- Main-2016]

- A. Log $(1/n)$ appears as the intercept
- B. Both k and $1/n$ appear in the slope term
- C. $1/n$ appears as the intercept
- D. Only $1/n$ appears as the slope



Q. The Tyndall effect is observed only when following conditions are satisfied

[JEE- Main (offline) -2017]

1. The diameter of the dispersed particles is much smaller than the wavelength of the light used.
 2. The diameter of the dispersed particles is not much smaller than the wavelength of the light used.
 3. The refractive indices of the dispersed phase and dispersion medium are almost similar in magnitude.
 4. The refractive indices of the dispersed phase and dispersion medium differ greatly in magnitude.
- A. (1) and (4)
- ~~B. (2) and (4)~~
- C. (2) and (3)



Q. Among the following, correct statement is: [JEE- Main (online)-2017]

- A. One would expect charcoal to absorb chlorine more than hydrogen sulphide.
- ~~B. Brownian movement is more pronounced for smaller particles than for bigger-particles~~
- C. Hardy Schulze law states that bigger the size of the ions, the greater is its coagulation power.
- D. Sols of metal sulphides are lyophilic



Q. Adsorption of a gas on a surface follows Freundlich adsorption isotherm. Plot of $\log x/m$ versus $\log p$ gives a straight line with slope equal to 0.5, then: [JEE- Main (online)-2017]

(x/m is the mass of the gas adsorbed per gram of adsorbent)

- A. Adsorption is proportional to the square of pressure.
- B. Adsorption is independent of pressure.
- C. Adsorption is proportional to the pressure.
- D. Adsorption is proportional to the square root of pressure.

$$\frac{x}{m} = K P^{\frac{1}{n}}$$

$$\frac{x}{m} = K P^{\frac{1}{2}} = (\sqrt{P})^{\frac{1}{n}}$$

$$\log \frac{x}{m} = \log K + \frac{1}{n} \log P$$

Slope = 0.5



**Q. Which one of the following is not a property of physical adsorption
[JEE- Main (online)-2018]**

- ~~A. Unilayer adsorption occurs~~
- B. Greater the surface area, more the adsorption
 - C. Lower the temperature, more the adsorption
 - D. Higher the pressure, more the adsorption





THANK YOU