Date: 22/10/2021

Q1. What modification can you suggest in the Hardy Schulze law?

Q2. What is the role of desorption in the process of catalysis?

Q3. Why is the ester hydrolysis slow in the beginning and becomes faster after some time?

Q4. Why is it necessary to remove CO when ammonia is obtained by Haber's process?

Q5. Why are powdered substances more effective adsorbent than their crystalline forms?

Q6. Why does physisorption decrease with the increase of temperature?

$$\text{Solid} \underset{-\Delta H}{\overset{+\Delta H}{\rightleftharpoons}} \text{gas}$$

Q7. Why are substances like platinum and palladium often used for carrying out electrolysis of aqueous solutions?

Q8. What role does adsorption play in heterogeneous catalysis?

Q9. What do you understand by activation of adsorbent? How is it achieved?

Q10. What are the factors, which influence the adsorption of a gas on a solid?

Q11. Give reason why a finely divided substance is more effective as an adsorbent.

Q12. Distinguish between the meaning of the terms adsorption and absorption. Give on example of each.

Q13. Why is it essential to wash the precipitate with water before estimating it quantitatively?

Q14. Why is adsorption always exothermic?

Q15. How are colloids classified on the basis of
(a) physical states of components? (b) nature of dispersion medium?
(c) intersection between dispersed phase and dispersion medium?

Q16. Explain what is observed when a beam of light is passed through a colloidal solution.

Q17. Explain what is observed when an electrolyte NaCl is added to ferric hydroxide solution.

Q18. Explain what is observed when electric current is passed through a colloidal solution.

Q19. What are emulsions? What are their different types? Give example of each type.

Q20. What is demulsification? Name two demulsifiers.

Q21. Action of soap is due to emulsification and micelle formation. Comment.

Q22. What is shape selective catalysis?

Q23. Comment on the statement that "colloid is not a substance but a state of substance".

Q24. What is Colloidon?

Q25. State an important use of electrodialysis in human beings.

Q26. The conductance of an emulsion increases on adding common salt. What type of emulsion is this?

Q27. What is sorption?

Q28. Give two examples each of negatively charged and positively charged solutions.

Q29. Which will be adsorbed more readily on the surface of Charcoal and why, NH_3 or CO_2?

Q30. How does the catalyst work in a chemical reaction?

Q31. What is electrokinetic potential or zeta potential?

Q32. Delta is generally formed when river meets the ocean. Why?

Q33. What is meant by kraft temperature (T_k) and critical micelle concentration (CMC)?

Q34. How cottrell smoke precipitator is used to purify smoke form colloidal particles?

Q35. Explain the peptization.

Q36. Which of the following electrolyte is more effective for the coagulation of $Fe(OH)_3$ sol and why? Na_3PO_4, Na_2SO_4, NaCl.

Q37. Give four applications of colloids.

Q38. Gelatin is generally added to ice cream.

Q39. What phenomena will occur, when silica gel and anhydrous calcium chloride are placed separately in two corners of a vessel containing water vapour?

Q40. Artificial rain can be caused by spray common salt on the clouds. How?

Q41. What is the colour of gold sol?

Q42. Explain the colour change of the mixture of milk and water in reflected light and in transmitted light.

Q43. What are catalytic poisons and catalytic promoters?

Q44. What is meant by Autocatalysis and induced catalysis?

Q45. Define the term Tyndall effect?

Q46. What causes Brownian movement in a colloidal solution?

Q47. Which has a higher enthalpy of adsorption, physisorption or chemisorption?

Q48. What is the difference between physisorption and chemisorption?

Q49. What are lyophilic and lyophobic sols? Give example of each type. Why are hydrophobic sols easily coagulated?

Q50. Explain what is observed when:

(a) an emulsion is subjected to centrifugation.

(b) direct current is passed through a colloidal sol.

Q51. What is the difference between multimolecular and macromolecular colloids? Give one example of each. How are associated colloids different from these two types of colloids?

Q52. What are micelles? Give an example of a miceller system.

Q53. Give four uses of emulsions.

Q54. Explain the following terms:
(a) Electrophoresis (b) Coagulation (c) Dialysis (d) Tyndall effect.

Q55. Describe some features of catalysis by zeolites.

Q56. What do you mean by activity and selectivity of catalysts?

Q57. Give four examples of heterogeneous catalysis.

Q58. How to prepare colloidal solution by chemical method?

Q59. What are enzymes? Write in brief the mechanism of enzyme catalysis.

Q60. Explain the following terms giving an example in each case.
(a) Emulsification (b) Coagulation

Q61. Explain the origin of charge on colloidal particles.

Q62. How charge develop on colloidal particles? Explain.

Q63. Explain the modern adsorption theory of heterogeneous catalysis.

Q64. Explain the term with suitable examples:
(a) Aerosol (b) Hydrosol.

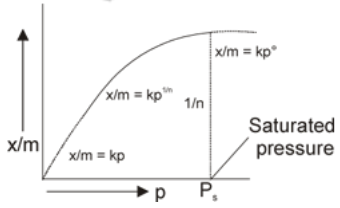
Q65. Answer the following:
(a) Why silica gel is used as dehumidizer?
(b) What is the significance of a gold number?
(c) Ferric hydroxide sol coagulates on addition of aqueous solution of sodium sulphate.

Q66. (a) In which of the following does adsorption take place and why?
(i) Silica gel placed in the atmosphere saturated with water.
(ii) Anhydrous $CaCl_2$ placed in the atmosphere saturated with water.
(b) How does BF_3 act as a catalyst in industrial process?
(c) Give an example of shape-selective catalysis.

Q67. Describe the following types of colloids, giving an example for each:
(a) Multimolecular colloids (b) Macromolecular colloids

Q68. Explain what is observed when:
(a) An electrolyte, KCl is added to hydrated ferric oxide sol.
(b) An electric current is passed through a colloidal solution.
(c) A beam of strong light is passed through a colloidal solution.

Q69. Discuss the effect of pressure and temperature on the adsorption of gases on solids.



Q70. What is an adsorption isothermal? Describe Freundlich adsorption isotherm.

Q71. Explain the following terms:

(a) Peptization (b) Dialysis (c) Hardy-Schulze rule.

Date: 22/10/2021

S1. When oppositely charged solutions are mixed in proper proportions to neutralize the charges of each other, coagulation of both the sol occurs.

S2. Desorption makes the surface of the solid catalyst free for fresh adsorption of the reactants on the surface.

S3. The ester hydrolysis takes place as follows

$$\underset{\text{Ester}}{RCOOR'} + \underset{\text{water}}{H_2O} \xrightarrow{H^{\oplus}} \underset{\text{Carboxylic acid}}{RCOOH} + \underset{\text{Alcohol}}{R'OH}$$

The acid produced in the reaction act as catalyst (auto catalyst). Hence after some time, the reaction becomes faster.

S4. CO acts as a poison for the catalyst used in the manufacture of ammonia by Halber's process. Hence, it is necessary to remove it.

S5. Because powdered substance has more surface area so more is the adsorption.

S6. According to Le-Chatelier's principle, if we increase the temperature equilibrium will shift in the backward direction, so gas is released from adsorbed surface. In other words, when temperature is increased, the kinetic energy of the molecules of the gas increases and they can easily leave the surface of adsorbent because of weak Van der Waals forces of attraction.

S7. Platinum and palladium form inert electrodes, so they are not attacked by ions of the electrolyte, the product of electrolysis easily get absorbed or deposited over these metals. Hence they are used as electrodes for carrying out electrolysis.

S8. In heterogeneous catalysis generally the adsorbent is solid while the reactants are gaseous. The reactions occur at the surface of the catalyst where the gaseous molecules get adsorbed either by physical adsorption or by chemical adsorption. As a result, the concentration of the reactant molecules on the surface of the catalvst increases and hence the rate of reaction increases.

S9. **Activation of adsorbent:** It is a phenomenon which increases the adsorbing power of an adsorbent by suitable means which is known as activation of adsorbent. Cleaning can be achieved by ultra high vacuum while large surface area can be achieved by grinding.

S10. (a) Nature of the adsorbate and adsorbent
(b) Surface area of adsorbent
(c) Pressure of the gas
(d) Temperature
(e) Reversible character
(f) Thickness of adsorbed layer
(g) Activation of the solid adsorbent.

S11. Due to large specific surface area, this provide more sites for adsorption.

S12. **Adsorption:** Adsorption is a surface phenomenon in which the substance gets accumulated on the surface of a solid. The surface that adsorbs is called adsorbent and the one that gets adsorbed is called an adsorbate.

For example: Pt can adsorb large amount of hydrogen gas.

Absorption: In absorption, molecules of a substance are uniformly distributed through-out the body of solid or liquid.

For example: Ammonia absorbed by water, water absorbed by anhydrous $CaCl_2$.

S13. Some amount of the electrolytes mixed to form the precipitate remains adsorbed on the surface of the particles of the precipitate. Hence, it is essential to wash the precipitate with water to remove the sticking electrolytes (or any other impurities) before estimating it quantitatively.

S14. Because of attraction between adsorbent and adsorbate molecules, energy is always released during adsorption. When a gas is adsorbed on the surface of solid, its entropy decrease, it means ΔS is –(ve). Now, $\Delta G = \Delta H - T\Delta S$ and for the process to be spontaneous, free energy change (ΔG), must be negative. If ΔH has sufficient high –(ve) value as $T\Delta S$ is positive. Thus in an adsorption process, which is spontaneous, a combination of these two factors makes ΔG negative. As the adsorption proceeds, ΔH become less and less negative ultimately ΔH becomes equal to $T\Delta S$ and ΔG bcomes zero at equilibrium state.

S15. (a) Sol, emulsion, gel, aerosol, foam

(b) Alcosol, benzosol, aquosol or hydrosol

(c) Lyophilic (solvent attracting) and lyophobic (solvent repelling)

S16. Light scattering (Tyndall effect).

S17. Coagulation because ferric hydroxide is precipitated.

S18. Movement of colloidal particles towards the oppositely charged electrodes (Electrophoresis).

S19. Emulsions are colloidal system. In which both dispersed phase and the dispersion medium are liquid.

Classification of emulsions

(a) Oil-in-water type, water acts as dispersion medium.

For example: milk vanishing cream.

(b) Water-in-oil type, oil acts as dispersion medium.

For example: butter, cold cream.

S20. Breaking up of an emulsion into two constituent liquids is called demulsification. Emulsion can be demulsified by separating or destroying the emulsification. centrifusion, freezing and addition of electrolytes causes demulsification.

(a) Electrostatic precipitation (b) Centrifugation.

S21. Soap molecules adsorb the dirty (oily) surface and try to emulsify it. Soap micelles do solubilize the insoluble dirt or greasy material.

S22. Shape selective catalysis is a catalystic reaction that depends upon the pore structure of the catalyst and the size of reactant or product molecules. Zeolite is a shape selective catalyst. Zeolites (ZSM-5) used in the cracking of hydrocarbons in oil industries.

S23. Colloidal solution is made up of dispersed phase and dispersion medium. The size of the particles of dispersed phase varies between 1nm to 100 nm in colloidal solution. On the basis of size of particles we can distinguish between colloidal solution and true solution.

For example: NaCl in water forms true solution but in benzene forms colloidal solution. A soap forms true solution in alcohol but colloidal solution in water.

S24. Colloidon is a sol of cellulose nitrate in ethyl alcohol.

S25. It is used for the purification of blood in case of kidney failure.

S26. Oil in water type emulsion.

S27. A process in which both adsorption and absorption take place simultaneously is called sorption.

S28. **Negatively charged solutions:** Arsenius sulphide and gold sol.

Positively charged solutions: Ferric hydroxide solution and aluminium hydroxide.

S29. NH_3, because it is more easily liquefiable. Hence, NH_3 has greater intermolecular force of attraction and will be adsorbed more readily.

S30. A catalyst always lower the value of activation energy and suggest a new pathway for conversion of reactants into the products.

S31. The potential difference between the fixed layer and the diffused layer of opposite charges is called the electrokinetic potential or zeta potential.

S32. River water is a colloidal solution of negatively charged silicates dispersed in water. The sea water contains $Ca^{2\oplus}$ and $Mg^{2\oplus}$ ions. Thus, where sea water meet with river water, the precipitate of silicates takes place leading to the formation of deltas.

S33. The formation of micelles take place only above a particular temperature called kraft temperature (T_k) and above a particular concentration called critical micelle concentration (CMC)?

S34. When smoke is passed through cottrell smoke precipitator the carbon particles get discharged by metal disc and precipitate, while gases come out from the chimney of an industrial plant.

S35. The Process of converting a freshly prepared precipitate into colloidal form by the addition of suitable electrolyte. The electrolyte used for this purpose is called peptizing agent. This process is known as peptization.

S36. We know $Fe(OH)_3$ is a positive charged sol, hence the anion having maximum charge will be more effective. Therefore Na_3PO_4 will be more effective because $PO_4^{3\ominus}$ having three negative charge.

S37. (a) Rubber plating (b) Sewage disposal

(c) In disinfectants (d) In building roads.

S38. Ice cream is an emulsion of milk or cream in water. Gelatin is added in the preparation of Ice cream to act as emulsifiers *i.e.*, it helps in the formation of stable emulsion.

S39. Adsorption of water will occur on silica gel and absorption of water will occur on calcium chloride (anhydrous).

S40. Clouds are colloidal dispersion of water particles in air. These colloidal water particles carry some charge. On applying salt in the cloud, coagulation of water particles takes place.

S41. Gold sol is red in colour, when the particles are fine but as the size of the particles increases, its colour changes to purple, then blue and finally golden.

S42. A mixture of milk and water appear blue colour when viewed by the reflected light, but in transmitted light, it is red in colour, because the colour of colloidal solution depends on the wavelength of the light scattered by the dispersed particles.

S43. **Catalytic poisons:** Those substances which decrease the activity of a catalyst are called catalytic poisons.

For example: Arsenic, cobalt etc.

Catalytic promoters: Those substance which increase the activity of a catalyst are called catalytic promoters.

For Example: Molybdenum acts as a promoter for iron catalyst in the manufacture of NH_3 by Haber's process.

S44. **Autocatalysis:** It is a phenomenon in which one of the product formed during the chemical reaction act as a catalyst and speeds up the reaction. For example, Mn^{2+} ions produced during oxidation of oxalic acid by acidified $KMnO_4$ act as catalyst and speed up the chemical reaction as it progresses.

$$2MnO_4^{\oplus} + 6H^{\oplus} + 5H_2C_2O_4 \longrightarrow 2Mn^{2\oplus} + 10CO_2 + 8H_2O$$

S45. **Tyndall effect:** Scattering of light by the colloidal particles which is passed through a colloidal sol placed in a dark place, is called tyndall effect.

S46. Due to unbalanced bombardment of the colloidal particles by the molecules of the dispersion medium.

S47. Chemisorption.

S48.

Physisorption	Chemisorption
1. It usually takes place at a low temperature and decreases with increasing temperature.	1. It takes place at a high temperature.
2. It is reversible.	2. It is irreversible.
3. It is related to the ease of liquification of the gas	3. The extent of adsorption not related to liquification of the gas.
4. It is not very specific.	4. It is highly specific.
5. It forms multimolecular layers.	5. It forms monomolecular layers.
6. It does not require any activation energy.	6. It requires activation energy.

S49. **Lyophilic Sol:** Lyophilic means "solvent-loving" These are the substance which when mixed with a suitable solvent as the dispersion medium directly form the colloidal solution are called lyophilic and solution thus form lyophilic solution.

For example: Gum Gelatine, Starch, Rubber.

Lyophobic Sol: Lyophobic means "solvent-hating". These are the substances, when mixed with dispersion medium do not form colloidal solution. Their solution can be prepared only by special method, such substances are called lyophobic and the solution formed by them are called ***lyophobic*** solutions.

For example: Metal and their sulphides.

Lyophobic sols are not stable so these sols are readily coagulated on the addition of small amount of electrolytes, by heating or by shaking. Once precipitated, they do not give back the colloidal sol by simple addition of the dispersion medium. Hence lyophobic sols require stabilising agent for preservation.

S50. (a) When an emulsion subjected to centrifugation emulsion is broken into constituent liquids.

(b) Movement of colloidal particles towards the oppositely charged electrodes (Electrophoresis).

S51. (a) **Multimolcular Colloids:** Multimolecular colloids contain dispersed particles less than 1 nm made of aggregates of many molecules. These are lyophobic colloids. In mutlimolecular colloids, particles are held by weak Van der Waals forces. For example: As_2S_3 sol, Gold sol, Sulphur sol.

(b) **Macromolecular colloids:** Macromolecular colloids are molecularly dissolved solutions of a polymer with particle size of colloidal range and are lyophilic colloids. In macromolecular colloids, particles are hold by chemical bonds.

For example:

(i) **Naturally macromolecular colloids:** Starch, cellulose, proteins and enzyme.

(ii) **Man made macromolecular colloids:** Polythene, nylon, polystyrene, synthetic rubber.

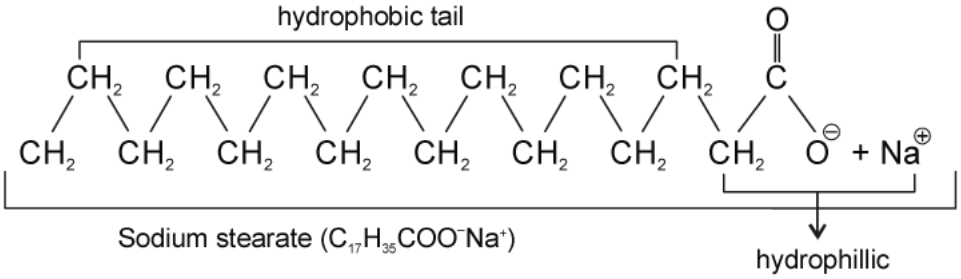
(c) **Associated colloids:** The colloids behave as normal electrolytes at low concentration but act as colloids at higher concentration, these are known as micelles or associated colloids.

For Example: Soaps and detergents.

S52. **Micelles:** Those colloids which behave as normal electrolyte at low concentration but act as colloids at higher concentration, these are known as micelles.

For example: Soap **miceller system**. Soap is sodium or potassium salt of a higher fatty acid and may be represented $RCOO^-Na^+$ (sodium stearate $CH_3(CH_2)_{16}$) $COO^{\ominus}Na^{\oplus}$). When it dissociates into $RCOO^{\ominus}$ and $Na^{\oplus}$ ions.

- a long hydrocarbon chain R (Non polar) hydrophobic (tail and water repelling)
- a polar group $COO^{\ominus}$ polar ionic, hydrophilic (head and water attracting).



S53. (a) Asphalt emulsified in water is used for building roads without the necessity of melting the asphalt.

(b) Many pharmaceuticals and cosmetics available in liquid form such as cod-liver oil. B-complex ointment are emulsions of water in oil. These are easily adsorbed in the intestines.

(c) The cleansing action of soap based upon the formation of oil in water type emulsion.

(d) Milk which is an important constituent of our diet is an emulsion of liquid fats in water.

S54. (a) **Electrophoresis:** Movement of colloidal particles under the external electrical field.

(b) **Coagulation:** Breaking of colloid into dispersed phase and dispersion medium.

(c) **Dialysis:** Purification of colloidal solutions by using a cellophane membrane or parchment paper.

(c) **Tyndall effect:** Scattering of light by the colloidal particles.

S55. Zeolites are porous aluminosilicates with pore size varying between 250-750 pm. These are shape-selective catalysts. Zeolites are the microporone alumino silicates.

Features of Zeolites:

(a) The reaction in presence of zeolite depend on the size of the cavities and pores present in zeolites. The pore size in zeolites varies from 260 to 740 pm.

(b) On the basis of the size of the reactants and products and those of the pores of the zeolites, the reaction can be made to proceed in a specific manner. For example: A zeolite sieve of molecular porosity-5 zeolite catalyst ZSM-5. It converts alcohols into petrol by dehydrating.

S56. **Activity:** Activity of a catalyst refers to the chemisorption of reactants reasonably strongly. It has ability to increase chemical reaction.

For example: Transition metals show catalytic activity. (Maximum activity group 7-9 metals).

Selectivity: Selectivity of a catalysts is its ability to speed up a reaction to yield a particular product.

For example:

(a) CO + H_2 combine to form CH_4 when Ni is the catalyst and methanol when Cr_2O_3 is catalysts.

$$CO + 3H_2 \xrightarrow{Ni} \underset{\text{Methane}}{CH_4} + H_2O$$

$$CO + 2H_2 \xrightarrow{Cr_2O_3} \underset{\text{Methanol}}{CH_3OH}$$

$$CO + H_2 \xrightarrow{Cu} \underset{\text{Formaldehyde}}{HCHO}$$

S57. (a) Haber's process of ammonia:

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

(b) Contact process for sulphuric acid:

$$2SO_2(g) + O_2(g) \xrightarrow{Pt(s)} 2SO_3(g)$$

(c) Ostwald process for nitric acid:

$$4NH_3(g) + 5O_2(g) \xrightarrow{Pt(s)} 4NO + 6H_2O$$

(d) Hydrogenation of vegetable oil:

$$\text{veg. oil}(l) + H_2(g) \xrightarrow{Ni(s)} \text{Vegetable ghee}(s)$$

S58. (a) **Double decomposition**

$$As_2O_3 + 3H_2S \longrightarrow As_2S_3(sol) + 3H_2O$$ **(Arsenic sol)**

(b) **Oxidation**

$$SO_2 + 2H_2S \longrightarrow 3S\ (sol) + 3H_2O$$ **(Sulphur sol)**

(c) **Reduction**

$$2AuCl_3 + 3HCHO + 3H_2O \longrightarrow 2Au(sol) + 3HCOOH + 6HCl$$ **(Gold sol)**

S59. **Enzymes:** Enzymes are defined as biochemical catalysts. Chemically, all enzymes are globular proteins which are complex nitrogenous compounds with high molar mass and form colloidal solution in water.

The most accepted mechanism of enzyme catalysed reaction is known as **lock and key mechanism**.

The enzyme catalysed reactions take place in 2 step as follows:

Step 1: Formation of enzyme-substrate activated complex.

$$\underset{\text{Enzyme}}{E} + \underset{\text{Substrate}}{S} \rightleftharpoons \underset{\text{Enzyme-substrate activated complex}}{ES}$$

Step 2: Dissociation of enzyme-substrate activated complex to form the product

$$\underset{\substack{\text{Enzyme}\\\text{substrate}\\\text{activated}\\\text{complex}}}{ES} \longrightarrow \underset{\substack{\text{Enzyme}\\\text{product}\\\text{association}}}{[EP]} \longrightarrow \underset{\substack{\text{Enzyme}\\\text{(regenerated)}}}{E} + \underset{\text{Product}}{P}$$

S60. (a) **Emulsification:** An emulsion is a colloidal system consisting of two immiscible liquid phases, one of which is dispersed as globules in another. *For examples*: milk (liquid fat dispersed in water), butter (water dispersed in liquid fat).

(b) **Coagulation:** The phenomenon of precipitation of a colloidal solution by adding electrolyte is called 'coagulation'.

S61. According to Helmhotlz, the charge on colloidal particles is due to the preferential adsorption of common ions on their surface and consequently an electrical double layer is formed. The first layer of ions is firmly held and is termed as fixed layer, while the second layer is mobile which is termed as diffused layer.

For Example:

(a) If $AgNO_3$ is added to an aqueous solution of KI, the precipitated AgI will adsorb negative I ions (common ions) from the dispersion medium to form a negatively charged sol.

$$\underset{\text{Dispersion medium (from KI)}}{AgI + I^{\ominus}} \longrightarrow \underset{\text{Negative sol}}{AgI : I^{\ominus}}$$

If KI is added to $AgNO_3$ the precipitated AgI will adsorb positive $Ag^{\oplus}$ ions, so positive charge sol will be formed.

(b) If $FeCl_3$ added to hot water, a positively charged sols of hydrated Ferric hydroxide is formed due to adsorption of $Fe^{3\oplus}$ ions. When $FeCl_3$ is added to NaOH, a negatively charged sols is formed due to the adsorption of OH– ions.

S62. Colloidal particles always carry an electric charge. The nature of this charge is the same on the all particles in a given colloidal solution may be either positive or negative. A charge on the sol particle is due to

(a) electron capture by sol particles during electrodispersion of metal.

(b) preferential adsorption of ions from solution

(c) formation of electrical double layer.

S63. Modern theory of heterogeneous catalysis involve the following steps.

(a) Diffusion of the reactants to the surface of the catalyst.

(b) Adsorption of the molecules of the reactant at the active site.

(c) Formation of intermediate on the surface of catalyst.

(d) Desorption of product molecules.

(e) Diffusion of products away from the surface of the catalyst.

S64. (b) **Aerosol:** Aerosol are those sols in which the dispersion medium is air.

For example: Smoke, dust

(c) **Hydrsol:** Hydrosol are those sols in which the dispersion medium is water.

For example: Starch solution, gold solution.

S65. (a) Silica gel is a strong absorber of moisture present in air. That is why, it is used as dehumidizer.

(b) Gold number is a measure of protective power of the colloids. Smaller the value of gold number larger will be the protective power of the colloids.

(c) Ferric hydroxide is a positively charged sol and it gets coagulated by the SO_4^{2-} ions provided by K_2SO_4.

S66. (a) (i) Adsorption take place in silica gel as water vapour is retained only on the surface of it.

(ii) Adsorption does not take place in anhydrous $CaCl_2$ because the water vapours are uniformly distributed throughout the body of the solid.

(b) BF_3 forms an intermediate complex due to its electron deficient nature.

(c) Zeolites are shape-selective catalysts.

S67. (a) **Multimolecular Colloids:** Multimolecular colloids contain dispersed particles less than 1 nm made of aggregates of many molecules. These are lyophobic colloids. In mutlimolecular colloids, particles are held by weak Van der Waals forces.

For Example: As_2S_3 sol, Gold sol, sulphur sol.

(b) **Macromolecular colloids:** Macromolecular colloids are molecularly dissolved solutions of a polymer with particle size of colloidal range and are lyophilic colloids. In macromolecular colloids, particles are hold by chemical bonds.

For example:

(i) **Naturally macromolecular colloids:** Starch, cellulose, proteins and enzyme.

(ii) **Man made macromolecular colloids:** Polythene, nylon, polystyrene, synthetic rubber.

S68. (a) Coagulation because ferric hydroxide is precipitated.

(b) Movement of colloidal particles towards the oppositely charged electrodes (Electrophoresis).

(c) Light scattering (Tyndall effect).

S69. Effect of pressure on adsorption:

At low pressure: At low pressure, the extent of x/m is linearly proportional to the pressure.

$$x/m \propto p$$

$$x/m = kp$$

At high pressure: At high pressure, the extent of x/m becomes independent of pressure.

$$x/m \propto p^\circ$$

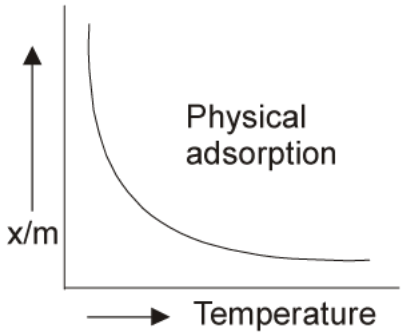
$$x/m = kp^\circ$$

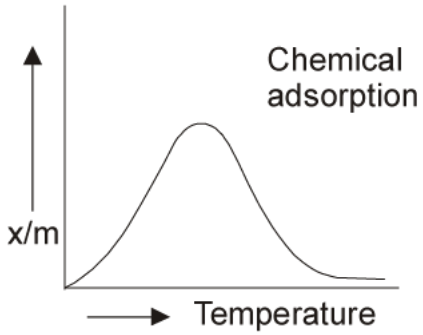
At intermediate pressure: At this state x/m depends upon pressure raised to the power between 1 and 0.

$$x/m = kp^{1/n} \qquad \text{where } 0 < \frac{1}{n} < 1.$$

Effect of temperature on adsorption

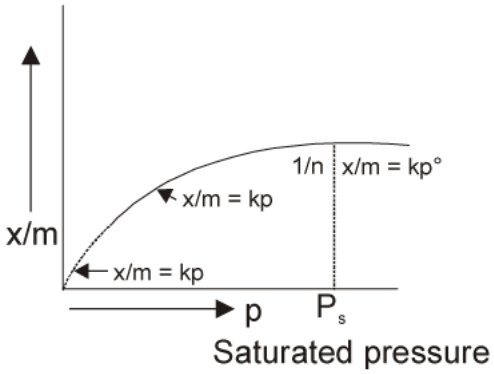
In physical adsorption x/m decreases with increase in temperature because of weak force of attraction while in chemical adsorption. x/m, first increase with increase in temperature and then decreases due to strong force of attraction.

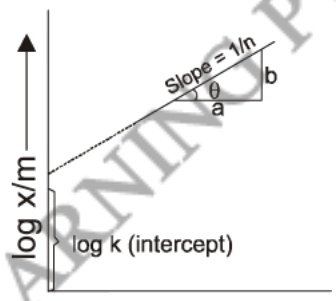




S70. **Adsorption Isotherm:** The plot of adsorption $\frac{x}{m}$ vs pressure (p) at constant temperature is called adsorption isotherm, where "x" is the quantity of gas adsorbed by unit mass "m" of the solid adsorbent.

Freunidlich adsorption isotherm: It is an empirical equation expressing the relationship between the extent adsorption $\left(\frac{x}{m}\right)$ and pressure (p) which is graphically depicted as under.





On the basis of above, it is clear that

(a) **At low pressure**

The graph is a slight sloping line

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

(b) **At high pressure**

The graph becomes independent of pressure

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

(iii) **At intermediate pressure**

$\frac{x}{m}$ varies with the power of the pressure lying between 0 and 1.

$$\frac{x}{m} \propto p^{1/n} \text{ or } \frac{x}{m} = kp^{1/n}$$

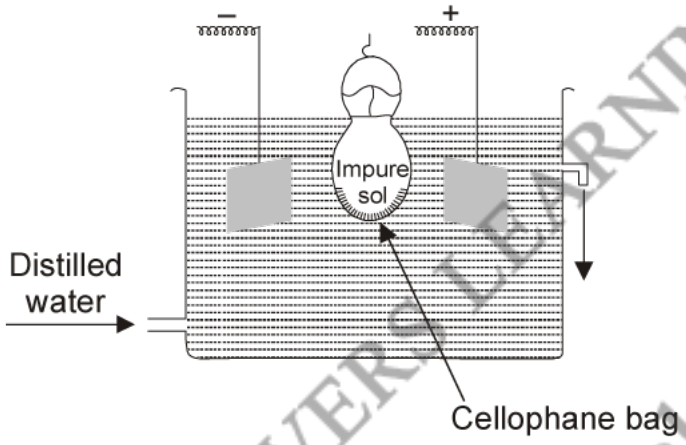
Taking logarithm $\log \frac{x}{m} = \log k + \frac{1}{n} \log p$

Where n is an integer ($n > 1$), k is a constant.

S71. (a) **Peptization:** The method of changing a freshly prepared precipitate into colloidal form by adding an electrolytic solution is called peptization, and the electrolyte used for this purpose, is called peptizing agent. *For example:* Freshly precipitated ferric hydroxide can be peptized to a reddish brown sol by the addition of a small quantity of ferric chloride solution (a peptizing agent).

(b) **Dialysis:** Particles of true solutions can pass through parchment paper of cellophane membrane. On the other hand, sol particles cannot pass through these membranes. A bag made up of such a membrane is filled with the colloidal solution and is then suspended in fresh water. The electrolytic particles pass out leaving behind the colloidal sol.

Movement of ions across membrane can be expedited by applying electric potential through two electrodes. This method is faster than simple dialysis and is known as electrodialysis.



(c) **Hardy-Schulze rule:** The precipitating power of an electrolyte is given by the generalisation called *Hardy-Schulze rule* according to which the greater the valence of the active ion, the greater is its precipitating power. For example, in the precipitation of negatively charge sol such as muddy water, trivalent $Al^{3\oplus}$ ions are more effective than bivalent $Ba^{2\oplus}$ ions or monovalent $Na^{\oplus}$ ions. Similarly in the coagulation of positively charged sol such as $Fe(OH)_3$ sol, trivalent $PO_4^{3\ominus}$ ions are more effective than bivalent $SO_4^{2\ominus}$ ions or monovalent $Cl^{\ominus}$ ion.