TOPIC : SURFACE CHEMISTRY EXERCISE # 1

Section (A)

- It involves's vanderwall's interaction b/w adsorbent and adsrobate that's why its enthalpy is quite law (20–40 kJ mol⁻¹) this is only due to weak vanderwall's forces b/w gas molecules and solid surface. It is all reversible in nature. Solid + gas a gas /solid + heat.
- **2.** It involves on the basis of equation $\Delta G = \Delta H T\Delta S$ So it is dependent on temperature.
- 3. Physical adsorption decreases as temperature increases.
- 4. On increasing pressure more molecule will into contact with the surface of solid adsorbent.
- 5. It's activation energy is high (80–240 kJ mol⁻¹)

Section (B)

1. Molybdnum acts as a promoter for iron which is used as a catalyst

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

2. A catalyst increases rate of reaction by decreasing activation energy.

3.
$$2SO_2 + O_2 \rightarrow V_2O_5 \xrightarrow{V_2O_5} 2SO_3$$

- 5. Catalyst affects the rate of chemical reactions.
- **8.** Numereous reaction that occur in the bodies of animals and plants to maintain the life process are catalysed by enzymes. So an enzyme acts as a biological catalyst.

Section (C)

- 2. Egg albumin is an solvent attraction (lyophilic colloid).
- **4.** Peptisation is conversion of precipitate into colloidal sol by shaking it with dispersion medium in the presence of a small amount of electrolyte.
- 7. Liquid (disperesed phase) & gas (dispersion medium) type of colloid (Aerosol) enample is cloud.

Section (D)

3. The grater the valence of the floculating ion added, the greater its power to cause precipitation. In the coagulation of a (–ve) sol, the flocculating power is in the order $Al^{3+} > Ba^{2+} > Na^+$.

Section (E)

1. If a mixture of two immiscible or partially miscible liquid is shaken, a coarse dispersion of one liquid in the other is obtained which is called emulsion.

EXERCISE # 2

- **5.** $\frac{\text{coagulation power of AICI}_3}{\text{coagulation power of NaCl}} = \frac{\text{coagulation value of NaCl}}{\text{coagulation value of AICI}_3} = \frac{52}{0.093} = 559.8$
- 6. $\log \frac{x}{M} = \log k + \frac{1}{n} \log P$ $\frac{1}{n} = \tan 45^{\circ}$ $\ln k = 0.69$ n = 1 k = 2 $\frac{x}{m} = 2 \times (0.5)^{1}$ x = 1.
- 7. Lyophilic means liquid loving or solvent attracting so it is quite stable in solvent.
- 9. Gel (liquid in solid)
- 14. Impurities present in a solution makes it more unstable.
- **15.** In hydrophilic colloid : there is a strong attraction b/w the dispersed phase and water but in hydrophobic lack of attraction between dispersed phase and water.
- 18. For lyophilic solGold number ↓ protective power ↑
- **19.** The greater the valence of the flocculating ion added, the greater is its power to cause precipitation.
- **21.** When light fall on smoke particles, the blue colour of light scattared.
- **23.** For hydrophilic sols when compared to water viscosity is greater than water.
- **24.** Brownian movement is independent of nature but depand on the size of particles and viscosity of the solution. Smallest the size and lesser the viscosity faster is the motion.
- **27.** In lyophilic sols the dispersed phase have great affnity (attraction) towards dispersion medium. So they are self stabilizing.
- **28.** Longer the hydrophobic part of the molecule easy will be the formation of micelle. (Longest hydrocarbon chain)
- **29.** Most effective coagulating agent for Sb_2S_3 is $Al_2(SO_4)_3$ because of high charge.
- **30.** As the adsorption of methylene blue over activated characoal is physisorption (Reference : NCERT), it is accompanied by decrease in enthalpy.

EXERCISE # 3 PART - I

- 1. On addition of electrolyte charge of colloidal particles will neutralise and hence coagulation or precipitation of colloidal solution will occur.
- **2.** Adsorption is the ability of substance to concentrate or hold gases, liquids or dissolved substance upon its surface.
- **3.** Micelles are the clusters formed by the association of colloids. They are formed by lyophillic and lyophobic groups. As the concentration is increased the lyophobic parts receding away from the solvent approach each other and form a cluster, the lyophobic ends are in the interior lyophilic groups projecting outward in contact with the solvent.
- **4.** According to adsorption theory of catalysis, the speed (rate) of the reaction increase because adsorption lowers the activation energy of the reaction.

(:: Rate of reaction
$$\propto \frac{1}{\text{activation energy}}$$
)

- 5. Sodium acetate forms cationic micells above a certain concentration. In the molecule of detergents and soap, the negative ions aggregate to form a micelle of colloidal size. In polar medium (like water), the negative ion has a long hydrocarbon chain and a polar group (-COO⁻) at one end and on other end, it has Na⁺ ions, thus cationic micelle is formed.
- 6. Zeolites are aluminosilications having three dimensional open structure in which four or six membered rings prodominates. Thus, due to open chain structure, they have cavities and can take up water and other small molecules.
- **7.** Surfactants detergents form micelles in aqueous solution above to their C.M.C. (critical micelle concentration). Dodecyl trimethyl ammonium chloride is an example of surfactant (cationic surfactant), so it shows a following phenomena.

$$\begin{array}{c} CH_{3}-(CH_{2})_{11}-\overset{+}{N}\overset{CH_{3}}{\underset{C}{\overset{}}}_{CH_{3}}\\ \hline \\ Non-polar part \overset{+}{\underset{Polar part}{\overset{}}} \end{array}$$

8. The empirical reaction $\frac{x}{m} = kp^{1/n}$, put forward by Freundlic is known as Freundich adsorption isotherm.

Taking logarithm log $\frac{x}{m} = \log x + \frac{1}{n} \log p$. If a following curve is plotted

$$\log \frac{x}{m}$$

$$\log \frac{1}{k}$$

$$\log P$$

9. The main points of Langmuirs theory of adsorption are as :

(i) Adsorption takes place on the surface of the solid only till the whole of the surface of the solid only till the whole of the surface is completely covered with a unimolecular layer of the adsorbed gas.

(ii) Adsorption consist of two opposing process (a) condensation, and (b) evaporation.

(iii) The rate of condensation depend upon the uncovered surface of the adsorbent available for condensation.

 $\frac{x}{M} = KP^{\frac{1}{n}} \implies 0 \le \frac{1}{n} \le 1$ 10. Rb⁺ < K⁺ < Na⁺ < Li⁺. 11. 12. By definition it is gold number. 13. Tyndal effect is due to Scattering of light and not due to charge. 14. $\Delta G = \Delta H - T \Delta S$ $\Delta S = -ve$ for adsorption So, ΔH must be –ve to make ΔG = –ve $\Delta G = \Delta H - T \Delta S$ 15. Tyndal effect is not depends on charge of colloidal particles 16. According to Gibbs Helmholtz equation, $\Delta G = \Delta H - T \Delta S$

According to Globs Heimholtz equation, $\Delta G = \Delta H - I\Delta S$ Adsorption is a spontaneous process (where $\Delta S < 0$, $\Delta G < 0$ and $\Delta H < 0$)

Dispersed phase is liquid

Dispersion medium is gas

18. Coagulation power
$$\propto \frac{1}{Coagulation \ value}$$

Higher the coagulation power, lower is coagulation values in millimoles per litre.

 $MgSO_4 > BaCl_2 > NaCl.$

17.

- **19.** Both magnitude and sign of the charge on the ion
- 20. In compare to 1.5 M KI, 2M KI is conc. solution and In 2M KI solution, extra K⁺ ion can lead coagulation so better option is 1.5 M KI

 $\frac{\mathbf{x}}{m} = \mathbf{k}(\mathbf{p})^{\frac{1}{n}}$ then value of slope $\left(0 < \frac{1}{n} < 1\right)$

PART - II

- Milk is a type of colloidal solution (emulsion) in which both dispersed phase and dispersion medium are liquid i.e., liquid fats are dispersed in water.
 Note : Foam is an example of gas dispersed in liquid dispersion medium.
 Sols in water do not form a colloidal solution but form a true solution.
 Sugar in water do not form a colloidal solution but form a true solution.
- 2. The sky appears blue because of scattering of sunlight by the colloidal particles of air (dust, dirt etc.) this effect of scattering of light by colloidal particles is called Tyndall effect.
- **4.** Blood is an example of colloid. Particles which range between 1 nm 100 nm form colloidal solution. It is a heterogeneous solution.

Urea, cane sugar and NaCl are crystalloids i.e., form true solution. Crystalloids can easily pass through parchment membranes while colloids do not diffuse or diffuse slowly.

- The movement of colloidal particles under applied electric current is known as electrophoresis.
 Dialysis is a method for purification of colloids. Colloidalparticles cannot pass through perchment paper but true solutions can. Movement of particles across the membrane can be expidited by applying electric current through two electrodes. The method is fast and known as electrodialysis.
- 6. **Physical absorption** is a phenomenon taking place in the entire body and not only on the surface and it is a simple physical phenomenon which involves no breaking of bond.
- **7.** The species, which have both polar and non polar ends is surfactant. Thus $CH_3(CH_2)_{14} CH_2NH_2$ is not a surfactant.
- **10.** The correct reason is that molecules of liquid absorb on the surface of precipitate, Due to repulsion between adsorbed ions, the precipitate undergo fragmentation resulting in colloidal state.
- **11.** A catalyst lowers the activation energy of the reaction following adsorption mechanism.

:. Rate of reaction $\propto \frac{1}{\text{Activation energy}}$

- **12.** Gold sol is a lyophobic sol. Gold particles have very less affinity towards dispersion medium, hence its sol can be easily coagulated.
- **13.** The Brownian movement has been explained due to the unbalanced bombardment of the particles by the molecules of the dispersion mdium. The brownian movement has a stirring effect which does not permit the particles to settle and is responsible for the stability of solution.
- **14.** Since, the adsorption process is exothemic, the physical adsorption occurs readily at low temperature and decreases with increase in temperature (Le-Chatelier's principle.)
- **15.** The movement towards anode shows that sol is negative. For coagulation of negative sol. Cation with higher charge is more effective.
- **16.** The movement towards anode shows that sol is negative. For coagulation of negative sol cation with higher charge is more effective.
- **17.** Asseration is true, reasons is false.

When several lines have the same value of $\frac{1}{n}$, then the lines by which their adsorption isotherms can be represented will be parallel and will not meet at a point.

- **19.** Proteins starch and rubber molecules have strong interaction with the dispersion medium. So, act as lyophilic colloids.
- **21.** Mixing AgNO₃ in excess KI forms negatively charged colloid
- **22.** $Fe(OH)_3$ and As_2S_3 are positive and negative colloids. On mixing mutual coagulation causes precipitation
- **23.** Charge get neutralize by addition of some electrolyte called coagulation
- 25. For emulsification soap is added in O/W emulsion as it reduces surface tension and forms better colloid.

PART - III

- **1.** Since the physical adsorption process is exothermic, the physical adsorption occures readily at low temperature and decreases with increasing temperature. (Le Chatelier's principle).
- 2. On mixing, they will coagulate each other being +ve and ve charged.
- **3.** For true solution the diameter range is 1 to 10 Å and for colloidal solution diameter range is 10 to 10,000 Å.

$$\frac{V_{c}}{V_{s}} = \frac{(4/3)\pi r_{c}^{3}}{(4/3)\pi r_{s}^{3}} = \left(\frac{r_{c}}{r_{s}}\right)^{3}$$

Ratio of diameters = $(10/1)^{3} = 10^{3}$
 $V_{c}/V_{s} = 10^{3}$.

- **4.** The adsorption of a gas is directly proportional to the pressure of gas.
- 5. Higher the gold number, lesser will be the protective power of colloid.
- **6.** Since adsorption is exothermic process so ΔH of adsorption is always negative.

7.
$$\frac{x}{m} \propto P^{1/n}$$

where $n \ge 1$

- **8.** According to Hardy Schulze rule, greater the charge on cation, greater is its coagulating power for negatively charged solution. So, order of coagulating power : Na⁺ < Ba²⁺ < Al³⁺.
- 13. Fact
- 14. Factual
- **15.** $K_2[HgI_4] \longrightarrow 2K^+ + [HgI_4]^{-2}; n = 3$ $i = 1 + (3 - 1) \times 0.4$ $= 1 + 2 \times 0.4 = 1.8$