

<H1> Additional Objective Questions

<H2> Single Correct Choice Type

1.(D) The conditions necessary for observation of Tyndall effect are: (A) The diameter of the particles should be of the order of wavelength of light used and (B) the refractive indices of the dispersed phase and the dispersion medium should be vastly different.

2.(A) Freezing point is a colligative property. The colligative properties are properties that depend only on the number of solute particles in a solution but are independent of the nature of those particles. Therefore, freezing point of colloidal solution will be same as that of true solution at same concentration of a solute.

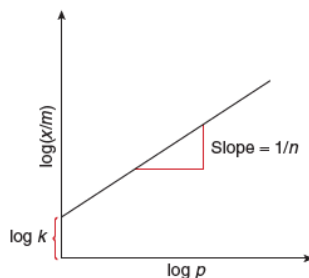
3.(D) According to Freundlich adsorption isotherm

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

Taking log on both sides, we get

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

On plotting the graph between $\log (x/m)$ and $\log p$, a straight line is obtained with the slope equal to $1/n$ and the intercept equal to $\log k$.



4.(D) In physical adsorption, forces of attraction involved between adsorbent and adsorbate are weak, long-range van der Waals forces. The adsorption is generally multilayered.

5.(A) According to Hardy-Schulze rule, greater the valency of the active ion or flocculating ion, greater will be its coagulating power.

6.(C) According to Freundlich isotherm,

$$\frac{x}{m} = kp^{1/n}$$
$$\log\left(\frac{x}{m}\right) = \log k + \frac{1}{n} \log p$$

From the graph, slope = $\frac{2}{4} = \frac{1}{n} \Rightarrow n = 2$

Therefore, $\frac{x}{m}$ is proportional to $p^{1/2}$.

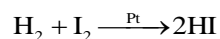
7.(B) Sulphide sol is negative charged colloid, so cation with maximum charge will be most effective for coagulation $Al^{3+} > Ba^{2+} > Na^{+}$ (coagulating power).

Therefore, aluminium will be the most effective for coagulation of sulphide sol

8.(B) No catalyst is required in combustion of coal.

9.(A) Gold sol is negatively charged sol and Hb is positively charged.

10.(A) Since I_2 is the least reactive halogen, so it required a catalyst (i.e., Pt) to react with H_2 .



11.(A) Electrolyte used for the electroplating of gold is the electrolyte contains gold metal, that is, $[Au(CN)_2]^-$ in the same way for electroplating of silver, electrolyte contain silver metal is used, that is, $[Ag(CN)_2]^-$.

12.(D) Colloids in which solid particles are dispersed in solid medium are solid sol. Gemstones are an example of solid sol.

13.(B) $100 \times 10^{-3} (0.6 - 0.5) 60 = 0.6$ g

Amount of acetic acid adsorbed = $0.6/2 = 0.3$ g

14.(B)

Colloid	Dispersed phase	Dispersion medium
Cheese	Liquid	Solid
Milk	Liquid	Liquid
Smoke	Solid	Gas

15.(D) Smaller the value of critical temperature of gas, lesser is the extent of adsorption. So, least adsorbed gas is H_2 .

16.(B) Autocatalysis is reaction in which product itself catalyze the reaction.

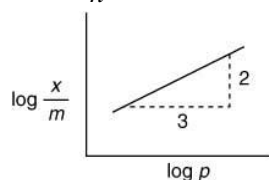
17.(D) Latex is a colloidal solution of rubber particles which are negatively charged.

18.(C) As they are solvent loving.

19.(A) From Freundlich's adsorption isotherm

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

for the plot $\log \frac{x}{m}$ vs $\log p$, the slope is $\frac{1}{n}$.



from the graph slope $= \frac{1}{n} = \frac{2}{3}$

Therefore, in the adsorption isotherm, $\frac{x}{m} \propto p^{2/3}$.

20.(B) The concern colloidal system is gel.

21.(A) Aerosol are of two type colloids:

Dispersed phase	Dispersion medium	Examples
Solid	Gas	Smoke, dust, etc.,
Liquid	Gas	Fog, mist, clouds, etc.

22.(B) We have

Total area = Area covered by one particle \times Total number of particles

$$0.24 = a^2 \times \frac{10^{-3} \times 10}{10^3} \times 6.023 \times 10^{23} \Rightarrow a = 2.0 \text{ pm}$$

23.(C) Since, the crystal structure of AgI is similar to ice, therefore, it is used as producing artificial rain.

24.(B) As the charge on Pb is +2 while that on Ag is +1.

25.(C) The size of colloidal particle is 10^{-9} to 10^{-6} m.

26.(C) Freundlich absorption isotherm

$$\frac{x}{m} = kp^{0.5}$$

On increasing pressure, the amount of adsorbate per unit mass of adsorbent increases, that is, $\frac{x}{m}$ increases. Since, physical adsorption is an exothermic process, so with increase in temperature adsorption decreases.

27.(D) Due to coagulation of blood forming a clot.

28.(B) Since, the adsorption is an exothermic process, therefore, on increasing the temperature, the adsorption decreases.

29.(C) Option (A) Incorrect. Many medicines are colloidal solutions because the drug particles being larger in size are more effective and easily assimilated in the body.

Option (B) Incorrect. Alum $[KAl(SO_4)_2 \cdot 12H_2O]$ is used for coagulation of the impurities present in water.

Option (D) Incorrect. The Brownian movement varies with the size of the particles and viscosity of the solution.

30.(C) Adsorbed moles of $H_2 = \frac{0.03 \times 2.46 \times 10^{-3}}{0.0821 \times 300} = 3 \times 10^{-6}$

Number of adsorbed molecules of $H_2 = 3 \times 10^{-6} \times 6 \times 10^{23}$ or 18×10^{17}

Total number of surface sites available = $6 \times 10^5 \times 1000 = 6 \times 10^{18} \text{ cm}^2$

Number of surface sites that is occupied by adsorption of

$$H_2 = \frac{10}{100} 6 \times 10^{18} = 6 \times 10^{17}$$

Number of surface sites occupied by one molecule

$$\text{or } \frac{18 \times 10^{17}}{6 \times 10^{17}} = 3$$

31.(A) In this type, the phase of the catalyst and the reactants/products are different.

32.(B) Enzymes are biological catalyst, which are normally heterogeneous and specific in its action.

33.(A) Forms positively charged $SnCl_4$.

34.(B) Syneresis.

35.(B) The process of converting a fresh precipitate into colloidal particles by shaking it with dispersion medium in presence of a small amount of suitable electrolyte is called peptization.

36.(A) The reaction involved is $(\text{NH}_4)_3\text{PO}_4 \rightarrow 3\text{NH}_4^+ + \text{PO}_4^{3-}$. Greater is the valency, greater is the coagulating power and coagulating power is inversely proportional to the coagulation value or flocculation value. As $\text{Fe}(\text{OH})_3$ is a positively charged sol so, a negative ion will be needed to coagulate it. Out of the given anions, PO_4^{3-} has the maximum coagulating power and Cl^- has the least coagulating power. In other words, PO_4^{3-} has the least flocculation value and Cl^- has maximum flocculation value.

37.(C) As strong bonds are formed in chemisorption.

38.(A) According to Hardy–Schulze rule, greater the valence of the active ion or flocculating ion, greater will be its coagulating power.

39.(A) Peptization takes place forming a colloidal sol of FeCl_3 .

40.(C) From Freundlich isotherm, the slope is

$$\begin{aligned}1/n &= -\tan \theta = 1 \\ \log k &= 0.6990 \\ k &= \text{antilog } (0.6990) = 5 \\ p &= 0.5 \text{ atm} \\ x/m &= 5 \times (0.5)^1 = 2.5\end{aligned}$$

41.(C) The zigzag random movement of colloidal particles is called Brownian movement.

42.(C) In colloidal solutions, the values of colligative properties such as osmotic pressure is of lower order as compared to true solutions of same concentration.

43.(A) This is known as Tyndall effect.

44.(A) The flocculation value is expressed in terms of mmol L^{-1} .

45.(B) Gas (adsorbate) + solid (adsorbent) \rightleftharpoons adsorption + heat

On increasing the pressure, the equilibrium will shift in the direction in which there is decrease in number of moles (i.e., in forward direction).

46.(A) As the hydrocarbon chain increases, the critical concentration for micelle formation decreases. This is because the true solubility of the surfactant decreases, and the tendency to associate into micelles increases.

47.(D) This is called Helmholtz layer.

48.(B) Gold number measures the protective ability of colloid.

49.(A) From Freundlich isotherm,

$$\frac{x}{m} = kp^{1/n} \quad (1)$$

Taking antilog of Eq. (1), we get

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

Given, slope = $1/n = 1.0$

Intercept = $\log k = 0.3010$

$k = \text{antilog } 0.3010 = 2$

$p = 0.5 \text{ atm}$

Substituting the values in Eq. (1), we get

$$x/m = 2 \times (0.5)^1 = 1.0$$

50.(C) Given,

$$32 \text{ g of O}_2 = 22.4 \text{ L}$$

$$1 \text{ g} = \frac{22.4}{32} = 0.7$$

$$\frac{3.6}{1.2} = 3 \text{ g of O}_2$$

$$3 \text{ g of O}_2 = 32 \times 3/22.4 = 2.1 \text{ L}$$

<H2> Multiple Correct Choice Type

1.(B, C) On polishing the surface or making the surface smooth, rate of adsorption decreases. The activation of a solid adsorbent decreases with increase in temperature. A quantity of heat known as heat of adsorption is evolved on adsorption of one mole of gas. By Le Chatelier's principle, high temperature would shift the equilibrium towards desorption.

2.(B, C, D)

Case I – At low pressure: The plot is straight and sloping, indicating that the pressure is directly proportional to (x/m) , that is,

$$(x/m) \propto p$$

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

where x is the mass of the adsorbate and m is the mass of the adsorbent at pressure p ; k is constant depending upon the nature of adsorbate and adsorbent.

Case II – At high pressure: When pressure exceeds the saturated pressure, (x/m) becomes independent of p values.

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

Case III – At intermediate pressure: In this case, (x/m) depends on p raised to the powers between 1 and 0, that is, fractions. This relationship is known as the **Freundlich adsorption isotherm**.

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

3.(B, D) Concept based.

4.(A, B, D) Flocculation value is inversely proportional to the coagulation value. More is the coagulation value, less is the flocculation value.

The negatively charged colloidal particles get neutralized by the Al^{3+} ions (present in alum) and settle down, thus pure water can be separated out.

Milk is an emulsion of liquid fat in water.

Gelatin is used as a stabilizing agent and is added to ice cream.

5.(A, B, C) During adsorption, surface energy decreases and also the molecules of the adsorbate are held together on the surface of solid adsorbent, so entropy also decreases and according to the equation

$$\Delta G = \Delta H - T\Delta S$$

ΔG is negative only when $T\Delta S$ will be positive

6.(A, B, D) Hygroscopic nature of CaCl_2 is not the application of adsorption and rest are adsorption examples.

7.(A, B, D) For chemisorption, initially, the adsorption will increase with temperature and then after reaching equilibrium position, it decreases. The initial increase is due to the high activation energy required for chemisorption, and the decrease in the curve after equilibrium is due to exothermic nature of adsorption.

8.(A, B, D) Electrophoresis is the movement of colloidal particles under the influence of electric field.

9.(A, B, C) Concept based.

10.(B, C, D) Adsorption is a spontaneous process.

11.(A, B, C) Coagulation of colloids cannot be achieved by addition water.

12.(A, B) From Freundlich isotherm, we have

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

At very high pressure the (x/m) is constant.

At intermediate pressure

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

Assertion–Reasoning Type

1.(A) A strongly adsorbed substance can easily displace a weakly adsorbed substance; that is why, when charcoal comes in contact with poisonous gases such as CH_4 and SO_2 which are strongly adsorbable then the O_2 , N_2 already adsorbed on it get displaced.

2.(A) Soap molecules are concentrated over the surface of the oil drop and thus lower the interfacial tension between oil and water.

3.(D) No activation energy is required in physisorption as it is simply a physical change and no chemical bond is formed.

4.(A) Scattering of light by colloidal particles brings about the red color.

5.(A) Lyophilic sols are more stable than lyophobic sols due to greater solvation.

6.(C) The reaction involved is $\text{As}_2\text{O}_3 + 3\text{H}_2\text{S} \rightarrow \text{As}_2\text{S}_3 + 3\text{H}_2\text{O}$. On passing excess of H_2S , S^{2-} ions get adsorbed on the surface forming a negatively charged sol of As_2S_3 .

7.(B) Enzymes being globular proteins are very sensitive to changes in pH and temperature. Activity of enzyme is maximum at pH = 7.4. Due to variations in pH, the solubility of enzymes is also affected.

<H2> Comprehension Type

1.(B) ΔH for chemisorption is high, that is, 80–240 kJ mol⁻¹.

2.(B) Physical absorption is an exothermic process, therefore, it is appreciated at lower temperature. As it does not require activation energy

3.(D) This is according to Freundlich isotherms.

4.(C) $\text{Fe}(\text{OH})_3$ is a positively charged colloid and can be coagulated by negatively charged ion. Among the given ions, that is, CO_3^{2-} , SO_4^{2-} , CN^- and I^- . The least effect will be of CN^- as the valency is the least.

5.(D) According to Hardy–Schulze rule, greater the valence of the active ion or flocculating ion, greater will be its coagulating power.

6.(B) Aluminium hydroxide is a negatively charge sol.

7.(D) Greater the valence of the active ion or flocculating ion, greater will be its coagulating power.

<H2> Integer Answer Type

1.(8) Amount of starch adsorbed (in 100 mL) = $0.08 \times 1000 = 80$ mg

Gold number = $80 \times 10\%$ (NaCl) = $80 \times 10/100 = 8$.

2.(1) As S_4 sol is negatively charged owing to preferential adsorption of S^{2-} ions. Cation would be the effective ion in coagulation. Flocculating value = minimum mmol of the effective ion per liter of sol =

$$\frac{4 \times 0.005 \times 10^3}{4 + 16} = 1.0$$

3.(2) There are two phases – dispersed phase and dispersion medium.

4.(5) Adsorption can be physical or chemical. Silica, alumina, charcoal, calcium chloride, and powdered cellulose will adsorb water vapor.

<H2> Matrix–Match Type

1.(A) → (p, s); (B) → (r); (C) → (q), (D) → (p, s)

- (A) Gelatin sol is an example of lyophilic, macromolecular colloid.
- (B) Gold sol is an example of multimolecular colloid.
- (C) Soap sol is an associated colloid.
- (D) Starch sol is a lyophilic, macromolecular colloid.

2.(A) → (s); (B) → (q); (C) → (p), (D) → (r)

- (A) Milk is an emulsion of liquid fat in water, that is, liquid in liquid.
- (B) Mist is an aerosol in which dispersed phase is liquid, whereas the dispersion medium is gas.
- (C) Gold sol is a sol in which dispersed phase is solid, whereas dispersion medium is liquid.
- (D) Ruby glass is a solid sol in which dispersed phase as well as medium is solid.

3.(A) → (p); (B) → (q, t); (C) → (r), (D) → (s)

- (A) Physisorption is non-specific and decreases with increase of temperature.
- (B) Chemisorption is specific in nature and increases with increase in temperature.
- (C) Desorption increases the surface tension of the liquid surface
- (D) Adsorption decreases the surface tension of the liquid surface.

4.(A) → (q); (B) → (r); (C) → (r), (D) → (q, t)

- (A) Bredig's arc method is used for the preparation of colloidal sol of gold, silver, etc.
- (B) Electrodialysis is used for the purification of colloidal sols.
- (C) Ultracentrifugation method is used for the purification of colloidal solution by ultra-filter paper.
- (D) Peptization is a process wherein a freshly generated precipitate is converted into a colloidal sol by shaking it in dispersion medium in the presence of an electrolyte which is called peptizing agent.