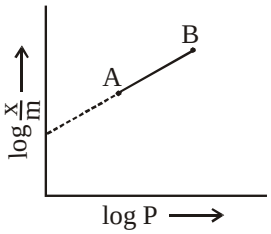
SURFACE CHEMISTRY

1. In Freundlich adsorption isotherm, slope of AB line is :



(1) log n with (n > 1)

(2) n with (n, 0.1 to 0.5)

(3) $\log\frac{1}{n}$ with $(n<1)$

(4) $\frac{1}{n}$ with $\left(\frac{1}{n}=0 \text{ to } 1\right)$

2. In Freundlich adsorption isotherm at moderate pressure, the extent of adsorption $\left(\frac{x}{m}\right)$ is directly proportional to P^x. The value of x is

(1) zero (2) $\frac{1}{n}$ (3) 1 (4) ∞

3. Which one of the following statements is FALSE for hydrophilic sols ?

(1) Their viscosity is of the order of that of H_2O.

(2) The sols cannot be easily coagulated.

(3) They do not require electrolytes for stability.

(4) These sols are reversible in nature.

4. 3.12 g of oxygen is adsorbed on 1.2 g of platinum metal. The volume of oxygen adsorbed per gram of the adsorbent at 1 atm and 300 K in L is_____.

[R = 0.0821 L atm K^{-1} mol^{-1}]

5. The nature of charge on resulting colloidal particles when $FeCl_3$ is added to excess of hot water is :

(1) Positive

(2) Sometimes positive and sometimes negative

(3) Neutral

(4) Negative

6. The INCORRECT statements below regarding colloidal solutions is :

(1) A colloidal solution shows colligative properties.

(2) An ordinary filter paper can stop the flow of colloidal particles.

(3) The flocculating power of Al^{3+} is more than that of Na^+.

(4) A colloidal solution shows Brownian motion of colloidal particles.

7. A colloidal system consisting of a gas dispersed in a solid is called a/an :

(1) solid sol (2) gel

(3) aerosol (4) foam

8. For the coagulation of a negative sol, the species below, that has the highest flocculating power is :

(1) SO_4^{2-} (2) Ba^{2+} (3) Na^+ (4) PO_4^{3-}

9. The charges on the colloidal CdS sol and TiO_2 sol are, respectively :

(1) positive and positive

(2) positive and negative

(3) negative and negative

(4) negative and positive

10. The conditions given below are in the context of observing Tyndall effect in colloidal solutions:

(A) The diameter of the colloidal particles is comparable to the wavelength of light used.

(B) The diameter of the colloidal particles is much smaller than the wavelength of light used.

(C) The diameter of the colloidal particles is much larger than the wavelength of light used.

(D) The refractive indices of the dispersed phase and the dispersion medium are comparable.

(E) The dispersed phase has a very different refractive index from the dispersion medium.

Choose the most appropriate conditions from the options given below:

(1) (A) and (E) only

(2) (C) and (D) only

(3) (A) and (D) only

(4) (B) and (E) only

11. Match **List I** with **List II** :

List-I **Example of colloids**	**List-II** **Classification**
(a) Cheese	(i) dispersion of liquid in liquid
(b) Pumice stone	(ii) dispersion of liquid in gas
(c) Hair cream	(iii) dispersion of gas in solid
(d) Cloud	(iv) dispersion of liquid in solid

Choose the most appropriate answer from the options given below

(1) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(2) (a)-(iv), (b)-(i), (c)-(iii), (d)-(ii)

(3) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

(4) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

12. CO_2 gas adsorbs on charcoal following Freundlich adsorption isotherm. For a given amount of charcoal, the mass of CO_2 adsorbed becomes 64 times when the pressure of CO_2 is doubled.

The value of n in the Freundlich isotherm equation is _____ $\times 10^{-2}$.

(Round off to the Nearest Integer)

13. Given below are two statement : one is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A : $SO_2(g)$ is adsorbed to a large extent than $H_2(g)$ on activated charcoal.

Reason R : $SO_2(g)$ has a higher critical temperature than $H_2(g)$.

In the light of the above statements, choose the most appropriate answer from the options given below.

(1) Both **A** and **R** are correct but **R** is not the correct explanation fo **A**

(2) Both **A** and **R** are correct and **R** is the correct explanation of **A**.

(3) **A** is not correct but **R** is correct.

(4) **A** is correct but **R** is not correct.

14. Which one of the following is correct for the adsorption of a gas at a given temperature on a solid surface?

(1) $\Delta H > 0, \Delta S > 0$ (2) $\Delta H > 0, \Delta S < 0$

(3) $\Delta H < 0, \Delta S < 0$ (4) $\Delta H < 0, \Delta S > 0$

15. The sol given below with negatively charged colloidal particles is :

(1) $FeCl_3$ added to hot water

(2) KI added to $AgNO_3$ solution

(3) $AgNO_3$ added to KI solution

(4) $Al_2O_3.xH_2O$ in water

16. Tyndall effect is more effectively shown by :

(1) true solution (2) lyophilic colloid

(3) lyophobic colloid (4) suspension

17. Lyophilic sols are more stable than lyophobic sols because :

(1) there is a strong electrostatic repulsion between the negatively charged colloidal particles.

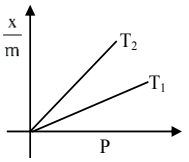
(2) the colloidal particles have positive charge.

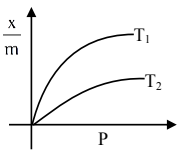
(3) the colloidal particles have no charge.

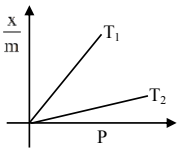
(4) the colloidal particles are solvated.

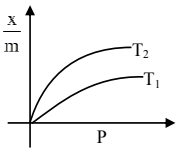
18. Select the graph that correctly describes the adsorption isotherms at two temperatures T_1 and T_2 ($T_1 > T_2$) for a gas :

(x – mass of the gas adsorbed ; m – mass of adsorbent ; P – pressure)

(1) 

(2) 

(3) 

(4) 

19. CH_4 is adsorbed on 1 g charcoal at 0°C following the Freundlich adsorption isotherm. 10.0 mL of CH_4 is adsorbed at 100 mm of Hg, whereas 15.0 mL is adsorbed at 200 mm of Hg. The volume of CH_4 adsorbed at 300 mm of Hg is 10^x mL. The value of x is ____ $\times 10^{-2}$. (Nearest integer)

[Use $\log_{10}2 = 0.3010$, $\log_{10}3 = 0.4771$]

SOLUTION

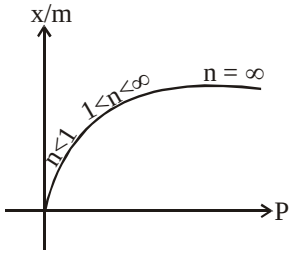
1. Official Ans. by NTA (4)

Sol. $\frac{x}{m} = K(P)^{1/n}$

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

$y = c + mx$

$m = 1/n$ so slope will be equal to 1/n.



Hence $\boxed{0 \le \frac{1}{n} \le 1}$

2. Official Ans. by NTA (2)

Sol. As per Freundlich adsorption isotherm

$\left(\frac{x}{m}\right) = KP^{\frac{1}{n}} \rightarrow x = \frac{1}{n}$

Hence answer is (2)

3. Official Ans. by NTA (1)

Sol. → Viscosity of hydrophilic sol > viscosity of H_2O

→ Hydrophilic sol is more stable so can't be easily coagulated.

→ Hydrophilic sols are reversible sols.

→ No electrolytes are required to stabilise hydrophilic sol.

4. Official Ans. by NTA (2)

Sol. $V = \frac{\frac{3.12}{32} \times 0.0821 \times 300}{1} = 2.40\,l$

$\because$ 1.2 gm adsorbs 2.40 *l*

$\therefore$ 1 gm adsorbs 2 *l*

5. Official Ans by NTA (1)

Sol. If $FeCl_3$ is added to hot water, a positively charged sol, hydrated ferric oxide is formed due to adsorption of Fe^{3+} ions.

$Fe_2O_3 . xH_2O/Fe^{3+}$

Positively charged.

6. Official Ans. by NTA (2)

Sol. * Colloidel solution exhibits colligative properties

* An ordinary filter can not stop the flow of colloidal particles.

* Flocculating power increases with increase the opposite charge of electrolyte.

* Colloidal particles show Brownian motion.

7. Official Ans. by NTA (1)

Sol. Colloid of gas dispersed in solid is called solid sol.

8. Official Ans. by NTA (2)

Sol. To coagulate negative sol, cation with higher charge has higher coagulation value.

9. Official Ans. by NTA (4)

Sol. CdS sol → –ve sol

TiO_2 sol → +ve sol

10. Official Ans. by NTA (1)

Sol. The phenomenon of scattering of light by colloidal particles as a result of which the path of the beam becomes visible is called a tyndall effect.

smaller the diameter and similar the magnitude of refractive indices, lesser is the scattering and hence the tyndall effect and viced-versa.

The diameter of the dispersed phase particle should not be smaller than the wavelength of light used because they won't be able to scatter the light so, therefore, the diameter of the dispersed particles should be equal or not much smaller than the wavelength of the light used.

2. The refractive indies (i.e. the ratio of the velocity of light in vacuum to the velocity of light in any medium) of the dispersed phase and the dispersion medium should differ greatly in magnitude than only the particles will be able to scatter the light and tyndall effect will be obersved. On the other hand, if the refractive indices of the dispersed phase and dispersion medium are almost similar in magnitude, then there will be no scattering of light and hence, therefore, no tyndall effect effect is observed.

Hence answer A and E are correct.

11. Official Ans. by NTA (4)

Sol. Cheese $\rightarrow$ liquid in solid

Pumice stone $\rightarrow$ gas in solid

Hair cream $\rightarrow$ liquid in liquid

Cloud $\rightarrow$ liquid in gas

12. Official Ans. by NTA (17)

Sol. Freundlich isotherm. ;

$$\frac{x}{m} = k.p^{\frac{1}{n}}$$

Substituting values ;

$$\left(\frac{64}{1}\right) = (2)^{\frac{1}{n}} \Rightarrow n = \frac{1}{6} = 0.166$$

$$\cong 17 \times 10^{-2}$$

13. Official Ans. by NTA (2)

Sol. Gases having higher critical temperature absorb to a greater extent.

14. Official Ans. by NTA (3)

Sol. (i) Adsorption of gas at metal surface is an exothermic process so $\Delta H < 0$

(ii) As the adsorption of gas on metal surface reduces the free movement of gas molecules thus restricting its randomness hences

$\Delta S < 0$

15. Official Ans. by NTA (3)

16. Official Ans. by NTA (3)

Sol. Tyndall effect is observed in lyophobic colloids

17. Official Ans. by NTA (4)

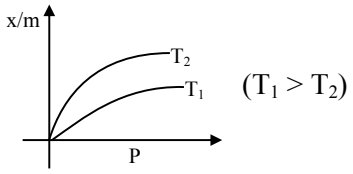
Sol. In the lyophilic colloids, the colloidal particles are extensively solvated.

18. Official Ans. by NTA (4)

Sol. $\frac{x}{m} \alpha P^{1/n} \left(0 < \frac{1}{n} < 1\right)$

On Increasing temperature $\frac{x}{m}$ decreases.

$\because$ adsorption is generally exothermic



$(T_1 > T_2)$

19. Official Ans. by NTA (128)

Sol. We know

$$\frac{x}{m} = KP^{1/n} \text{ ; using } (x \propto V)$$

$$\Rightarrow \quad \frac{10}{1} = K \times (100)^{1/n} \qquad \ldots(1)$$

$$\frac{15}{1} = K \times (200)^{1/n} \qquad \ldots(2)$$

$$\frac{V}{1} = K \times (300)^{1/n} \qquad \ldots(3)$$

Divide

(2) / (1)

$$\frac{15}{10} = 2^{1/n}$$

$$\log\left(\frac{3}{2}\right) = \frac{1}{n}\log 2$$

$$\frac{1}{n} = \frac{\log 3 - \log 2}{\log 2} = \frac{0.4771 - 0.3010}{0.3010}$$

$$\frac{1}{n} = 0.585$$

Divide

(3) / (1)

$$\frac{V}{10}=3^{1/n}$$

$$\log\left(\frac{V}{10}\right)=\frac{1}{n}\log 3$$

$$\log\left(\frac{V}{10}\right) = 0.585 \times 0.4771 = 0.2791$$

$$\frac{V}{10}=10^{0.279} \Rightarrow V = 10 \times 10^{0.279}$$

$$\Rightarrow V = 10^{1.279} = 10^{x}$$

$$\Rightarrow x = 1.279$$

$$\Rightarrow x = 128 \times 10^{-2} \text{ (Nearest integer)}$$