CBSE Test Paper-04

Class - 12 Chemistry (Surface Chemistry)

1. The substance that gets adsorbed on the surface of the solid is called
   a. Adsorbate
   b. Inner phase
   c. Adsorbent
   d. Micelle
2. The phenomenon in which adsorption and absorption takes place simultaneously is called
   a. Sorption
   b. Physiorption
   c. Desorption
   d. Chemisorption
3. When 50 mL of 1M oxalic acid is mixed with 0.5 g of wood charcoal, the final concentration of the solution after adsorption is 0.5 M. The amount of the oxalic acid adsorbed per gram of charcoal is
   a. 4.5 g
   b. 6.30 g
   c. 3.15 g
   d. 1.25 g
4. The path of light becomes visible when it is passed through As_2S_3 sol in water. (give reason)
   a. Due to Brownian movement
   b. Due to micelle formation
   c. Due to colour formation
   d. Due to Tyndall effect
5. Which adsorption takes place at low temperature?
   a. Chemical
   b. Can not say
   c. Physical
   d. Both Physical and Chemical

6. What is demulsification? Name two demulsifiers.
7. What is observed when sodium chloride is added to a colloidal solution of ferric hydroxide?
8. Are the sols of metals hydrophilic or hydrophobic?
9. What are the two types of emulsions?
10. How is dialysis carried out? Mention its one application.
11. Explain shape selective catalysis.
12. What is an adsorption isotherm? Describe Freundlich adsorption isotherm in detail.
13. Write the differences between physisorption and chemisorption with respect to the following aspects:
    i. Specificity.
    ii. Temperature dependence.
    iii. Reversibility.
    iv. Enthalpy change.
14. Explain how the phenomenon of adsorption finds application in each of the following process:
    1. Production of vaccum
    2. Haterogeneous catalysis
    3. Froth floatation process
15. What are the differences between physisorption and chemisorption?

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Solutions

1. a. Adsorbate

   Explanation: In adsorption process, the molecular species or substance, which concentrates or accumulates at the surface is termed adsorbate.

2. a. Sorption

   Explanation: Both adsorption and absorption can take place simultaneously also. The term sorption is used to describe both the processes.

3. a. 6.30 g

   Explanation: 1M oxalic acid solutions means

   1 mole of oxalic acid presents in 1000mL solution

   1 mole of oxalic acid = 126g

   i. 126g of oxalic acid = 1000mL

      how much x g? = 50 mL

      1000x= $126 \times 50 \implies$ x = $126 \times \frac{50}{1000}$ = 6.3g of oxalic acid present in 50mL

   ii. For 50mL of 1M oxalic acid = 6.3g of oxalic acid

      0.5M oxalic acid = xg?

      1x =6.3×0.5 = 3.15g

   iii. For 0.5g of Charcoal = 3.15g of oxalic acid adsorbed

      1g of charcoal = x g?

   iv. 0.5x = $3.15 \times 1 \implies$ x= $\frac{3.15}{0.5}$ = 6.3g

      So, Amount of oxalic acid adsorbed per gram of charcoal=6.3g

4. d. Due to Tyndall effect

   Explanation: This is because of tyndall effect caused by the scattering of light by colloidal particles of As_2S_3.

5. c. Physical

   Explanation: Physical adsorption is favoured at low temperature because it involves only vanderwall interactions between adsorbate and adsorbent.

6. The process of breaking of an emulsion into it's constituent liquids by heating,

freezing or centrifuging, is called as demulsification. Examples of demulsifiers are surfactants, ethylene oxide etc.

7. Coagulation takes place.

8. Sols of metals are hydrophobic.

9. The two types of emulsions are:
   a. Oil dispersed in water (o/w type)
   b. Water dispersed in oil (w/o type)

10. Dialysis is used for purification of colloidal solution. It is carried out by putting impure colloidal solution in parchment paper bag and then dipping it in distilled water.

11. A catalytic reaction which depends upon the pore structure of the catalyst and on the size of the reactant and the product molecules is called shape-selective catalysis. For example, catalysis by zeolites is a shape-selective catalysis. The pore size present in the zeolites ranges from 260-740 pm. Thus, molecules having a pore size more than this cannot enter the zeolite and undergo the reaction.

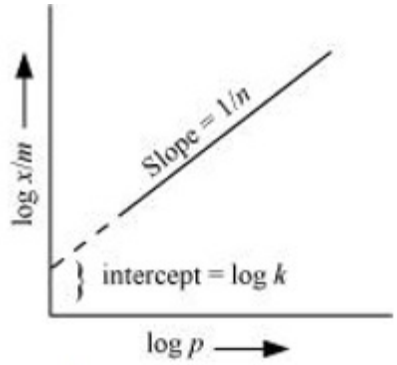
12. Adsorption isotherm:
    The plot between the extent of adsorption $\left(\frac{x}{m}\right)$ against the pressure of gas (P) at constant temperature (T) is called the adsorption isotherm.
    Freundlich adsorption isotherm:
    Freundlich adsorption isotherm gives an empirical relationship between the quantity of gas adsorbed by the unit mass of solid adsorbent and pressure at a specific temperature.
    From the given plot it is clear that at pressure P_s, $\left(\frac{x}{m}\right)$ reaches the maximum valve.
    P_s is called the saturation pressure. Three cases arise from the graph now.
    Case I- At low pressure:
    The plot is straight and sloping, indicating that the pressure in directly proportional to $\left(\frac{x}{m}\right)$ i.e., $\frac{x}{m} \alpha P$
    $\frac{x}{m} = kP$ (k is constant)
    Case II- At high pressure:

When pressure exceeds the saturated pressure, $\left(\frac{x}{m}\right)$ becomes independent of P values.

$\frac{x}{m} \alpha P^{\circ}$ $\frac{x}{m} kP^{\circ}$

Case III- At intermediate pressure:

At intermediate pressure, $\left(\frac{x}{m}\right)$ depends on P raised to the powers between 0 and 1. This relationship is known as the Freundlich adsorption isotherm.



$\frac{x}{m} \alpha P^{\frac{1}{n}}$

$\frac{x}{m} kP^{\frac{1}{n}} \quad n > 1$

Now, taking log:

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

On plotting the graph between log $\left(\frac{x}{m}\right)$ and log P, a straight line is obtained with the slope equal to $\frac{1}{n}$ and the intercept equal to log k.

13.

	Physisorption	**Chemisorption**
(i) Specificity	It is not very specific.	It is highly specific in nature.
(ii) Temperature dependence	It usually takes place at low temperature and decreases with increasing temperature.	It takes place at high temperature.
(iii) Reversibility	It is reversible.	It is irreversible.
(iv) Enthalpy change	Low enthalpy of adsorption (20-40 kJ mol^{-1}).	High enthalpy of adsorption (80-240 kJ mol^{-1}).

14. 1. Production of vacuum: In the production of vacuum, firstly container is exhausted by an ordinary exhaust pump. Remaining gases can be removed by charcoal.
    2. Heterogeneous catalysis: When the catalyst forms a separate phase (usually a solid phase), from reactants it is said to be heterogeneous catalysis. In a heterogeneous catalysis, initially reactants gets adsorb on the catalyst surface and then reaction happens.
    3. Froth floatation process: The principle of froth floatation process is that sulphide ores are preferentially wetted by (adsorbed on) the pine oil and frothing agent whereas the gangue particles are wetted by the water.

15.
- **Physisorption**
    1. It is due weak Van der Waals forces.
    2. It is reversible in nature.
    3. Enthalpy of adsorption is low (20 - 40 K J mol^{-1}) in this case.
    4. It increases with the increase in pressure.
    5. It is not specific in nature.
    6. It decreases with increase of temperature
    7. It results into multimolecular layers on adsorbent surface under high pressure.
- **Chemisorption**
    1. It takes place due to the formation of chemical bond with the adsorbent.
    2. It is irreversible.
    3. Enthalpy of adsorption is high (40 - 400 KJ mol^{-1}) in this case.
    4. It first increases and then becomes independent of pressure.
    5. It is highly specific in nature.
    6. It increases with increase of temperature
    7. It results into unimolecular layer.