Chemistry Worksheets Class 12 on Chapter 5 Surface Chemistry with Answers - Set 4

Q1. Choose an example of homogeneous catalysis.

a.) Ostwald's process
b.) Lead chamber process
c.) Haber's process
d.) Contact process

Correct Answer– (a.) Ostwald's process.

Q2. Which of the following statement is incorrect?

a.) Enzymes are in colloidal state
b.) Enzymes are catalysts
c.) Enzymes can catalyze any reaction
d.) Urease is an enzyme

Correct Answer– (c.) Enzymes can catalyze any reaction

Q3. The magnitude of ___ decreases in the presence of a catalyst.

a.) activation energy
b.) dissociation energy
c.) energy barrier
d.) intermolecular forces

Correct Answer– (c.) energy barrier

Q4. Rate of physisorption increases with:

a.) decrease in temperature
b.) increase in temperature
c.) decrease in pressure
d.) decrease in surface area

Correct Answer– (a.) decrease in temperature

Q5. Which type of metals form effective catalysts?

a.) Alkali metals
b.) Transition metals
c.) Alkaline earth metals
d.) Radioactive metals

Correct Answer– (b.) Transition metals

Q6. Why zeolites are good shape-selective catalysts?

Answer. The honey comb like structure of the zeolites makes them good shape-selective catalysts as only those reactants and products will be adsorbed on the zeolite which have a size smaller than the pore size of zeolite and has a structure similar to the pore of zeolite.

Q7. Define catalysis

Answer. Catalysis is the process of speeding up a chemical reaction by using a catalyst.
Since the catalyst serves as both a reactant and a product in the reaction, it is not consumed.
Catalysis works by lowering the reaction's activation energy, making it more thermodynamically favourable. Catalysis is important because catalysts are used in the production of approximately 90% of commercial chemicals.

Q8. What are the two steps to proceed with the enzyme catalysed reactions?

Answer. The enzyme - catalysed reactions may be considered to proceed in two steps.
Step 1 : Binding of substrate to enzyme to form an activated complex ($ES^{\neq}$).
$E+S \rightarrow ES^{\neq}$
Step 2 : Decomposition.of the activated complex to form product.
$ES^{\neq} \rightarrow E+P$

Q9. What are associated colloids? Give an example.

Answer. Associated colloids are substances that, when dissolved in a medium, behave as a normal, strong electrolyte at low concentrations but exhibit colloidal state properties at higher concentrations due to the formation of aggregated particles. For example: Micelles formation in soaps and detergents.

Q10. What is the activation of an adsorbent? How can it be achieved?

Answer. Activation of adsorbent means, increasing the adsorbing power of an adsorbent. This can be one by increasing the surface area of. the adsorbent, which can be achieved in. any of.the following ways :
(i) By removing the gases adsorbed i.e., wood charcoal can be activated by heating it between 650 K and 1330 K in the vacuum or in superheated steam.
(ii) By breaking the adsorbent into small pieces.

(iii) By making the surface of adsorbent rough.

Q11. Give the general methods of preparation of lyophilic colloids and lyophobic colloids.

Answer.

- The lyophilic colloids have a strong affinity between particles of the dispersed phase and dispersed medium. Therefore, these colloidal solutions are readily formed by simply mixing the dispersed phase and dispersion medium under ordinary conditions.
  For example, substances like gelatin, gum, starch, etc., pass readily into the water to give a colloidal solution. They are reversible in nature because they can be precipitated and directly converted into a colloidal state.
- Preparation of lyophobic Colloids-
  Lyophobic sols can be prepared by mainly two methods-
  - Condensation methods
  - Dispersion methods.

Q12. How do the size of particles of adsorbent, pressure of gas and prevailing temperature influences the extent of adsorption?

Answer. (i) Smaller the size of the particles of adsorbent, greater is the surface area and hence greater is the adsorption.
(ii) At constant temperature, adsorption first increases with increase of pressure and then attains equilibrium at high pressure and becomes constant.
(iii) In physical adsorption, it decreases with increase of temperature but in chemisorption, it first increases, becomes maximum and then decreases.

Q13. Classify colloids where the dispersion medium is water. State their characteristics and write an example of each of these classes.

Answer. When the dispersion medium is water, colloids are classified into two types. They are as follows:
(i) Hydrophilic or Lyophilic colloids: Hydrophilic colloids are those substances that, when mixed with the dispersion medium, form a colloidal solution directly. They are reversible, stable solutions that cannot be easily precipitated.
Example: gum, gelatine, starch, rubber etc.

(ii) Hydrophobic or Lyophobic colloids: Hydrophobic colloids are substances that do not form a colloidal solution when simply mixed with the dispersion medium. They are irreversible, unstable, and easily precipitated solutions. Example: Metals and their sulphides.

Q14. What is an adsorption isotherm? Describe Freundlich adsorption isotherm?

Answer. The variation of the mass of the gas (adsorbate) adsorbed per g of adsorbent with pressure at constant temperature is known as the adsorption isotherm.

At a given temperature, the Freundlich adsorption isotherm is the mathematical representation of the variation of the extent of adsorption (x/m) with pressure (P). Here, x represents the mass of adsorbate and m represents the mass of adsorbent.

The expression is $\frac{x}{m} = k \times P^{\frac{1}{n}}$

Q15. Describe some features of catalysis by Zeolites.

Answer. Features of catalysis of Zeolites are:
(i) Zeolites are hydrated alumino silicates which have a three dimensional network structure containing water molecules in their pores.
(ii) To use them as catalysts, they are heated so that water of hydration present in the pores is lost and the pores become vacant.
(iii) The size of the pores varies from 260 to 740 pm. Thus, only those molecules can be adsorbed in these pores and catalyzed whose size is small enough to enter these pores. Hence, they act as molecular sieves or shape selective catalysts.

An important catalyst used in petroleum industries is ZSM-5. It converts alcohols into petrol by first dehydrating them to form a mixture of hydrocarbons.

$$Alcohols \xrightarrow[Dehydration]{ZSM-5} Hydrocarbons$$

Q16. Define each of the following terms :
(i) Micelles
(ii) Peptization
(iii) Desorption

Answer. (i) Micelles: Substances that, when dissolved in a medium, behave as normal, strong electrolytes at low concentrations but, at higher concentrations, exhibit colloidal state properties due to the formation of aggregated particles, and these aggregated particles are referred to as micelles.
(ii) Peptization: This is the process of converting a fresh precipitate into colloidal particles by shaking it in the presence of a small amount of a suitable electrolyte with the dispersion medium.
(iii) Desorption: Desorption is the removal of an adsorbed substance from the surface of a solid or liquid by heating or decreasing pressure.

Q17. What are the characteristics of the enzyme catalysts?

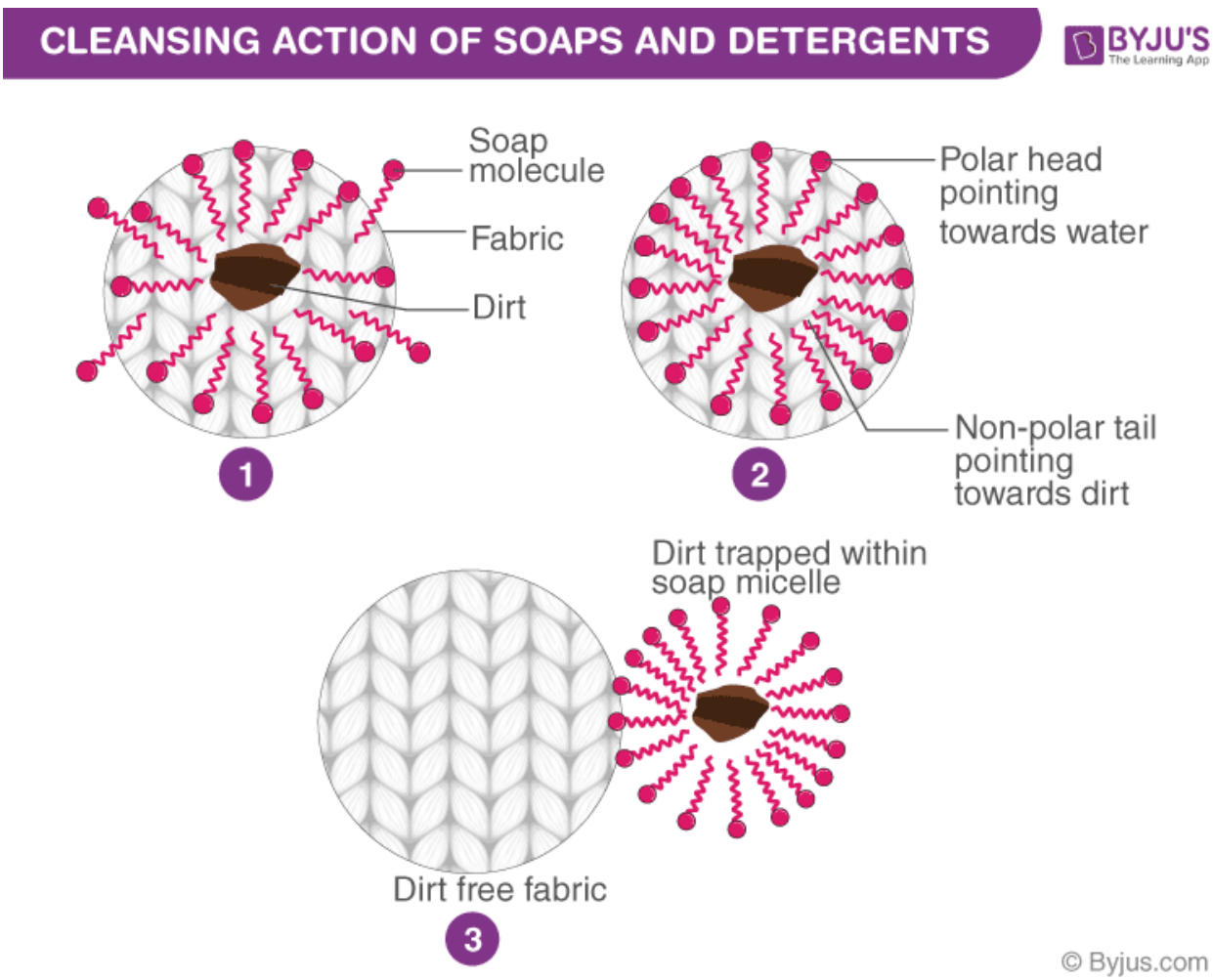
Answer. Characteristics of enzyme catalysis

(1) They are extremely efficient in catalysis. An enzyme molecule can convert molecules of reactants per minute.
(2) They are highly specific in nature, for example, urease only catalyses the hydrolysis of urea.
(3) They work best at room temperature. The rate of enzyme catalysed reaction decreases with increasing temperature, implying that hot milk does not easily transform into cure.
(4) They are most active at a specific pH level known as optimum pH. In acidic pH, the amylase becomes inactive.
(5) In the presence of coenzymes, which are known as promoters, enzymatic activity can be increased. Metal ions are common activators. Many drugs are used because they act as enzyme inhibitors in the body.

Q18. Explain the mechanism of micelle formation.

Answer. Micelles are generally formed by the aggregation of several ions or molecules with lyophobic as well as lyophilic parts. Such molecules are called surface active molecules.
For example- Sodium stearate is a typical example of such type of molecule.
In soap, the hydrocarbon chain $C_{17}H_{35}COONa$ is lyophilic or hydrophilic, whereas -COONa is lyophilic or hydrophilic. The hydrocarbon tails are in the micelle's interior, and COO^- ions are on the surface. The grease stain gets absorbed into the micelle's interior, where it behaved like a liquid hydrocarbon. The dirt particles stuck to the strain are removed as the strain is detached from the fabric.

Soap molecule



Q19. How colloidal solutions can be purified?

Answer. Some of the methods of purification of a colloidal solution are stated below:

- Dialysis:

The process in which the ions are removed from the solution by the phenomenon of diffusion through a permeable membrane is known as dialysis. In this process, a sol consisting of ions or molecules is filled in a permeable membrane bag, and dipped in the water. The ion from the solution diffuses through the permeable membrane. Because of the continuous flow of water, the concentration of electrolytes outside the membrane is neutralized. For e.g.: Ferric hydroxide sol is purified by using this method.

- Electrodialysis:

In this process dialysis of the colloidal solution is carried out under the effect of the electric field. Some potential is applied between the metal screens that support the membranes. Due to this potential, the speed of the ions moving in the direction of opposite electrodes is increased. Thus, the rate of dialysis is increased. This method is not useful for the non-electrolyte impurities like urea etc.

- Ultrafiltration:

If filter paper is made with the colloidal or some regenerated cellulose like cellophane, the size of the pores is decreased. This modified form of filter paper is known as ultrafilter. The process in which the particles of the solution are removed from the liquid medium by electrolysis and by using this ultrafilter is known as ultrafiltration. It is a slow process. To speed up the process some external gas pressure has to be applied.

- Electro Decantation:

This method can be useful for the purification as well as for the concentration of the sol. When this process is carried out without stirring the solution, then the bottom layer settles down while the top layer consists of pure and concentrated colloids, which can be decantated.

Q20. What role does adsorption play in heterogeneous catalysis?

Answer. Gaseous reactants and solid catalysts are typically used in heterogeneous catalysis. The reactant molecules are adsorbed on the surface of the solid catalyst due to physisorption or chemisorption. This increases the concentration of reactant on the catalyst surface as well as the rate of the reaction.

One of the reactant molecules fragments on the catalyst surface, forming active sites that speed up the reaction. Product molecules that have no affinity for the adsorbent desorb, and the catalyst surface becomes available for the adsorption of other catalyst molecules. This is consistent with the adsorption theory.