Chemistry-STD-XII Science

Question Bank with Solution

Surface Chemistry

Adsorption

Question 1

What is meant by (i) peptide linkage (ii) biocatalysts?

Ans.

(i) Peptide linkage- It is an amide bond formed between –COOH group and $-NH_2$ group and results into formation of peptide bond –CO-NH-

(ii) Biocatalysts- A substance, especially an enzyme that initiates or modifies the rate of a chemical reaction in a living body is known as a biocatalyst or a biochemical catalyst.

Question 2

Name the two groups into which phenomenon of catalysis can be divided. Given an example of each group with the chemical equation involved.

Ans.

Catalysis can be divided in two types:

1. Homogeneous catalysis

   Ex:

   $$2SO_2(g)+O_2(g)\longrightarrow NO(g)+2SO_3(g)$$

2. Heterogeneous catalysis

   Ex:

   $$2SO_2(g)\xrightarrow{Pt(s)}2SO_3(g)$$

Question 3

List conditions optimum for enzymatic reactions.

Ans.

Conditions optimum for enzymatic reactions are:

1. Salt Concentration: More effective in dilute solutions.
2. Effects of Temperature:

The optimum temperature for human enzymes is between 35 and 40^{o}C.

3. Effects of pH: Most enzymes function between a pH of 6 and 8.

Question 4

What are co-enzymes and activators?

Ans.

Coenzymes are small non protein (vitamin) which enhances the activity of the enzyme considerably. Activators are generally metal ions such as etc. These metal ions, when weakly bonded to enzyme molecules, increase their catalytic activity. Amylase in presence of sodium chloride i.e., Na^+ ions are catalytically very active.

Question 5

Explain mechanism of enzymatic reaction.

Ans.

The mechanism is like a key fits into the lock and the active site of the enzyme fits into the substrate after which the enzyme separates and the substrate breaks into product.

Steps1: Binding of enzyme to substrate to form activated complex.

$E + S \longrightarrow ES^*$

Step2: Decomposition of activated complex to form product.

$ES^* \longrightarrow E + P$

Question 6

Describe some of the important features of catalysts.

Ans.

Important features of catalysts are

1. Activity means that the reactant adsorbs catalyst on its surface to increase probability of effective collision. For example, platinum is used in the manufacture of nitric acid (HNO_3).
2. Selectivity indicates that the same reactant can give different product if the catalyst is different.

(i) $CO+3H_2 \longrightarrow CH_4 + H_2O(Ni)$

(ii) $CO+H_2 \longrightarrow HCHO(Cu)$

(iii) $CO+2H_2 \longrightarrow CH_3OH$ ($Cu/ZnO-Cr_2O_3$)

3. Shape selective Catalysts are effects only those reaction which depend upon the pore structure of the catalyst and size of the reactant, the process is called shape selective catalysis. e.g. zeolite.

Question 7

Classify catalysis and give one example each.

Ans.

Catalysis can be broadly divided into two types;

(i) Heterogeneous catalysis. Example hydrogenation of oil to ghee.

Vegetable oils(l) + $H_2(g) \longrightarrow$ Vegetable ghee(s)

(ii) Homogeneous catalysis. Example Hydrolysis of ester in presence of acid.

$CH_3COOCH_3(l) + H_2O(l) \longrightarrow CH_3COOH(aq) + CH_3OH(aq)$

Question 8

How does a catalyst alter the rate of reaction?

Ans.

Catalyst alters the rate of a reaction by the Adsorption and sorption. The probability of effective collision increases once the reactant is adsorbed on the surface and then desorps as product Catalyst forms a activated complex with the reactant which is at a lower energy level and provides an alternate path with lesser energy barrier.

Question 9

What is the difference between catalyst and catalysis?

Ans.

A catalyst is defined as a substance, which accelerates the rate of a chemical reaction and is itself unchanged and not consumed in the overall reaction. Catalysis is the phenomenon of altering the rate of a reaction with the help of a catalyst.

Question 10

Why is platinum used in combustion of hydrocarbons and the reactions that occur in the treatment of vehicle exhaust?

Ans.

Platinum is especially good for reactions where selectivity is not so important, e.g. in the catalytic combustion of hydrocarbons and the reactions that occur in the treatment of vehicle exhaust.

Question 11

List the criteria for metals to act as catalyst.

Ans.

A number of criteria are required to be met before a metal can be selected as a 'good' catalyst for any reaction.

The three most important are:

(i) its activity, that is the speed with which it makes the reaction go,

(ii) its selectivity, that is, the extent to which it produces the desired product rather than any others, and

(iii) its active life, that is, how long it can be used before it becomes deactivated by poisons, or loses its mechanical stability.

Question 12

Give characteristic of a good catalyst.

Ans.
The characteristics of a good catalyst can be summarised as follows:
(a) It must be able to chemisorb the reactants sufficiently strongly to cover the entire surface, but not so strongly that it is difficult to persuade them to react.
(b) They must also be chemisorbed in the right form, that is, in the way that encourages them to make only the desired product.

Emulsions

Question 1
What is an emulsion?
Ans.
Emulsion is a colloid in which the dispersed phase and dispersion medium are liquids. If a mixture of two immiscible or partially miscible liquids is shaken, a coarse dispersion of one liquid in the other is obtained which is called emulsion.

Question 2
Give two examples of man made colloids and natural colloids.
Ans.
Man made; Paint and ink
Natural colloid; Milk and clouds.

Question 3
Explain a sol & gel and how they can be inter converted.
Ans.
A sol is a dispersion of very thin solid particles in a liquid. It has a liquid consistency and resembles a true solution. These particles are very small, but they are still enough large to obstruct the light and diffuse it. Examples honey and glue.
A gel is a colloidal solution in which a liquid is dispersed in a solid. it has gelatinous consistency Examples like jellies and jams.
By increasing the concentration of the particles, a sol can be pass to the state of gel. On the contrary, by diluting a gel, a sol is obtain.

Question 4
What kind of colloid is fog?
Ans.
Fog is an aerosol. Aerosols are colloidal solutions in which liquids are dispersed in a gas. In case of fog, tiny particles of water are suspended in the air These occur naturally, as well as originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels and the alteration of natural surface cover, also generate aerosols.

Question 5
Write short on stability of emulsions.
Ans.

Emulsions are generally prepared by vigorously shaking two liquids. Since the two liquids do not mix well, the emulsion is generally unstable and the two liquids may separate out on standing for sometime. Therefore to form stable emulsions small quantities of certain other substances are added during their preparation. The substances which are added to stabilize the emulsions are called emulsifier or emulsifying agent. The substance that are commonly used as emulsifying agent are gum, soap of different forms, gelatin, albumin etc.

Question 6
Give a test to distinguish between two types of emulsions.
Ans.
The following test can distinguish between Oil/Water and Water/Oil
Dye test: On addition oil soluble dye to the colloid, background will be colored in Water/Oil emulsion and droplets will be colored in Oil/Water emulsion.
DilutionTest: Diluted with water, water forms a separate layer in Oil/Water emulsion.

Question 7
Classify emulsions and give example of each kind.
Ans.
Process of preparing emulsions is called Emulsification. E.g.: proteins, gum, Emulsions are classified as:
Oil/Water: Phase (oil) medium(water) e.g. milk(fat + water), vanishing cream (oil + water).
Water/Oil: Phase (water) medium (oil) e.g. butter, cold cream, cod liver oil.

Question 8
What type of colloidal system foam is? Give example.
Ans.
Foam is a dispersion of a gas in a liquid (liquid foams) Examples froth, whipped cream, soap lather.

Question 9
What is the environmental importance of aerosols?
Ans.
Aerosols tend to cause cooling of the Earth's surface them. Because most aerosols reflect sunlight back into space. They have a "direct" cooling effect by reducing the amount of solar radiation that reaches the surface. Indeed, if there were no aerosols in the atmosphere, there would be no clouds.

Question 10
What do you mean by (a) alcosol (b) hydrosol?
Ans.
A sol is a dispersion of very thin solid particles in a liquid. If the liquid is alcohol it is called alcosol and if the liquid is water it is called hydrosol or aquasol.

What do you mean by emulsion and emulsification?
Ans.
An emulsion is a dispersion of an insoluble liquid in another liquid. Process of preparing emulsions is called Emulsification.

Types of Colloids

Question 1
What is the difference between multimolecular and macromolecular colloids? Give one example of each type. How are associated colloids different from these two types of colloids?

Ans.

Multimolecular colloids	Macromolecular colloids
On dissolution, a large number of atoms or smaller molecules of a substance aggregate together to form species having size in the colloidal range (diameter<1nm). The species thus formed are called multimolecular colloids.	Macromolecules in suitable solvents form solutions in which the size of the macromolecules may be in the colloidal range. Such systems are called macromolecular colloids.
Example: gold sol / sulphur sol (Any one)	Example: starch, cellulose, proteins, enzymes, polythene, nylon, polystyrene, synthetic rubber (Any one)

Some substances at low concentrations behave as normal strong electrolytes, but at higher concentrations exhibit colloidal behaviour due to the formation of aggregates. The aggregated particles thus formed are calledassociated colloids or micelles. The formation of micelles takes place only above a particular temperature calledKraft temperature and above a particular concentration called critical micelle concentration. On dilution, these colloids revert back to individual ions.

Question 2
Explain the following terms giving one example for each:
(i) Miscelles

(ii) Aerosol

Ans.

(i) A micelle is an aggregate of surfactant molecules dispersed in a liquid colloid. A micelle in aqueous solution forms an aggregate with the hydrophilic head regions in contact with surrounding solvent and the non-polar tails of the molecules clump into the center of

the micelle. For example: Soap solution. It is a sodium or potassium salt of fatty acids. When dissolved in water, it dissociates into $RCOO^-$ and Na^+ ions. The $RCOO^-$ ions are present on the surface with their COO^- groups in water and the hydrocarbon chains R remain at surface.

(ii) Aerosols are colloids in which the dispersed phase is solid and the dispersed medium is gas. For example: Smoke is a colloidal solution of solid particles such as carbon, arsenic compounds etc, in air.

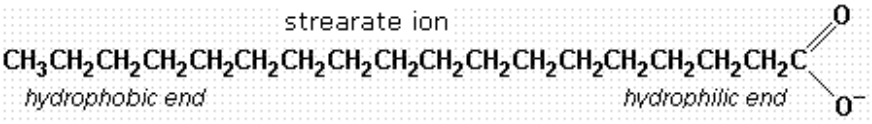
Question 3

What is a micelle? Explain formation of associate or aggregate colloid.

Ans.

When molecules or ions that have both a hydrophobic and a hydrophilic end are dispersed in water, they associate, or aggregate, to form colloidal-sized particles, or micelles. A micelle is a colloidal-sized particle formed in water by the association of molecules or ions that each has a hydrophobic end and a hydrophilic end. The hydrophobic ends point inward toward one another and the hydrophilic ends are on the outside of the micelle facing the water. A colloid in which the dispersed phase consists of micelles is called an association colloid.

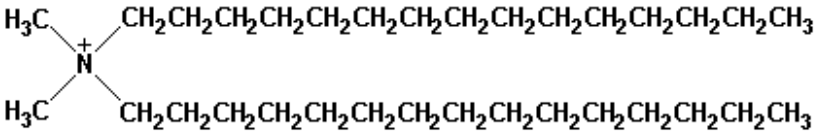
Example - ordinary soap in water which consists of compounds such as sodium stearate, $C_{17}H_{35}COONa$. The stearate ion has a long hydrocarbon end that is hydrophobic (because it is nonpolar) and a carboxyl group (COO^-) at the other end that is hydrophilic (because it is ionic).



Soap and sodium laurylsulfate (synthetic detergent present in toothpastes and shampoos):

$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2OSO_3^-Na^+$
sodium laurylsulfate

are examples of "anionic" - they have a negative charge at the hydrophilic end. Other detergent molecules are "cationic," because they have a positive charge at the hydrophilic end:



Many cationic detergents also have germicidal properties and are used in hospital disinfectants and in mouthwashes.

Question 4

What is peptization? Explain with example.

Ans.

Peptization: Peptization may be defined as the process of converting a precipitate into colloidal sol by shaking it with dispersion medium with a small amount of electrolyte. The electrolyte

used for this purpose is called peptizing agent. when ferric chloride is added to ferric hydroxide precipitate, the precipitate of hydroxide changes to sol by adsorbing ferric ions. Fe^{3+} is absorbed on $Fe(OH)_3$ and breaks into colloids.

Question 5

Describe any two methods of purifying colloids.

Ans.

Dialysis is a process in which colloid is placed inside a bag of semi permeable membrane like cellophane or parchment paper which permits ions and not colloids to pass through. The process becomes faster if it is done in electrical field and is called electro dialysis.

Ultrafiltration is a process in which a special pore size filter paper is made by coating normal filter paper with the colloidal particles and is called ultra filters .Filtration can be accelerated by pressure or suction.

Question 6

Why should colloids need purification?

Ans.

If colloids are not separated from impurities the colloids will be unstable. Ionic impurities precipitate the colloid and so it is important to purify colloids.

Question 7

Write short on dispersion methods of preparation of colloids.

Ans.

There are three dispersion methods:

1. Mechanical dispersion - Suspension dimension are grinded in colloidal mill or ultrasonic disintegrator to colloidal dimensions.
2. Electrical disintegration- Metal sols are prep by making electrode of the metal and immersed in dispersion medium and a electric arc is struck(involves dispersion plus condensation).
3. Peptization- Precipitate is converted into colloids sol by shaking in dispersion medium with an electrolyte called peptizing agent. e.g. $Fe(OH)_3$ ppt + $FeCl_3$. Fe^{+++} is absorbed on $Fe(OH)_3$ and breaks into colloids.

Question 8

Explain preparation of sulphur sol and gold sol.

Ans.

Sulphur sol and gold sol are Lyophobic sols and are unstable and are build to colloidal size from small particles by the Condensation method by Chemical reactions.

Oxidation sulphur sol is prepared by passing H_2S into SO_2

1. $H_2S + SO_2 \rightarrow S\ (sol) + H_2O$
2. Reduction of $AuCl_3$ with formaldehyde gives gold sol.
   $AuCl_3 + HCHO + 3H_2O \rightarrow Au\ (sol) + 3HCOOH + 6HCl$

Question 9
Classify colloids based on depending on the size of phase.
Ans.
Colloids are classified into three types depending on the size of phase.
Multimolecular colloids: If the particle size is less than 1nm and the particles they aggregate together and form colloid size ranging between 1nm to 1000nm. Example goldsol, sulphur sol.
Macromolecular colloids: If the particle size is in between 1nm to 1000nm, generally represented by polymers for example natural starch, cellulose, proteins, enzymes, man made polythene, nylon, polystyrene. They are stable and resemble true solutions.
Associated colloids: Such colloids are formed some times in high concentration, particles aggregate to form micelles it happens above $T_k$called kraft temperature and critical micelle concentration (CMC) and if the concentration is low it forms true solution.

Question 10
Name polymers which are lyophilic colloids.
Ans.
Polymers such as starch have hydrophilic and hydrophobic segments and form sols on vigorous stirring. Polymers can also form gels, such as gelatin, as a solid suspension. Entangled polymer chains trap solvent and form gels.

Question 11
Salad dressing is a common emulsion between oil and water. How is this emulsion formed?
Ans.
Oil in water with vinegar for salad dressing is a common emulsion. However, this is not a stable colloidal system. Usually, salad dressings must be shaken vigorously to redisperse the oil before pouring. The kinetic energy of shaking breaks up the oil into small droplets. But the oil quickly separates again, aggregating into a large, hydrophobic phase. This is called coalescence for droplets since they not only attach but also merge into a single, larger drop. The interfacial tension between oil and water is very high; in other words, they do not mix easily. The acetic acid in vinegar can act as a surfactant, but a much better one is needed to reduce the oil—water interfacial tension enough for stable emulsion formation.

Question 12
Classify colloids on basis of interaction between phase and medium.
Ans.
Lyophillic colloids are medium loving e.g. gum, starch, rubber and are reversible. If the medium in the colloid is water the colloid is called aqua sol/hydrosol and if the medium is alcohol it is called alcosol. Hydrophilic sols are stable can be prepared by shaking with medium that is water like gum, gelatin, starch, egg, albumen etc.
Lyophobic colloids are medium hating i.e. they cannot be converted into colloid easily they require an external agent to convert into colloid e.g. metal sulphides aluminium hydroxide and lyophobic colloids are irreversible.

Properties of Colloids

Question 1
Define 'electrophoresis'
Ans.
Electrophoresis is the phenomenon of movement of colloidal particles under the applied electric potential.

Question 2
Explain how the phenomenon of adsorption finds applications in each of the following processes:

(i) Production of high vacuum
(ii) Heterogeneous catalysis
(iii) Froth floatation process
OR
(i) Micelles
(ii) Peptization
(iii) Desorption

Ans.

(i) Production of high vacuum: Traces of air can be adsorbed by charcoal from a vessel, evacuated by a vacuum pump to give a very high vacuum.

(ii) Heterogeneous catalysis: The gaseous reactants are adsorbed on the surface of the solid catalysts. As a result, the concentration of the reactants increases on the surface and hence the rate of the reaction increases.

(iii) Froth floatation process: This process is used to remove gangue from sulphide ores. The basic principle involved in this process is adsorption.
In this process, a mixture of water pine oil is taken in tank. The impure powdered sulphide ore is dropped in through hopper and the compressed air is blown in through the agitator is rotator is rotated several times. As a result, froth is formed and the sulphide ores get adsorbed in the froth. The impurities settled down and are let out through an outlet at the bottom. The froth formed is collected in froth collector tank. After sometime, the ore particles in the froth collecting tank start settling gradually, which are then used for further metallurgical operations.
OR

(i) A micelle is an aggregate of surfactant molecules dispersed in a liquid. A micelle in aqueous solution forms as aggregate such that the hydrophilic "head" regions are in the centre of micelle.

(ii) Peptization is the process of conversion of a precipitate into a colloidal sol by shaking it with the dispersion medium in the presence of an electrolyte. The electrolyte used in this reaction is known as a peptizing agent.

(iii) Desorption is the process of removing an adsorbed substance from the surface through which it was adsorbed.

Question 3
How is cream separated from milk which is an emulsion.
Ans.
Suspended cream can be separated by centrifugation or ultracentrifugation.
Ultra centrifugation is a process in which rotation at high speed makes the colloid separates out from the medium.

Question 4
What is the process involved when impurities are precipitated from water on addition of alum.
Ans.
The process involved when impurities are precipitated from water on addition of alum is coagulation The role of alum in this process is that it coagulates particles present as impurities and deposits on the suspended clay particles in water. In this way water gets 'loaded' with alum and becomes heavy and settles down at the bottom.

Question 5
What is indicated if black smoke is coming out of a chimney in a factory?
Ans.
In chimneys we have electrodes in which high voltage is passed and the colloidal particles precipitate depending on the charge and smoke becomes white if suspended particles precipitate and the process is called electrophoresis. In case the Cottrell precipitators is not functional than the smoke that passes through the chimney is black.

Question 6
Which property of colloid is used in making of rubber gloves?
Ans.
Electrophoresis- In this colloidal particles move towards an electrode, when they are subjected to an electrical field. Rubber colloid is a negative colloid so the anode is made in shape of a hand during electrophoresis.

Question 7
Compare the colligative properties of colloids and true solutions.
Ans.
Colligative properties: Colloidal particles being bigger aggregates, the number of particles in a colloidal solution is comparatively small as compared to a true solution. Hence, the values of colligative properties (osmotic pressure, lowering in vapour pressure, depression in freezing point and elevation in boiling point) are of small order as compared to values shown by true solutions at same concentrations.

Question 8
Give an application of colloid formation in metallurgy.
Ans.

In metallurgical operations colloid is formed in concentration of ores by froth floatation. Sulphide ores are concentrated by adding pine oil and froth is formed between the ore and oil and floats on the surface.

Question 9
State Hardy Schulz law.
Ans.
Hardy Schulze law: Ions carrying opposite charge are effective in coagulation of solution and the coagulating power is directly proportional to the valency of the ion. For negative colloid (As_2S_3sol) the order of precipitation will be as follows $Fe^{3+} > Ba^{2+} > Na^+$ ions. For positive colloid the order of precipitation will be as follows ($Fe(OH)_3$) $PO_4^{3-} > SO_4^{2-} > Cl^-$.

Question 10
What is Brownian movement and why it is called so?
Ans.
Brownian movement is the continuous zig-zag motion of particles all over the field of view. when seen under ultra microscope. This motion was first observed by the British botanist, Robert Brown, and so known as Brownian movement

Question 11
Which effect is used to distinguish between solutions and colloids. Explain it.
Ans.
Tyndall effect is used for differentiating between true solution and colloidal system. Tyndall effect is scattering of light when a ray of light is passed through colloidal system forming a tyndall cone.

Question 12
What is the difference between flocculation and coagulation?
Ans.
Aggregation of colloidal particles into insoluble precipitate by addition of some suitable electrolyte is called coagulation or flocculation coagulation value: Minimum amount (in mill moles) of electrolyte required to cause complete coagulation in one liter colloidal solution in two hours is called precipitation or coagulation value.

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