Short Answer Questions-II

Short Answer Questions-II (PYQ)

Q.1. Define adsorption with an example. Why is adsorption exothermic in nature? Write the types of adsorption based on the nature of forces between adsorbate and adsorbent. [CBSE Ajmer 2015]

Ans. The accumulation of the molecular species at the surface rather than in the bulk of a solid or liquid is known as adsorption. For example, water vapour are adsorbed by silica gel.

When a gas is adsorbed on the surface of a solid its entropy decreases, *i.e*., D*S* becomes –ve. Since adsorption is a spontaneous process, therefore, D*G* (= D*H* – *T*D*S*) must be negative. As – *T*D*S* is +ve, D*G*can be negative only if D*H* has sufficiently high –ve value. Hence, adsorption is exothermic in nature.

There are two types of adsorption based on the nature of forces between adsorbate and adsorbent.

- **i.** Physical adsorption, when accumulation of gas on the surface of a solid occurs due to weak van der Waal forces.
- **ii.** Chemical adsorption, when the gas molecules or atoms are held to the surface of solid by chemical bonds.

Q.2. Answer the following questions.

Q. Production of vacuum

Ans. Production of Vacuum: Adsorption can be successfully applied to create conditions of high vacuum. For this, a bulb of charcoal cooled in liquid air, is connected to vessel which has already been exhausted as far as possible by vacuum pump. The remaining traces of air inspite of low pressure are adsorbed by the charcoal almost completely

Q. Heterogeneous catalysis

Ans. Heterogeneous Catalysis: There are many gaseous reactions of industrial importance involving solid catalyst. Manufacture of ammonia using iron as a catalyst, manufacture of H_2SO_4 by contact process using V_2O_5catalyst and use of finely divided nickel in the hydrogenation of vegetable oils are the excellent examples. The gaseous reactants are adsorbed on the surface of the solid catalyst. As a result, the

concentration of the reactants increases on the surface of the catalyst and hence the rate of reaction increases.

Q. Froth Floatation process

[*CBSE Delhi 2011; (F) 2011*]

Ans. Froth Floatation Process: In froth floatation process, the powdered ore is mixed with water. It is then mixed with pine oil (a frother). The oil particles are adsorbed on the surface of ore particles. Now a stream of air is blown through the mixture from below when froth is formed at the water surface. The ore particles stick to the bubbles of the air rises to surface along with the foam while the gangue particles which are wetted by water settle at the bottom. The foam is separated out and is collected and in the course, the ore particles also settle down.

Q.3. Classify colloids where the dispersion medium is water. State their characteristics and write an example of each of these classes.

[*CBSE (AI) 2011; (F) 2012*]

Ans. These are of two types:

i. **HydrophilicStability:** More stable as the stability is due to charge and water envelope surrounding the sol particles. **Nature:** Reversible **Examples:** Starch, gum, etc.
ii. **HydrophobicStability:** Less stable as the stability is due to charge only. **Nature:** Irreversible **Examples:** Metal hydroxide like $Fe(OH)_3$ and metal sulphide like As_2S_3.

Q.4. Define the following terms:

Q. Homogeneous catalysis

Ans. In a catalysis process if the catalyst and the reactants are in the same phase (liquid or gas), the process is said to be homogeneous catalysis. For example, oxidation of SO_2 to SO_3 with O_2 in the presence of NO as a catalyst.

$$2\,SO_2\,(g) \;+\; O_2(g) \xrightarrow{NO\ (g)} 2\,SO_3\,(g)$$

Q. Coagulation

Ans. The process of settling of colloidal particles forming a precipitate is called coagulation.

Q. Macromolecular colloids

Ans. Macromolecules in a suitable solvent form solutions in which the size of the macromolecules may be in colloidal range. Such colloids are called macromolecular colloids. These colloids are quite stable and resemble true solutions in many respect, *e.g.*, starch dispersed in water.

Q.5. Answer the following questions.

Q. Differentiate between adsorption and absorption.

Ans.

S.No.	Adsorption	Absorption
(*i*)	It is a surface phenomenon. Adsorbate molecules are held at the surface of adsorbent.	Absorption occurs in the bulk of absorbing substance.
(*ii*)	The concentration of the adsorbate at the adsorbent surface is much more than that in the bulk.	Absorbed material is uniformly distributed throughout the bulk. Thus, concentration is same throughout.
(*iii*)	Initially, rate of adsorption is rapid. It decreases slowly till equilibrium is attained. **Example:** Water vapours on silica gel.	Absorption occurs with uniform rate. **Example:**Water vapours are absorbed by anhydrous $CaCl_2$.

Q. Out of $MgCl_2$ and $AlCl_3$, which one is more effective in causing coagulation of negatively charged sol and why?

Ans. $AlCl_3$ is more effective in causing coagulation of negatively charged sol as Al^{3+} ion has greater positive charge than Mg^{2+} ion.

Q.6. Define the following terms:'

Q. Brownian movement

[*CBSE Patna 2015*]

Ans. Brownian movement: The motion of the colloidal particles in a zig-zag path due to unbalanced bombardment by the particles of dispersion medium is called Brownian movement.

Q. Peptization

[*CBSE Patna 2015*]

Ans. Peptization: The process of converting a precipitate into colloidal sol by shaking it with dispersion medium in the presence of a small amount of suitable electrolyte is called peptization. During peptization, the precipitate absorbs one of the ions of the electrolyte on its surface. This causes development of positive or negative charge on precipitates, which ultimately break up into particles of colloidal dimension.

Q. Multimolecular colloids

[*CBSE Patna 2015*]

Ans. Multimolecular colloids: A large number of atoms or smaller molecules (diameter < 1 nm) of a substance on dissolution aggregate together to form species having size in the colloidal range. Such species are called multimolecular colloids. Examples: a sulphur sol consist of particles containing thousands of S_8 sulphur molecules, a platinum or gold sol may have particles of various sizes having many atoms.

Q.7. Differentiate among a homogeneous solution, a suspension and a colloidal solution, giving a suitable example of each.

[CBSE (F) 2012]

Ans.

S.No.	**Property**	**Homogeneous solution**	**Colloidal solution**	**Suspension**
(***i***)	Particle size	Less than 1nm	Between 1 nm to 1000 nm	More than 1000 nm
(***ii***)	Separation by l ordinary filtration l ultra filtration	 Not possible Not possible	 Not possible Possible	 Possible Possible
(***iii***)	Settling of particles	Do not settle	Settle only on coagulation	Settle under gravity
(***iv***)	Appearance	Transparent	Opaque	Translucent
(***v***)	Example	Glucose dissolved in water	Smoke, milk, gold sol	Sand in water

Q.8. Explain the cleansing action of soap. Why do soaps not work in hard water?

[*CBSE (AI) 2012*]

Ans. The cleansing action of soap such as sodium stearate is due to the fact that soap molecules form micelle around the oil droplet in such a way that hydrophobic part of the stearate ions is in the oil droplet and hydrophilic part projects out of the grease droplet like the bristles. Since the polar groups can interact with water, the oil droplet surrounded by stearate ions is now pulled in water and removed from the dirty surface. Thus, soap helps in emulsification and washing away of oils and fats.

Hard water contains calcium and magnesium salts. In hard water, soap gets precipitated as calcium and magnesium soap which being insoluble stick to the clothes as gummy mass. Therefore, soaps do not work in hard water.

Q.9. Define the following terms giving one suitable example for each:

Q. Electrophoresis

Ans. The movement of colloidal particles towards oppositely charged electrodes in an electric field is called electrophoresis.

Q. Micelles

Ans. There are some substances such as soap which at low concentration behave as normal electrolytes, but at higher concentration exhibit colloidal behaviour due to the formation of aggregates. The aggregated particles thus formed are known as micelles or associated colloids.

Q. Peptization

Ans. The process of converting a precipitate into colloidal solution by shaking it with dispersion medium in the presence of small amount of electrolyte is called peptization.

Q.10. What are emulsions? What are their different types? Give one example of each type.

[*CBSE (AI) 2014*]

Ans. Emulsions are the colloidal solutions in which both the dispersed phase and dispersion medium are liquids. Emulsion can be classified into two types. These are:

i. **Oil in water (O/W) type emulsion:** In this type of emulsions oil acts as disperse phase and water acts as dispersion medium e.g., milk, vanishing cream.
ii. **Water in oil (W/O) type emulsion:** In this type of emulsions water acts as disperse phase and oil acts as dispersion medium e.g., butter, cod liver oil, cold cream.

Q. 11. Answer the following questions.

Q. Write the dispersed phase and dispersion medium of milk.

Ans. Both the dispersed phase and dispersion medium of milk are liquid.

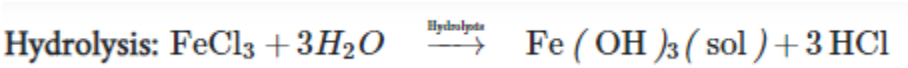
Q. Write one similarity between physisorption and chemisorption.

Ans. Both the physisorption and chemisorption increase with increase in surface area.

Q. Write the chemical method by which $Fe(OH)_3$ sol is prepared from $FeCl_3$.

[*CBSE (AI) 2017*]

Ans.



The $Fe(OH)_3$ molecules formed as result of hydrolysis of $FeCl_3$ aggregate leadig to the formation of sol.

Q.12. Write one difference in each of the following:

Q. Lyophobic sol and Lyophilic sol

Ans.

(*i*)	**Lyophobic Sol**	**Lyophilic Sol**
	Solvent hating Irreversible in nature	Solvent loving Reversible in nature (*Any one*)

Q. Solution and Colloid
Ans.

(*ii*)	**Solution**	**Colloid**
	Homogeneous mixture Does not show Tyndall effect	Heterogeneous mixture Shows Tyndall effect (*Any one*)

Q. Homogeneous catalysis and Heterogeneous catalysis

[CBSE Delhi 2017]

Ans. (iii)

Homogeneous catalysis	Heterogeneous catalysis
Reactants and catalyst are in same phase. $2\,SO_2\,(g) + O_2(g) \xrightarrow{NO(g)} 2\,SO_3\,(g)$ (Any one)	Reactants and catalyst are not in same phase. $N_2(g) + 3H_2(g) \xrightarrow{Fe(s)} 2\,NH_3\,(g)$ (Any one)

Q.13. Answer the following questions.

Q. Out of silica gel and anhydrous $CaCl_2$, which will adsorb the water vapours?

Ans. Silica gel

Q. Out of H_2SO_4 and H_3PO_4, which one is more effective in causing coagulation of positively charged sol? Give reason.

Ans.

$H_3\,PO_4$, as PO_4^{3-} ion has greater negative charge than SO_4^{2-}.

Q. Out of sulphur sol and proteins, which one forms macromolecular colloids?

[*CBSE South 2016*]

Ans. Proteins

Short Answer Questions-II (OIQ)

Q.1. How do size of particles of adsorbent, pressure of gas and prevailing temperature influence the extent of adsorption of a gas on a solid?

Ans. The influence is in the following ways:

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

Q.2. How does a solid catalyst enhance the rate of combination of gaseous molecules?

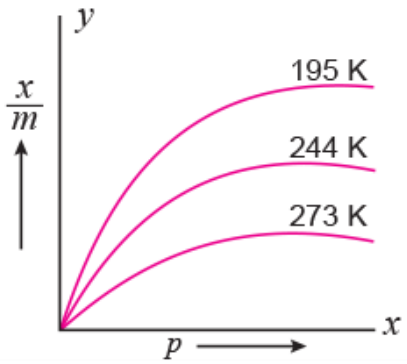
[*NCERT Exemplar*]

Ans. When gaseous molecules come in contact with the surface of a solid catalyst, adsorption of gaseous molecules takes place at the surface of the catalyst. It increases the concentration of reactants on the surface. Different molecules adsorbed side by side have better chance to react and form new molecules. This enhances the rate of reaction. Also, adsorption is an exothermic process. The heat released in the process of adsorption is utilised in enhancing the reaction rate.

Q.3. Consider the adsorption isotherms given alongside and interpret the variation in the extent of adsorption (*x*/*m*) when

i. **(*a*) temperature increases at constant pressure. (*b*) pressure increases at constant temperature.**
ii. **Name the catalyst and the promoter used in Haber's process for manufacture of ammonia.**

[*HOTS*]



Ans.

i. (*a*) At constant pressure, extent of adsorption $\left(\frac{x}{m}\right)$ decreases with increase in temperature as adsorption is an exothermic process.
ii. (*b*) At constant temperature, first adsorption $\left(\frac{x}{m}\right)$ increases with increase in pressure up to a particular pressure and then it remains constant.

$$\text{At low pressure, } \frac{x}{m} = kp$$

$$\text{At intermediate range of pressure, } \frac{x}{m} = kp^{1/n} \quad (n > 1)$$

$$\text{At high pressure, } \frac{x}{m} = k \text{ (independent of pressure)}$$

(*ii*) Finely divided iron is used as a catalyst and molybdenum is used as promoter.

Q.4. Explain the following observations:

[*HOTS*]

Q. Sun looks red at the time of setting.

Ans. At the time of setting, the sun is at horizon. The light emitted by the sun has to travel a relatively longer distance through the atmosphere. As a result, blue part of light is scattered away by the particulate in the atmosphere causing red part to be visible.

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Q. Cottrell's smoke precipitator is fitted at the mouth of the chimney used in factories.

Ans. Cottrell's smoke precipitator, neutralises the charge on unburnt carbon particles, coming out of chimney and they get precipitated and settle down at the floor of the chamber.]

Q. Physical adsorption is multilayered while chemical adsorption is monolayered.

[*HOTS*]

Ans. Physical adsorption involves van der Waals' forces, so any number of layers may be formed one over the other on the surface of the adsorbent. Chemical adsorption takes place as a result of the reaction between adsorbent and adsorbate. When the surface of adsorbent is covered with one layer, no further reaction can take place.

Q.5. What type of colloidal sols are formed in the following:

i. **Sulphur vapours are passed through cold water.**
ii. **White of an egg is mixed with water.**
iii. **Soap solution.**

Ans.

i. Multimolecular because sulphur molecules associate together to form multimolecular colloids.
ii. Macromolecular because protein molecules present in the white of the egg are macromolecules soluble in water.
iii. Associated because $RCOO^-$ ions associate together to form micelles.

Q.6. Answer the foolowing questions.

Q. What are micelles? How do they differ from ordinary colloidal particles? Give two examples of micelle forming substances.

Ans. There are some substances which at low concentration behave as normal electrolyte but at higher concentrations exhibit colloidal behaviour due to formation of aggregated particles. The aggregated particles thus formed are called micelles. Surface active agents such as soaps and detergents are the example of micelle forming substances.

The formation of micelles takes place only above a particular temperature called Kraft temperature and above a particular concentration called critical micelle concentration (CMC). On dilution, these colloids revert back to individual ions.

Q. State Hardy–Schulze rule.

Ans. Hardy and Schulze rules:

i. The ions carrying charge opposite to that of sol particles are effective in bringing about the coagulation of sol.
ii. Coagulating power of the electrolyte is directly proportional to the fourth power of the valency of the ions causing coagulation.

Q.7. SnO_2 forms a positively charged colloidal sol in acidic medium and a negatively charged sol in the basic medium. Why? Explain.

[*HOTS*]

Ans. SnO_2 is amphoteric in nature. It reacts with acids such as HCl, to form $SnCl_4$ in the solution. The common Sn^{4+} ions are adsorbed on the surface of SnO_2 particles to give a positively charged colloidal sol.

$$SnO_2 + 4HCl \rightarrow SnCl_4 + 2H_2O$$

$$SnO_2 + Sn^{4+} \rightarrow \underset{\text{Positively charged sol}}{(SnO_2) : Sn^{4+}}$$

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$$SnO_2 + 2NaOH \rightarrow \underset{\text{Sodium stannate}}{Na_2SnO_3} + H_2O$$

$$SnO_2 + SnO_3^{2-} \rightarrow \underset{\text{Negatively charged sol}}{(SnO_2) : SnO_3^{2-}}$$

Q.8. Answer the following questions.

Q. In reference to Freundlich adsorption isotherm write the expression for adsorption of gases on solids in the form of an equation.

Ans. Freundlich adsorption isotherm equation for adsorption of gases on solids:

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

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

where x is the mass of the gas adsorbed on mass m of the adsorbent at pressure p, k and n are constants which depends on the nature of the gas and adsorbent at a particular temperature.

Q. Write an important characteristic of lyophilic sols.

Ans. Important characteristics of lyophilic sols:

(*a*) They are reversible in nature, *i.e*., once the dispersed phase is separated from dispersion medium the sol can be made again by simply remixing with dispersion medium.

(*b*) They are quite stable and are not easily coagulated.

Q. Based on type of particles of dispersed phase, give one example each of associated colloid and multimolecular colloid.

Ans.

Type of Colloid	**Example**
Associated colloid	Surface active agents such as soap (CMC is 10^{-4} to 10^{-3} mol L^{-1}) and synthetic detergents.
Multimolecular colloid	Sulphur sol, gold sol

Q.9. Give reasons for the following:

[*CBSE Sample Paper 2013*]

Q. Rough surface of catalyst is more effective than smooth surface.

Ans. Rough surface of a catalyst provides more surface area for adsorption.

Q. Smoke passed through charged plates before allowing it to come out of chimneys in factories.

Ans. Smoke is passed through charged plates so that unburnt charged carbon particles get settled between the charged plate leaving behind air free from pollutants.

Q. Ne gets easily absorbed over charcoal than He.

Ans. Ne has higher critical temperature, *i.e.*, stronger van der Waals forces therefore easily adsorbed.

Q. Explain what is observed when

[*CBSE Sample Paper 2015*]

Q. silver nitrate solution is added to potassium iodide solution.

Ans. If silver nitrate solution is added to potassium iodide solution, the precipitated silver iodide adsorbs iodide ions from the dispersion medium and negatively charged colloidal solution results.

$$\underset{}{\mathrm{AgI}} + \underset{(\text{From dispersion medium})}{I^-} \rightarrow \underset{\text{Negatively charged Sol}}{\mathrm{AgI}\ /\ I^-}$$

Q. the size of the finest gold sol particles increases in the gold sol.

Ans. The colour of the colloidal solution depends on the wavelength of the light scattered by the colloidal particles which in turn depends on size and nature of the colloidal particle. Finest gold sol is red in colour, as the size of the particle increases, it appears purple, then blue and finally golden.

Q. two oppositely charged sols are mixed in almost equal proportions.

Ans. Two oppositely charged sols when mixed in almost equal proportions, neutralise their charges and get partially or completely precipitated. Such type of coagulation is called mutual coagulation.

Q.11. Answer the following questions:

[*CBSE Sample Paper 2016*]

Q. What happens when a freshly precipitated $Fe(OH)_3$ is shaken with a little amount of dilute solution of $FeCl_3$?

Ans. It is converted into colloidal state by preferential adsorption of Fe^{3+} ions.

$$Fe(OH)_3 + FeCl_3 \rightarrow \underset{\substack{\text{Reddish}\\\text{coloured}}}{[Fe(OH)_3]} \underset{\substack{\text{brown}\\\text{colloid}}}{} Fe^{3+} + 3Cl^-$$

Q. Why are lyophilic colloidal sols more stable than lyophobic colloidal sols?

Ans. This is because the stability of lyophobic sol is only due to the presence of charge on the colloidal particles. On the other hand, the stability of lyophilic sol is due to charge on the colloidal particles as well as solvation of colloidal particles.

Q. What form Freundlich adsorption equation will take at high pressure?

Ans.

Freundlich Adsorption Isotherm, $\frac{x}{m} = kp^{1/n}$

At high pressure (beyond saturation pressure), $\frac{1}{n} = 0$ and $\frac{x}{m}$ = constant *i.e.*, the adsorption is independent of pressure. So,

$\frac{x}{m} = kp^0$ or $\frac{x}{m} = k$.

Q.12. Answer the following questions.

Q. Why does leather get hardened after tanning?

Ans. Animal hides are colloidal in nature. When a hide, which has positively charged particles, is soaked in tannin, which contains negatively charged colloidal particles, mutual coagulation takes place. This results in the hardening of leather.

Q. On the basis of Hardy-Schulze rule explain why the coagulating power of phosphate is higher than chloride.

Ans. Greater the valency of flocculating ion added, greater is its power to cause coagulation. Thus, for the coagulation of a positively charged sol PO_4^{3-} ion has higher coagulating power than Cl^- ion.

Q. Do the vital functions of the body such as digestion get affected during fever? Explain your answer.

[*CBSE Sample Paper 2017*]

Ans. The optimum temperature for enzymatic activity is 298-310K. On either side of this range enzyme activity decreases, that is why vital function of the body such as digestion get affected during fever.