5 Surface Chemistry

I. Multiple Choice Questions (Type-I)

1. Which of the following process does not occur at the interface of phases?

(*i*) crystallisation (*ii*) heterogenous catalysis
(*iii*) homogeneous catalysis (*iv*) corrosion

Ans. (*iii*)

Explanation: In homogeneous catalysis only, the reactant and product are in same phase and composition is uniform throughout.

2. At the equilibrium position in the process of adsorption _____.

(*i*) $\Delta H > 0$ (*ii*) $\Delta H = T\Delta S$
(*iii*) $\Delta H > T\Delta S$ (*iv*) $\Delta H < T\Delta S$

Ans. (*ii*)

Explanation: At equilibrium $\Delta G = 0$

$\Delta G = \Delta H - T\Delta S$

Therefore $\Delta H = T\Delta S$

3. Which of the following interface cannot be obtained?

(*i*) liquid-liquid (*ii*) solid-liquid
(*iii*) liquid-gas (*iv*) gas-gas

Ans. (*iv*)

Explanation: Because gas-gas forms homogeneous composition.

4. The term 'sorption' stands for _____.

(*i*) absorption
(*ii*) adsorption
(*iii*) both absorption and adsorption
(*iv*) desorption

Ans. (*iii*)

Explanation: When adsorption and absorption occur simultaneously it is known as sorption.

5. Extent of physisorption of a gas increases with _____.

(*i*) increase in temperature.
(*ii*) decrease in temperature.
(*iii*) decrease in surface area of adsorbent.
(*iv*) decrease in strength of van der Waals forces

Ans. (*ii*)

Explanation: Since the adsorption (Solid + Gas ⇌ Gas/Solid + Heat) process is exothermic, the physical adsorption occurs readily at low temperature and decreases with increasing temperature as the equilibrium will shift in backward direction. (Le-Chatelier's principle).

6. Extent of adsorption of adsorbate from solution phase increases with _____.
   (*i*) increase in amount of adsorbate in solution.
   (*ii*) decrease in surface area of adsorbent.
   (*iii*) increase in temperature of solution.
   (*iv*) decrease in amount of adsorbate in solution.

Ans. (*i*)

Explanation: The extent of adsorption depends on the concentration of the solute in solution as the concentration of adsorbate increases interaction between adsorbate and adsorbent increases thus the extent of adsorption increases.

7. Which one of the following is **not** applicable to the phenomenon of adsorption?
   (*i*) $\Delta H > 0$ (*ii*) $\Delta G < 0$
   (*iii*) $\Delta S < 0$ (*iv*) $\Delta H < 0$

Ans. (*i*)

Explanation: Since adsorption is an exothermic process ΔH can not be greater than zero.

8. Which of the following is **not** a favourable condition for physical adsorption?
   (*i*) high pressure
   (*ii*) negative ΔH
   (*iii*) higher critical temperature of adsorbate
   (*iv*) high temperature

Ans. (*iv*)

Explanation: High temperature is not favourable for physical adsorption since it is an exothermic process.

9. Physical adsorption of a gaseous species may change to chemical adsorption with _____.
   (*i*) decrease in temperature
   (*ii*) increase in temperature
   (*iii*) increase in surface area of adsorbent
   (*iv*) decrease in surface area of adsorbent

Ans. (*ii*)

Explanation: on increasing the temperature activation energy of the adsorbate molecule increases. Which can convert physical adsorption into chemisorptions.

10. In physisorption adsorbent does not show specificity for any particular gas because _____.
    (*i*) involved van der Waals forces are universal.
    (*ii*) gases involved behave like ideal gases.
    (*iii*) enthalpy of adsorption is low.
    (*iv*) it is a reversible process.

Ans. (*i*)

11. Which of the following is an example of absorption?
(*i*) Water on silica gel
(*ii*) Water on calcium chloride
(*iii*) Hydrogen on finely divided nickel
(*iv*) Oxygen on metal surface

Ans. (*ii*)

12. On the basis of a data given below predict which of following gases shows least adsorption on a definite amount of charcoal?

Gas	CO_2	SO_2	CH_4	H_2
Critical temp./K	304	630	190	33

(*i*) CO_2 (*ii*) SO_2
(*iii*) CH_4 (*iv*) H_2

Ans. (*iv*)

Explanation: Lesser the value of critical temp of gases lesser will the force of attraction among molecules and least will be the adsorption.

13. In which of the following reactions heterogenous catalysis is involved?

(*a*) $2SO_2(g) + O_2(g) \xrightarrow{NO(g)} 2SO_3(g)$

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

(*c*) $N_2(g) + 3H_2(g) \xrightarrow{Fe(s)} 2NH_3(g)$

(*d*) $CH_3COOCH_3(l) + H_2O(l) \xrightarrow{HCl(l)} CH_3COOH(aq) + CH_3OH(aq)$

(*i*) (*b*), (*c*) (*ii*) (*b*), (*c*), (*d*)
(*iii*) (*a*), (*b*), (*c*) (*iv*) (*d*)

Ans. (*i*) (*b*), (*c*)

Explanation: When the reactant and catalyst are in different phase it is known as heterogeneous catalysis.

14. At high concentration of soap in water, soap behaves as _____.
(*i*) molecular colloid (*ii*) associated colloid
(*iii*) macromolecular colloid (*iv*) lyophilic colloid

Ans. (*ii*)

Explanation: There are some substances which 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 called micelles. These are also known as associated colloids.

15. Which of the following will show Tyndall effect?
(*i*) Aqueous solution of soap below critical micelle concentration.
(*ii*) Aqueous solution of soap above critical micelle concentration.
(*iii*) Aqueous solution of sodium chloride.
(*iv*) Aqueous solution of sugar.

Ans. (*ii*)

Explanation: Tyndall effect is the optical property shown by the colloidal particle. Above critical micelle concentration, a solution of soap behave as associated colloid that is why it shows tyndall effect.

16. Method by which lyophobic sol can be protected.

(*i*) By addition of oppositely charged sol.

(*ii*) By addition of an electrolyte.

(*iii*) By addition of lyophilic sol.

(*iv*) By boiling.

Ans. (*iii*)

Explanation: Lyophilic colloids have a unique property of protecting lyophobic colloids. When a lyophilic sol is added to the lyophobic sol, the lyophilic particles form a layer around lyophobic particles and thus protect the latter from electrolytes. Lyophilic colloids used for this purpose are called protective colloids.

17. Freshly prepared precipitate sometimes gets converted to colloidal solution by _____.

(*i*) coagulation (*ii*) electrolysis

(*iii*) diffusion (*iv*) peptisation

Ans. (*iv*)

Explanation: Peptisation is the process in which freshly prepared precipitate can be converted into colloidal solution.

18. Which of the following electrolytes will have maximum coagulating value for AgI/Ag^+ sol?

(*i*) Na_2S (*ii*) Na_3PO_4

(*iii*) Na_2SO_4 (*iv*) NaCl

Ans. (*ii*)

Explanation: Higher the value of oppositely charge electrolyte faster will be the rate of coagulation.

19. A colloidal system having a solid subtance as a dispersed phase and a liquid as a dispersion medium is classified as _____.

(*i*) solid sol (*ii*) gel

(*iii*) emulsion (*iv*) sol

Ans. (*iv*)

Explanation: Solid + liquid = sol (here solid is the dispersed phase and liquid is the dispersion medium.)

20. The values of colligative properties of colloidal solution are of small order in comparison to those shown by true solutions of same cocentration because of colloidal particles _____.

(*i*) exhibit enormous surface area.

(*ii*) remain suspended in the dispersion medium

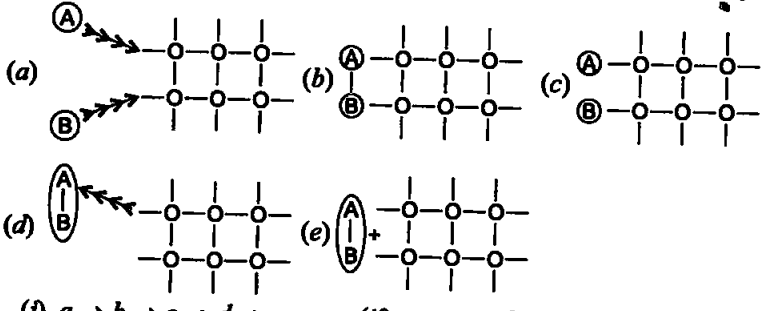
(*iii*) form lyophilic colloids

(*iv*) are comparatively less in number.

Ans. (*iv*)

Explanation: 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 concentration

21. Arrange the following diagrams in correct sequence of steps involved in the mechanism of catalysis, in accordance with modern adsorption theory.



(*i*) $a \rightarrow b \rightarrow c \rightarrow d \rightarrow e$ (*ii*) $a \rightarrow c \rightarrow b \rightarrow d \rightarrow e$

(*iii*) $a \rightarrow c \rightarrow b \rightarrow e \rightarrow d$ (*iv*) $a \rightarrow b \rightarrow c \rightarrow e \rightarrow d$

Ans. (*ii*)

Explanation: Correct sequence of steps involed in catalysis is:

(*i*) → Adsorption of Aand B on surface

(*ii*) → Interaction between Aand B to form intermediate

(*iii*) → Starting of desorption from surface

(*iv*) → Complete desorption from the surface

22. Which of the following process is responsible for the formation of delta at aplace where rivers meet the sea?

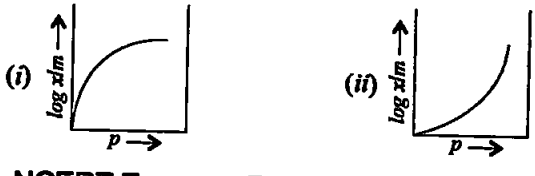
(*i*) Emulsification (*ii*) Colloid formation

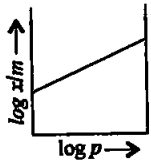
(*iii*) Coagulation (*iv*) Peptisation

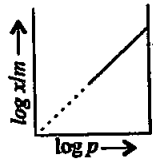
Ans. (*iii*)

Explanation: River water is a colloidal solution of clay. Sea water contains a number of electrolytes. When river water meets the sea water, the electrolytes present in sea water coagulate the colloidal solution of clay resulting in its deposition with the formation of delta.

23. Which of the following curves is in accordance with Freundlich adsorption isotherm?



(iii) 

(iv) 

Ans. (*i*)

Explanation: Freundlich, in 1909, gave an empirical relationship between the quantity of gas adsorbed by unit mass of solid adsorbent and pressure at a particular temperature.

$$x/m = k p^{1/n} \quad (n > 1)$$

The adsorption varies directly.

Where x/m = mass of gas adsorbed per unit mass of adsorbent particle

P = Pressure of gas at particular temperature.

24. Which of the following process is **not** responsible for the presence of electric charge on the sol particles?

(*i*) Electron capture by sol particles.

(*ii*) Adsorption of ionic species from solution.

(*iii*) Formation of Helmholtz electrical double layer.

(*iv*) Absorption of ionic species from solution.

Ans. (*iv*)

Explanation: The charge on the sol particles is due to one or more reasons, viz.,

(*a*) due to electron capture by sol particles during electrodispersion of metals,

(*b*) due to preferential adsorption of ions from solution and/or

(*c*) due to formulation of electrical double layer.

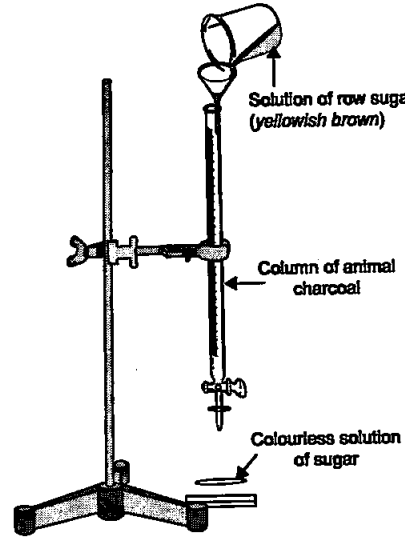
25. Which of the following phenomenon is applicable to the process shown in the figure?

(*i*) Absorption

(*ii*) Adsorption

(*iii*) Coagulation

(*iv*) Emulsification



Ans. (*ii*)

Explanation: In the figure adsorption of coloured particle from charcoal is shown. Solution of raw sugar is filtered by animal charcoal and yellowish

brown colour of raw sugar is adsorbed and filterate is colourless which gives white colour on crystallization.

II. Multiple Choice Questions (Type-II)

Note: In the following questions two or more options may be correct.

26. Which of the following options are correct?

(*i*) Micelle formation by soap in aqueous solution is possible at all temperatures.

(*ii*) Micelle formation by soap in aqueous solution occurs above a particular concentration.

(*iii*) On dilution of soap solution micelles may revert to individual ions.

(*iv*) Soap solution behaves as a normal strong electrolyte at all concentrations

Ans. (*ii*) and (*iii*)

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

27. Which of the following statements are correct about solid catalyst?

(*i*) Same reactants may give different product by using different catalysts.

(*ii*) Catalyst does not change ΔH of reaction.

(*iii*) Catalyst is required in large quantities to catalyse reactions.

(*iv*) Catalytic activity of a solid catalyst does not depend upon the strength of chemisorption

Ans. (*i*) and (*ii*)

Explanation: Action of a catalyst is highly selective in nature, i.e., a given substance can act as a catalyst only in a particular reaction and not for all the reactions. It means that a substance which acts as a catalyst in one reaction may fail to catalyse another reaction. Catalyst do not change the enthalpy of reaction.

28. Freundlich adsorption isotherm is given by the expression $\frac{x}{m} = k\, p^{\frac{1}{n}}$ which of the following conclusion can be drawn from this expression.

(*i*) When $\frac{1}{n} = 0$, the adsorption is independent of pressure.

(*ii*) When $\frac{1}{n} = 0$, the adsorption is directly proportional to pressure.

(*iii*) When $n = 0$, $\frac{x}{m}$ vs p graph is a line parallel to x-axis.

(*iv*) When $n = 0$, plot of $\frac{x}{m}$ vs p is a curve.

Ans. (*i*) and (*iii*)

Explanation: Freundlich gave an empirical relationship between the quantity of gas adsorbed by unit mass of solid adsorbent and pressure at a particular temperature.

$$\frac{x}{m} = kp^{1/n}$$

If $\frac{1}{n} = 0$; $\frac{x}{m} = k$ extent of adsorption is independent of pressure.

When $n = 0$; $\frac{x}{m} = kp^{\infty}$

$\frac{x}{m}$ vs p is a line parallel to x-axis

29. H_2 gas is adsorbed on activated charcoal to a very little extent in comparison to easily liquefiable gases due to _____.

(*i*) very strong van der Waal's interaction.
(*ii*) very weak van der Waals forces.
(*iii*) very low critical temperature.
(*iv*) very high critical temperature.

Ans. (*ii*) and (*iii*)

Explanation: H_2 molecule on an activated charcoal is adsorbed to a very little extent in comparison to easily liquefiable gases because it has
(*a*) very weak van der Waals force of attraction
(*b*) very low critical temperature

30. Which of the following statements are correct?

(*i*) Mixing two oppositely charged sols neutralises their charges and stabilises the colloid.
(*ii*) Presence of equal and similar charges on colloidal particles provides stability to the colloids.
(*iii*) Any amount of dispersed liquid can be added to emulsion without destabilising it.
(*iv*) Brownian movement stabilises sols.

Ans. (*ii*) and (*iv*)

Explanation: The presence of equal and similar charges on colloidal particles is largely responsible in providing stability to the colloidal solution, because the repulsive forces between charged particles having same charge prevent them from coalescing or aggregating when they come closer to one another.

The Brownian movement has a stirring effect which does not permit the particles to settle and thus, is responsible for the stability of sols.

31. An emulsion cannot be broken by _____ and _____.

(*i*) heating
(*ii*) adding more amount of dispersion medium
(*iii*) freezing
(*iv*) adding emulsifying agent

Ans. (*ii*) and (*iv*)

Explanation: Emulsions can be broken into constituent liquids by heating, freezing and centrifuging.

32. Which of the following substances will precipitate the negatively charged emulsions?

(*i*) KCl (*ii*) glucose
(*iii*) urea (*iv*) NaCl

Ans. (*i*) and (*iv*)

Explanation: Negatively charged emulsion can be precipitated by oppositely charged electrolyte. Na^+ and K^+ from the electrolyte can neutralize the negatively charge emulsion and precipitate the colloid.

33. Which of the following colloids cannot be coagulated easily?

(*i*) Lyophobic colloids. (*ii*) Irreversible colloids.
(*iii*) Reversible colloids. (*iv*) Lyophilic colloids.

Ans. (*iii*) and (*iv*)

Explanation: Sols directly formed by mixing substances like gum, gelatin, starch, rubber, etc., with a suitable liquid (the dispersion medium) are called lyophilic sols. They are also known as reversible colloid. These sols are very stable and cannot coagulate easily.

34. What happens when a lyophilic sol is added to a lyophobic sol?

(*i*) Lyophobic sol is protected.
(*ii*) Lyophilic sol is protected.
(*iii*) Film of lyophilic sol is formed over lyophobic sol.
(*iv*) Film of lyophobic sol is formed over lyophilic sol.

Ans. (*i*) and (*iii*)

Explanation: Lyophilic colloids have a unique property of protecting lyophobic colloids. When a lyophilic sol is added to the lyophobic sol, the lyophilic particles form a layer around lyophobic particles and thus protect the latter from electrolytes. Lyophilic colloids used for this purpose are called protective colloid.

35. Which phenomenon occurs when an electric field is applied to a colloidal solution and electrophoresis is prevented?

(*i*) Reverse osmosis takes place.
(*ii*) Electroosmosis takes place.
(*iii*) Dispersion medium begins to move.
(*iv*) Dispersion medium becomes stationary.

Ans. (*ii*) and (*iii*)

Explanation: When electrophoresis, i.e., movement of particles is prevented by some suitable means, it is observed that the dispersion medium begins to move in an electric field. This phenomenon is termed electroosmosis.

36. In a reaction, catalyst changes _____.
(*i*) physically (*ii*) qualitatively
(*iii*) chemically (*iv*) quantitatively

Ans. (*i*) and (*ii*)

Explanation: Substances, which accelerate the rate of a chemical reaction and themselves remain chemically and quantitatively unchanged after the reaction, are known as catalysts they can undergo physical change.

37. Which of the following phenomenon occurs when a chalk stick is dipped in ink?
(*i*) adsorption of coloured substance
(*ii*) adsorption of solvent
(*iii*) absorption and adsorption both of solvent
(*iv*) absoprtion of solvent

Ans. (*i*) and (*iv*)

Explanation: When a chalk stick is dipped in ink, the surface retains the colour of the ink due to adsorption of coloured molecules while the solvent of the ink goes deeper into the stick due to absorption.

III. Short Answer Type

38. Why is it important to have clean surface in surface studies?

Ans. If the surface is covered by the other gaseous molecule it will not available for the desired molecules. To accomplish surface studies meticulously, it becomes imperative to have a really clean surface.

39. Why is chemisorption referred to as activated adsorption?

Ans. Chemisorption is caused by chemical bond formation. It involves a high energy of activation and is, therefore, often referred to as activated adsorption.

40. What type of solutions are formed on dissolving different concentrations of soap in water?

Ans. Soap solutions at low concentrations behave as normal electrolytes, but after a certain concentration, called critical micelle concentration, exhibit colloidal behaviour due to the formation of aggregates. The aggregated particles thus formed are called micelles. These are also known as associated colloids.

41. What happens when gelatin is mixed with gold sol?

Ans. Gold sol is a lyophobic colloid it is quite unstable in nature. Gelatin is a lyophilic colloid it stablises the sol and act as protective colloid.

42. How does it become possible to cause artificial rain by spraying silver iodide on the clouds?

Ans. Clouds are aerosols having small droplets of water suspended in air. The rainfall occurs when two oppositely charged clouds meet. Sometimes, it is possible to cause artificial rain by throwing electrifieds and or spraying

a sol carrying charge opposite to the one on the clouds. Spraying of silver iodide, an electrolyte, on clouds results in its congulation leading to rain.

43. Gelatin which is a peptide is added in icecreams. What can be its role?

Ans. Gelatin act as a emulsifying agent in the icecreams. The emulsifying agent forms an interfacial film between suspended particles and the medium.

44. What is collodion?

Ans. Collodion is a 4% solution of nitrocellulose in a mixture of alcohol and ether.

45. Why do we add alum to purify water?

Ans. The water obtained from natural sources often contains suspended impurities. Alum is added to such water to coagulate the suspended impurities and make water fit for drinking purposes.

46. What happens when electric field is applied to colloidal solution?

Ans. The existence of charge on colloidal particles is confirmed by electrophoresis experiment. When electric potential is applied across two platinum electrodes dipping in a colloidal solution, the charged colloidal particles start moving towards oppositely charged electrode. The movement of colloidal particles under an applied electric potential is called electrophoresis.

47. What causes brownian motion in colloidal dispersion?

Ans. The Brownian movement has been explained to be due to the unbalanced bombardment of the particles by the molecules of the dispersion medium. The Brownian movement has a stirring effect which does not permit the particles to settle and thus, is responsible for the stability of sols.

48. A colloid is formed by adding $FeCl_3$ in excess of hot water. What will happen if excess sodium chloride is added to this colloid?

Ans. By adding $FeCl_3$ in excess of hot water a positively charged colloid is formed. When excess of sodium chloride is added to the solution negatively charged chloride ions coagulate the positvely charged colloidal solution of $FeCl_3$.

49. How do emulsifying agents stabilise the emulsion?

Ans. The emulsifying agent forms an interfacial film between suspended particles and the medium.

50. Why are some medicines more effective in the colloidal form?

Ans. Most of the medicines are colloidal in nature. For example, argyrol is a silver sol used as an eye lotion. Colloidal antimony is used in curing kalaazar. Colloidal medicines are more effective because they have large surface area and are therefore easily assimilated.

51. 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.

52. How does the precipitation of colloidal smoke take place in Cottrell precipitator?

Ans. Smoke is a colloidal solution of solid particles such as carbon, arsenic compounds, dust, etc., in air. The smoke, before it comes out from the chimney, is led through a chamber containing plates having a charge opposite to that carried by smoke particles. The particles on coming in contact with these plates lose their charge and get precipitated. The particles thus settle down on the floor of the chamber.

53. How will you distinguish between dispersed phase and dispersion medium in an emulsion?

Ans. Emulsion can be diluted with any amount of the dispersion medium. On the other hand, the dispersed liquid when mixed, forms a separate layer.

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

Ans. Greater the valence of the flocculating ion added, the greater is its power to cause precipitation. This is known as Hardy-Schulze rule. Phosphate ion has greater charge (–3) than chloride ion (–1), so coagulating power of PO_4^{3-} is more than Cl^-.

55. Why does bleeding stop by rubbing moist alum?

Ans. Blood is a colloidal solution of an albuminoid substance. The styptic action of alum and ferric chloride solution is due to coagulation of blood forming a clot which stops further bleeding.

56. Why is $Fe(OH)_3$ colloid positively charged, when prepared by adding $FeCl_3$ to hot water?

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

57. Why do physisorption and chemisorption behave differently with rise in temperature?

Ans. Physisorption involves weak vander Waals forces. So, adsorption occurs readily at low temperature and decreases with increasing temperature because vander Waals forces weaken with rise in temperature. Chemisorption increases on increasing the temperature because it involves the formation of chemical bond which requires high energy of activation.

58. What happens when dialysis is prolonged?

Ans. Colloid becomes unstable and coagulation occurs because the traces of electrolyte which is needed for the stabilization of the sol get removed due to prolonged dialysis.

59. Why does the white precipitate of silver halide become coloured in the presence of dye eosin.

Ans. Because the dye eosin get adsorbed on the surface of the precipitate of silver halide.

60. What is the role of activated charcoal in gas mask used in coal mines?

Ans. Gas mask (a device which consists of activated charcoal or mixture of adsorbents) is usually used for breathing in coal mines to adsorb poisonous gases.

61. How does a delta form at the meeting place of sea and river?

Ans. River water is a colloidal solution of clay. Sea water contains a number of electrolytes. When river water meets the sea water, the electrolytes present in sea water coagulate the colloidal solution of clay resulting in its deposition with the formation of delta.

62. Give an example where physisorption changes to chemisorption with rise in temperature. Explain the reason for change.

Ans. Adsorption of H_2 on finely divided nickel is an example of physisorption but when the temperature is increased it changes into chemisorption. Hydrogen molecule dissociate into hydrogen atom and form chemical bond at the surface of the metal.

63. Why is desorption important for a substance to act as good catalyst?

Ans. The reactants must get adsorbed reasonably strongly on to the catalyst to become active. However, they must not get adsorbed so strongly that they are immobilised and other reactants are left with no space on the catalyst's surface.

Desorption is very important so that the surface of the catalyst can be available for the other reactant.

64. What is the role of diffusion in heterogenous catalysis?

Ans. The catalytic process in which the reactants and the catalyst are in different phases is known as heterogeneous catalysis. First step involve in the heterogeneous catalysis is the diffusion of reactant on the surface of catalyst which facilitates adsorption. Second step involves diffusion of reaction products away from the catalyst's surface leaving the surface free for more ractant molecules to get adsorbed and undergo reaction. It is also very important for the whole process of catalysis.

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

Ans. The surface of the catalyst unlike the inner part of the bulk, has free valencies which provide the seat for chemical forces of attraction. When a gas comes in contact with such a surface, its molecules are held up there due to loose chemical combination. Different molecules adsorbed side by side have better chance to react and form new moleculs. 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.

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

Ans. The rate of an enzyme reaction is maximum at a definite temperature, called the optimum temperature. On either side of the optimum temperature, the enzyme activity decreases. The optimum temperature range for enzymatic activity is 298-310 K. Human body temperature being 310 K is suited for enzyme-catalysed reactions. Therefore during fever, catalytic activity of the enzyme may get affected.

IV. Matching Type

Note: Match the items of Column I and Column II in the following questions:

67. Method of information of solution is given in Column I. Match it with the type of solution given in Column II.

Column I	Column II
(*i*) Sulphur vapours passed through cold water	(*a*) Normal electrolyte solution
(*ii*) Soap mixed with water above critical micelle concentration	(*b*) Molecular colloids
(*iii*) White of egg whipped with water	(*c*) Associated colloid
(*iv*) Soap mixed with water below critical micelle concentration	(*d*) Macro molecular colloids

Ans. (*i*) → (*b*) (*ii*) → (*c*) (*iii*) → (*d*) (*iv*) → (*a*)

Explanation:

(*i*) By passing vapours of sulphur through cold water sulphur sol can be prepared which is a molecular colloid.

(*ii*) When soap is mixed with water above critical micelle concentration forms associated colloid.

(*iii*) White of egg whipped with water forms macromolecular colloid.

(*iv*) Soap mixed with water below critical micelle concentration behave as normal electrolyte.

68. Match the statement given in Column I with the phenomenon gives in Column II.

Column I	Column II
(*i*) Dispersion medium moves in an electric field	(*a*) Osmosis
(*ii*) Solvent molecules pass through semi permeable membrane towards solvent side	(*b*) Electrophoresis
(*iii*) Movement of charged colloidal particles under the influence of applied electric potential towards oppositely charged electrodes	(*c*) Electroosmosis
(*iv*) Solvent molecules pass through semi permeable membranes towards solution side	(*d*) Reverse osmosis

Ans. (*i*) → (*c*) (*ii*) → (*d*) (*iii*) → (*b*) (*iv*) → (*a*)

Explanation:

(*i*) When electrophoresis, i.e., movement of particles is prevented by some suitable means, it is observed that the dispersion medium begins to move in an electric field. This phenomenon is termed Electroosmosis.

(*ii*) Solvent molecules pass through semi-permeable membrane towards solvent side is termed as reverse osmosis.

(*iii*) When electric potential is applied across two platinum electrodes dipping in a colloidal solution, the colloidal particles move towards one or the other electrode. The movement of colloidal particles under an applied electric potential is called electrophoresis.

(*iv*) Solvent molecules pass through semipermeable membrane towards solution side is termed as osmosis.

69. Match the items given in Column I and Column II.

Column I	Column II
(*i*) Protective colloid	(*a*) $FeCl_3$ + NaOH
(*ii*) Liquid-liquid colloid	(*b*) Lyophilic colloids
(*iii*) Positively charged colloid	(*c*) Emulsion
(*iv*) Negatively charged colloid	(*d*) $FeCl_3$ + hot wataer

Ans. (*i*) → (*b*) (*ii*) → (*c*) (*iii*) → (*d*) (*iv*) → (*a*)

Explanation:

(*i*) Lyophilic colloids have a unique property of protecting lyophobic colloids. When a lyophilic sol is added to the lyophobic sol, the lyophilic particles form a layer around lyophobic particles and thus protect the colloid.

(*ii*) 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.

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

(*iv*) When ferric chloride is added to NaOH a negatively charged sol is obtained with adsorption of OH^- ions.

70. Match the types of colloidal systems given in Column I with the name given in Column II.

Column I	Column II
(*i*) Solid in liquid	(*a*) Foam
(*ii*) Liquid in solid	(*b*) Sol
(*iii*) Liquid in liquid	(*c*) Gel
(*iv*) Gas in liquid	(*d*) Emulsion

Ans. (*i*) → (*b*) (*ii*) → (*c*) (*iii*) → (*d*) (*iv*) → (*a*)

Explanation:

S. No.	Dispersed phase	Dispersion medium	colloid
(*i*)	solid	liquid	sol
(*ii*)	liquid	solid	gel
(*iii*)	liquid	liquid	emulsion
(*iv*)	gas	liquid	foam

71. Match the items of Column I and Column II.

Column I	Column II
(*i*) Dialysis	(*a*) Cleansing action of soap
(*ii*) Peptisation	(*b*) Coagulation
(*iii*) Emulsification	(*c*) Colloidal sol formation
(*iv*) Electrophoresis	(*d*) Purification

Ans. (*i*) → (*d*) (*ii*) → (*c*) (*iii*) → (*a*) (*iv*) → (*b*)

Explanation:

(*i*) **Dialysis:** process used for the purification of colloid.

(*ii*) **Peptisation:** Peptisation may be defined as the process of converting a precipitate into colloidal sol by shaking it with dispersion medium in the presence of small amount of electrolyte.

(*iii*) **Emulsification:** Process of cleansing of oil and dirt from soap by emulsification.

(*iv*) **Electrophoresis:** The movement of colloidal particles under an applied electric potential is called electrophoresis.

72. Match the items of Column I and Column II.

Column I	Column II
(*i*) Butter	(*a*) dispersion of liquid in liquid
(*ii*) Pumice stone	(*b*) dispersion of solid in liquid
(*iii*) Milk	(*c*) dispersion of gas in solid
(*iv*) Paints	(*d*) dispersion of liquid in solid

Ans. (*i*) → (*d*) (*ii*) → (*c*) (*iii*) → (*a*) (*iv*) → (*b*)

Explanation:

Dispersed phase	Dispersion medium	Ex: colloidal solution
solid	liquid	butter
gas	solid	Pumice stone
liquid	liquid	milk
solid	liquid	paint

V. Assertion and Reason Type

Note: In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(*i*) Assertion and reason both are correct and the reason is correct explanation of assertion.

(*ii*) Assertion and reason both are correct but reason does not explain Assertion.
(*iii*) Assertion is correct but reason is incorrect.
(*iv*) Both assertion and reason are incorrect.
(*v*) Assertion is incorrect but reason is correct.

73. Assertion : An ordinary filter paper impregnated with collodion solution stops the flow of colloidal particles.
Reason : Pore size of the filter paper becomes more than the size of colloidal particle.

Ans. (*iii*)

Explanation: Colloidal particles can pass through ordinary filter paper because the pores are too large. However, the pores of filter paper can be reduced in size by impregnating with collodion solution to stop the flow of colloidal particles.

74. Assertion : Colloidal solutions show colligative properties.
Reason : Colloidal particles are large in size.

Ans. (*i*)

Explanation: 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 concentration.

75. Assertion : Colloidal solutions do not show brownian motion.
Reason : Brownian motion is responsible for stability of sols.

Ans. (*v*)

Explanation: Colloidal particle shows Brownian movement.The Brownian movement has a stirring effect which does not permit the particles to settle and thus, is responsible for the stability of sols.

76. Assertion : Coagulation power of Al^{3+} is more than Na^{+}.
Reason : Greater the valency of the flocculating ion added, greater is its power to cause precipitation (Hardy Schulze rule).

Ans. (*i*)

Explanation: The greater the valence of the flocculating ion added, the greater is its power to cause precipitation. This is known as Hardy-Schulze rule. In the coagulation of a negative sol, the flocculating power is in the order: $Al^{3+} > Ba^{2+} > Na^{+}$.

77. Assertion : Detergents with low CMC are more economical to use.
Reason : Cleansing action of detergents involves the formation of micelles. These are formed when the concentration of detergents becomes equal to CMC.

Ans. (*i*)

Explanation: Detergents with low CMC are more economical to use as they involves the formation of micelle which is used for cleaning of oil and dirt from our cloth. Micelle formation takes place when the concentration of detergent become equal to CMC.

VI. Long Answer Type

78. What is the role of adsorption in heterogenous catalysis?

Ans. In heterogeneous catalysis reactants are generally in gas phase and catalyst are in solid phase. The activity of a catalyst depends upon the strength of chemisorption to a large extent. The reactants must get adsorbed reasonably strongly on to the catalyst to become active. However, they must not get adsorbed so strongly that they are immobilised and other reactants are left with no space on the catalyst's surface for adsorption. It has been found that for hydrogenation reaction, the catalytic activity increases from Group 5 to Group 11 metals with maximum activity being shown by groups 7-9 elements of the periodic table. Catalyst also direct a reaction to yield a particular product. For example, starting with H_2 and CO, and using different catalysts, we get different products.

79. What are the applications of adsorption in chemical analysis?

Ans. (*i*) **Separation of inert gases:** Due to the difference in degree of adsorption of gases by charcoal, a mixture of noble gases can be separated by adsorption on coconut charcoal at different temperatures.

(*ii*) **Adsorption indicators:** Surfaces of certain precipitates such as silver halides have the property of adsorbing some dyes like eosin, fluorescein, etc. and thereby producing a characteristic colour at end point.

(*iii*) **Chromatographic analysis:** Chromatographic analysis based on the phenomenon of adsorption finds a number of applications in analytical and and industrial fields.

80. What is the role of adsorption in froth floatation process used especially for concentration of sulphide ores?

Ans. This method has been in use for removing gangue from sulphide ores. In this process, a suspension of the powdered ore is made with water. To it, collectors and froth stabilisers are added. Collectors (e.g., pine oils, fatty acids, xanthates, etc.) enhance non-wettability of the mineral particles and froth stabilisers (e. g., cresols, aniline) stabilise the froth.

81. What do you understand by shape selective catalysis? Why are zeolites good shape selective catalysts?

Ans. The catalytic reaction that depends upon the pore structure of the catalyst and the size of the reactant and product molecules is called shape-selective catalysis. Zeolites are good shape-selective catalysts because of their honeycomb-like structures. They are aluminosilicates with three dimensional network of silicates in which some silicon atoms are replaced by aluminium atoms giving Al–O–Si framework. The reactions taking place in zeolites depend upon the size and shape of reactant and product molecules as well as upon the pores and cavities of the zeolites. They are found in nature as well as synthesised for catalytic selectivity. Zeolites are being very widely used as catalysts in petrochemical industries for cracking of hydrocarbons and isomerisation.

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