# $\underset{S}{A}$ Answers and Solutions

## Adsorption and Adsorption isotherm

1. (b) Chemical adsorption is irreversible due to formation of new bonds and compounds.

2. (a) Chemical adsorption increases with temperature.

6. (b) When the temperature is raised, the viscosity of liquid decreases, this is because increase in temperature increases the average kinetic energy of molecules which overcome the attractive force between them.

13. (d) Charge on $As_2S_3$ sol is due to the adsorbed sulphide ion.

19. (a) According to langmuir Adsorption isotherm the amount of gas adsorbed at very high pressures reaches a constant limiting volume.

21. (a) According to definition of adsorbent.

24. (b) Adsorption increase when temperature decreases (Adsorption $\propto$ 1/Temperature)

25. (a) In chemical adsorption, one layers are adsorbed.

26. (a) Adsorption of a gas on solid independent of the pressure start fast and after some time becomes slow.

27. (d) Chemisorption first increases and then decreases with temperature.

28. (b) Adsorption is an exothermic process.

32. (d) $\log x/m = \log k + \frac{1}{n}\log p$ ; this is Freundlich isotherm.

    Thus $p \propto \frac{1}{n}$ .

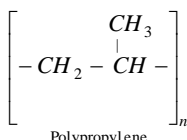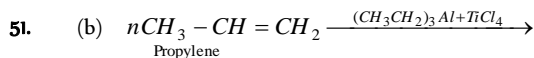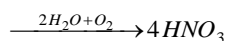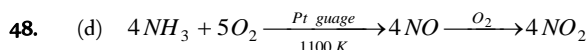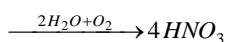36. (c) Heterogeneous catalysis can be explained by the adsorption theory.

37. (a) Adsorption due to strong chemical bond is called chemical adsorption or chemisorption or Langmuir adsorption.

39. (c) Physical adsorption decreases with increase of temperature.

40. (c) $W = \frac{126 \times 1 \times 50}{1000} \Rightarrow 6.3$

    (Molecular weight of oxalic acid $\Rightarrow$163)

    $0.5\ gm \rightarrow \frac{6.3}{2}$

    $1\ gm \rightarrow \frac{6.3}{2 \times 0.5} \times 1 \Rightarrow 6.3\ gm.$

41. (d) Noble gases are adsorbed by coconut charcoal. The adsorption of different noble gases occur at different temperatures, hence charcoal is used to separate these gases. Helium is not adsorbed by charcoal (as it is very difficulty liquifiable gas).

42. (a) Animal charcoal is a good adsorbate. The impurities adsorbs on its surface and thus it decolourises colour of liquids.

43. (a) Since adsorption is an exothermic process (taking place with the evolution of heat) therefore in accordance with Lechatelier's principle, the magnitude of physical adsorption will decrease with the increase in temperature. In case of chemisorption the adsorption first increase and then decreases with increase in temperature.

44. (c) Concentration of the solution decreases because acetic acid gets adsorbed on charcoal.

45. (d) $\frac{x}{m} = kp^{1/n}$ or $x = m \cdot kp^{1/n}$ or $x/m = kp^{-n}$

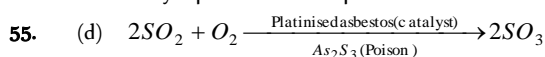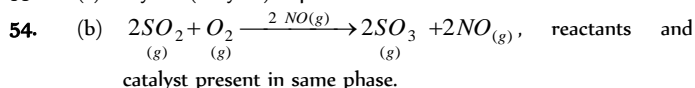All of these equation represent freundlich adsorption isotherm.

47. (d) It has been observed that the surface of a solid (or liquid) has the tendency to attract and retain the molecules of other immiscible phase with which it is brought into contact. These molecules remian only at the surface and do not go deeper into the bulk. This tendency of accumulation of molecular species at the surface than in the bulk of a solid (or liquid) it termed adsorption.
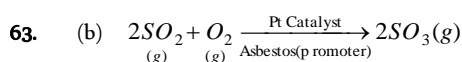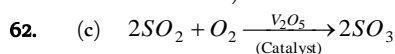
## Catalyst and Catalysis

3. (d) A catalyst does not take part in the reaction but can speed it up. It can be recovered after the reaction.

4. (a) $\underset{(g)}{N_2} + \underset{(g)}{3H_2} \xrightarrow[Mo\ promoter]{Fe\ Catalyst} \underset{(g)}{2NH_3}$

5. (d) $2KClO_3 \xrightarrow{MnO_2} 2KCl + 3O_2$

6. (b) $2SO_2 + O_2 \xrightarrow[As_2O_3(poison)]{Pt(Catalyst)} 2SO_3$

7. (d) It is a shape-selective catalyst.

8. (a) All substance have average energy and before the reaction occurs energy of the reactant should be higher than the average energy. We also know that catalyst lower the activation energy. Therefore, rate of reaction is increased.

9. (b) $2SO_2 + O_2 \xrightarrow{NO} 2SO_3$

12. (b) Transition metals are most efficient catalysts due to half filled $d$-orbitals.

16. (d) An increase in rate of reaction in forward direction by a catalyst for a reaction in equilibrium brings in an increase in concentration of products and thus rate of backward reaction also increase to same magnitude and so allow the equilibrium to be achieved quickly.

17. (c) $\underset{(g)}{2SO_2} + \underset{(g)}{O_2} \xrightarrow{V_2O_5} \underset{(g)}{2SO_3}$

19. (c) Catalyst never change the equilibrium constant.

21. (b) Because reactant and catalyst are present in same physical state.

23. (a) $\underset{Glucose}{C_6H_{12}O_6} \xrightarrow[Enzyme]{Zymase} \underset{Ethanol}{2C_2H_5OH} + 2CO_2$

24. (b) $C_6H_6 + CH_3Cl \xrightarrow[AlCl_3]{Anhydrous} C_6H_5CH_3 + HCl$

25. (c) $CH_3COOC_2H_5 + HOH \xrightarrow[Catalyst]{Conc.\ H_2SO_4}$

    $CH_3COOH + C_2H_5OH$

27. (d) Catalyst does not depend on the enthalpy of the reactants.

30. (c) Catalyst does not depend on the free energy change in the reaction.

31. (d) Activation energy changes when catalyst is used in a reaction.

32. (c) In the reversible reaction a catalyst is the substance which reduces the time required for reaching the equilibrium state in the reaction.

36. (b) $Maltose \xrightarrow[enzyme]{Maltase} Glucose$

37. (d) Efficiency of catalysing property is inversely proportional of activation energy.

39. (a) $\underset{(g)}{2SO_2} + \underset{(g)}{O_2} \xrightarrow[Asbestose\ (s)]{Platinized} 2SO_3$ ; Example of heterogeneous catalyst.

40. (d) $Oil + H_2 \xrightarrow{Ni} Ghee$ .

41. (b) Catalyst is not effect on equilibrium concentrations.

42. (a) $4NH_3 + 5O_2 \xrightarrow[1100\ K]{Pt\ guage} 4NO \xrightarrow{O_2} 4NO_2$

$$\xrightarrow{2H_2O+O_2} 4HNO_3$$

**48.** (d) $4NH_3 + 5O_2 \xrightarrow[1100\,K]{Pt\ guage} 4NO \xrightarrow{O_2} 4NO_2$

$$\xrightarrow{2H_2O+O_2} 4HNO_3$$

**51.** (b) $nCH_3 - CH = CH_2 \xrightarrow{(CH_3CH_2)_3\,Al+TiCl_4}$

Propylene

$$\left[ -CH_2 - \overset{\overset{\displaystyle CH_3}{|}}{CH} - \right]_n$$

Polypropylene

**53.** (a) Ptyline (enzyme) is present in saliva.

**54.** (b) $2SO_2 + O_2 \underset{(g)\ \ (g)}{\xrightarrow{2\ NO(g)}} 2SO_3 + 2NO_{(g)}$, reactants and catalyst present in same phase.

**55.** (d) $2SO_2 + O_2 \xrightarrow[As_2S_3\,(Poison)]{Platinised\,asbestos(catalyst)} 2SO_3$

**58.** (d) $Mn^{++}$ is a product in reaction so it is auto catalyst (according to definition).

**62.** (c) $2SO_2 + O_2 \xrightarrow[(Catalyst)]{V_2O_5} 2SO_3$

**63.** (b) $2SO_2 + O_2 \underset{(g)\ \ (g)}{\xrightarrow[Asbestos(promoter)]{Pt\ Catalyst}} 2SO_3(g)$

**65.** (a) Generally transition elements acts as catalysts. Adam's catalyst is another name of platinum.

**69.** (b) Enzyme activity is maximum at $310\,K$.

**70.** (b) Catalyst is a substance which changes the rate of reaction without affecting the overall energetics of the reaction.

**71.** (d) $Ni, Pt$ and $Co$ all three transition metals are used as a catalysts.

**72.** (d) Catalyst is a substance which changes the rate of reaction without affecting the overall energetics of the reaction.

**73.** (c) Many of the $d$-block (transition) elements and their compounds act as catalyst. Catalytic property is probably due to the utilisation of $(n-1)d$ orbitals or formation of interstitial compounds.

**74.** (a) The catalytic process in which the reactants and the catalyst are in different phases is known as heterogenous catalysis.

$$N_{2(g)} + 3H_{2(g)} \xrightarrow{Fe(s)} 2NH_{3(g)}$$
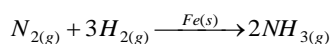
The reactants are in gaseous state while the catalyst is in solid state.

## Colloids, Emulsion, Gel and Their properties with application

**4.** (a) Negatively charged $As_2S_3$ sol coagulated most effectively by $AlCl_3$. This is because oppositely charged $Al^{+++}$ ions have maximum charge.

$$As^{3+} > Ca^{2+} > Na^+$$
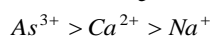
**6.** (d) $K_3[Fe(CN)_6]$ is most effective in coagulating a ferric hydroxide sol.

**7.** (d) Sky looks blue due to scattering of light by dust particles present in the atmosphere.

**10.** (c) $KBr$ is least effective in causing flocculation of ferric hydroxide sol due to minimum charge at $(KBr)\ Br^-$

**11.** (c) $\underset{\substack{(Dispersed\\phase)}}{Liquid} + \underset{\substack{(Dispersion\\medium)}}{Solid} = \underset{(Colloid)}{Gel}$ (e.g. Butter)

**13.** (d) By definition gold number of starch is the amount of starch in $mg$ added to 10 $ml$ standard gold sol which prevents the coagulation of gold on adding 1 $ml$ of 10% $NaCl$ solution. So the amount of starch is $0.25g = 250\ mg$. Hence gold number is 250.

**15.** (c) According to Hardy schulze rule the ions having opposite charge to sol particle cause coagulation and greater the valency of oppositely charged ion more is the coagulating power $(PO_4^{3-} > SO_4^{2-} > NO_3^-)$.

**17.** (b) Gold number is associated with only lyophilic colloids due to protective nature.

**19.** (a) Negatively charged sols require minimum amount of electrolyte having higher valence of cation.

**22.** (b) Lyophilic possesses solvent loving nature and thus a thin layer of dispersed phase is formed round sol particles.

**23.** (a) Milk is a colloid of liquid ($H_2O$) dispersed in liquid (fat).

**24.** (c) Smoke is an example of solid dispersed in gas.

**26.** (a) Movement of (charged) colloidal particles under the influence of electrostatic field is called electrophoresis due to opposite charge.

**27.** (c) $Fe(OH)_3$ gives a positively charged sol as it adsorbs $Fe^{3+}$ ions from $FeCl_3$ solution.

**29.** (a) Flocculation value is expressed in terms of millimole per litre.

**32.** (b) Gelatin is a protective colloid.

**36.** (b) $ZnCl_2$ has maximum coagulation power due to more charge on the $Zn$

**37.** (c) Air is not a colloidal solution because it is a homogeneous mixture.

**43.** (d) In Purification separation of colloids from crystalloids is done by the process of ultra-filtration.

**45.** (b) $\underset{(liquid)}{dispersed\ phase} + \underset{(gas)}{dispersion\ medium}$

$$= \underset{(clouds)}{colloidal\ system}$$

**46.** (b) Tyndall phenomenon is exhibited by starch solution because starch solution is a colloidal solution.

**53.** (b) Milk can be preserved by adding a few drops of $HCHO$ solution. $HCHO$ is an emulsifier.

**55.** (c) Properties of the colloidal solution depend upon physical state of dispersed phase and mol. wt.

**57.** (d) According to Graham, colloids are separated from crystalloids by parchment paper.

**60.** (b) Liquid aerosol involves liquid dispersed in gas, e.g. cloud, fog, mist etc.

**64.** (b) $2HNO_3 + 3H_2S \rightarrow \underset{(Sol)}{3S} + 4H_2O + 2NO$
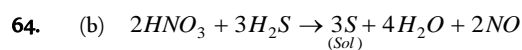
**65.** (b) Lyophobic colloids are irreversible colloids.

**66.** (b) Crystalloids are diffuse through parchment membranes.

**67.** (a) Colloidal particles range between $10^{-7}$ to $10^{-9}\ m$ or $10^{-5}$ to $10^{-7}\ cm$.

**70.** (c) $Fe^{3+}$ ion coagulates $-ve$ sol particles of blood and seals the cut.

**79.** (a) When a substance comes in colloidal state the surface area of the particles increases due to small size than substance.

**80.** (b) Alum can be separated from a solution by electrodialysis due to alum give $Al^{3+}$ ion in solution.

**82.** (d) The amount of electrolyte required to coagulate a fixed amount of a solution depends upon the valency of the flocculation ion.

The flocculating power of the various ions follows the following order, larger the valency lesser will be coagulating value. $Al^{3+} > Mg^{2+} > Na^+$, hence lowest coagulation value is of $AlCl_3$

**88.** (d) Gelatin is a protective colloid in ice-cream.

**90.** (c) Tyndall effect is not observed in sugar solution due to homogeneous nature.

**92.** (a) Dispersion medium and dispersed phase are phase of colloid.

**99.** (a) $As_2S_3$ is coagulated by addition of electrolyte due to opposite charge.

**104.** (c) According to Hardy-Schulze rule.

**111.** (a) Scattering of light is a property of colloid.

**115.** (c) Some gelatin is mixed in colloidal solution of gold to form ppt of gold (peptization of gold). Because formation of layer on colloidal particle.

**120.** (b) "Delta" at the rivers are formed due to coagulation between sea water (+ve charged particles) and river water (−ve charged particles)

**121.** (b) Tyndall effect expressed by hydrophobic sols.

**129.** (c) Protein sol in water is a example of heteropolar sol.

**130.** (d) For stabilise the sol.

**131.** (c) Solution of urea is not a colloid.

**135.** (b) Liquid + Gas = Whipped cream
(Dispersion medium)  (Dispersed phase)  Colloidal solution

**137.** (b) Alum is a coagulating agent, frequently added to water to remove impurities from water because impurities contain negative charge and alum give positive charge particle for coagulation.

**139.** (c) Alum is purifies muddy water by coagulation due to opposite charge.

**142.** (c) The particle size is in the order $10 \text{Å} - 1000 \text{Å}$.

**144.** (a) $FeCl_3$ is a electrolyte give $Fe^{3+}$ and blood contain negatively colloid so stop bleeding due to coagulation.

**145.** (c) AT (CMC) critical micellization concen-tration, the surfactant molecules associate to form miscelles. For soap CMC is $10^{-3}$ $mol/litre$

**146.** (b) Inhibitors are also known as negative catalyst.

**147.** (c) Benzene is non polar in nature. As we know that non-polar disperses more to non-polar substances. Therefore, meta-metyl nonylbenzene being nonpolar from both sides will disperse more to benzene. All other substances (a, b and d) have either one side polar or both sides polar.

$$\equiv H_{10}C_0 - C_6H_4 - CH_2$$
non-polar end   (metamethyl nonylbenzene)   non-polar end
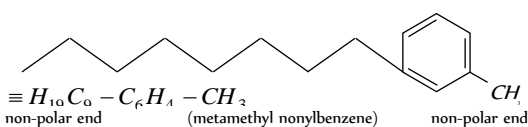
**151.** (a) The protective action of different colloids is expressed in terms of Gold number.

**156.** (a) Tyndall effect may be defined as the scattering of light by the colloidal particles present in a colloidal sol.

**158.** (a) It is due to adsorption of $S^{2-}$ ions on the surface of the colloidal particles and $H^+$ ions in the diffused layer.

**168.** (c) Alum helps in purifying water by $Al^{3+}$ ions which coagulate the negative mud particles.

**169.** (d) $Sn^{+4}$ contain maximum coagulation power (coagulation power ∝ number of charge on ion)

**170.** (d) It is liquid in gas colloidal solution.

**175.** (c) Colloidal particles becomes uncharged at isoelectric point.

**176.** (c) Example of multimolecular colloid system is a gold dispersed in water.

**179.** (a) The phenomenon of converting of fresh mass into colloidal state by the action of solute or solvent is known as peptization.

**180.** (a) Surface tension of lyophilic sol is lower than that of the dispersion medium (i.e. $H_2O$ in this case.)

**182.** (b) Hydrophilic sol can act as protective colloids for hydrophobic solution.

**183.** (d) Metal sulphide is not used for preparing lyophilic sol.

**185.** (b) According to definition emulsification.

**186.** (d) Toilet soap is a mixture of potassium salt of higher fatty acids.

**187.** (c) Coagulation is governed by Hardy Schulze rule.

**189.** (a) Protective power $\propto \dfrac{1}{\text{Gold number}}$

Gold number of $A$ is least, therefore, it has the highest protective power.

**190.** (b) Bredig's arc method is suitable for the preparation of colloidal solution of metal like gold silver, platinum etc. An arc is struck between the metal electrode under the surface of water containing some stabilizing agent such as a trace of KOH. However, $Fe$ does not react with alkalies that is why it is not obtained by Bredig's arc method.

**191.** (d) Gold number shows the protective power of a lyophilic solution. Lesser the gold number, greater will be the protecting power of that colloid. Gelatin is one of the best protective colloid. Among the given colloids, potato starch has maximum gold number.

**192.** (a) Protective power $\propto \dfrac{1}{\text{Gold number}}$

Thus gelatin is the best protective colloid.

**193.** (b) Protective power $\propto \dfrac{1}{\text{Gold number}}$

Hence, the correct order of protective power is $B > A > C > D$.

**194.** (c) A catalyst does not participate in the reaction but alters the rate of reaction.

**195.** (a) A colloid of liquid in liquid is called emulsion cod liver oil is such an emulsion.

**196.** (a) Suspension of solid in a liquid.

**197.** (c) By the peptization, precipitate is changed to colloidal solution.

**198.** (a) An aerosol is a dispersion of a solid or liquid in a gas.

**199.** (d) Lyophilic sols are self stabilizing because these sols are reversible and are highly hydrated in the solution.

**200.** (d) $\dfrac{V_c}{V_s} = \dfrac{10^{-5}}{10^{-7}} \approx 10^3$

**204.** (a) Alum contains many cations and water has many anionic impurities. On adding alum coagulates the suspended impurities and make water fit for drinking purposes.

**205.** (a) For the stabilisation of an emulsion a third component called emulsifying agent is usually added. The emulsifier forms an interfacial film between suspended particles and the medium.

**206.** (b) Alum is added to muddy water so as to destroy the bacteria as well as to coagulate the suspended impurities.

**207.** (b) Fog is an example of aerosol where the dispersed phase is liquid and dispersion medium is gas.

**208.** (c) Lyophilic sols, are more stable than Lyophobic sols because after vaporization its remaining residue, convert into colloidal state after the addition of solvent.

**209.** (e) The substance, whose molecules associate with given solvent to form colloidal particle known as association colloidal. The molecule of soap & detergent are generally smaller than colloidal particle. These molecules associate in concentration solution to form colloidal size particle. These association of soap & detergent known as miscelle.

## Critical Thinking Questions

**1.** (a) Lyophillic means liquid loving hence hydration is contributed toward the extra stability of lyophillic colloids.

**2.** (d) Traces of electrolytes are essential for stabilising the sales hence for sales destruction addition of electrolytes are required.

**3.** (c) A catalyst is a substance which alters the rate of reaction and shortens the time to reach equilibrium.

**4.** (d) Inhibitors are also catalysts but they slow down the rate of reaction.

**5.** (d) The ability of an ion to bring about coagulation of a given calloid depend upon both the magnitude and sign of its charge.

**6.** (c) Physiorption is a process in which the particles of adsorbate are held to the surface of adsorbent by physical forces hence does not requires activation energy.

**7.** (a) Egg is a calloid of solid and liquid; Ruby glass is a colloid of solid and solid. Milk is a colloid of liquid and liquid but chlorophyll is a complex of magnesium.

**8.** (b) Surfactant are those which have charge on their tail e.g., cetyltrimethyl ammonium bromide.

$$CH_3 - (CH_2)_{15} - \overset{\overset{\displaystyle CH_3}{|}}{N^+} - CH_3 - Br^-$$
$$\underset{\displaystyle CH_3}{|}$$
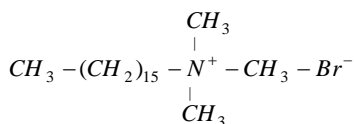
Surfactants are those, which dissociate in water to yield positively charged ion.

**9.** (a) The size of colloidal particles is of the order $0.1 m\mu$ to $0.001 m\mu$.

**10.** (b) $K_4[Fe(CN)_6]$ is most effective in the coagulation of gold-solution.

**11.** (d) A catalyst is used to decrease the time required for the reaction hence it can decease or increase the rate of reaction.

**12.** (d) Absorption, Tyndall effect and flocculation all are related to sol but paramagnetism is not represented by sol.

**13.** (a) On shaking with the dispersion medium, colloids directly form the colloidal sol. Hence they are called intrinsic colloids. *i.e.,* glue.

**14.** (c) Arsenious sulphide can be prepared by double decomposition
$$As_2O_3 + 3H_2S \rightarrow As_2S_3 + 3H_2O$$

**15.** (c) The amount of electrolyte required to coagulate a fixed amount of a sol depends upon the valency of flocculating ion.

**16.** (d) Gold no. is a measure of protective power of a lyophillic colloid.

**17.** (c) The colloidal solution of liquid in liquid is called emulsion not gel.

**18.** (d) Linseed oil, lanolin and Glycogen attract water hence contain a hydrophobic structure but rubber does not attract water and does not contain a hydrophobic structure.

**19.** (c) Gum-arabic has protective power hence the function of it ion in preparation of indian ink is protective action.

**20.** (b) Easily liquefiable gases like $SO_2, NH_3, CO_2$ are adsorbed to a greater extent than the elemental gases like $N_2, O_2, H_2$.

**21.** (d) Volume of the gold dispersed in one litre water $= \dfrac{Mass}{Density}$

$$= \dfrac{1.9 \times 10^{-4}\ gm}{19\ gm\ cm^{-3}} = 1 \times 10^{-5}\ cm^{-3}$$

Radius of gold sol particle $= 10\ nm = 10 \times 10^{-9}\ m$

$$= 10 \times 10^{-7}\ cm = 10^{-6}\ cm$$

Volume of the gold sol particle $= \dfrac{4}{3}\pi r^3$

$$= \dfrac{4}{3} \times \dfrac{22}{7} \times (10^{-6})^3 = 4.19 \times 10^{-18}\ cm^3$$

No. of gold sol particle in $1 \times 10^{-5}\ cm^3 = \dfrac{1 \times 10^{-5}}{4.19 \times 10^{-18}}$

$$= 2.38 \times 10^{12}$$

No. of gold sol particle in one $mm^3$

$$= \dfrac{2.38 \times 10^{12}}{10^6} = 2.38 \times 10^6$$

**22.** (d) Sodium acetate forms cationic micelles in the molecule of soap and detergent the negative ions aggregate to form a micelle of colloidal size. The negative ion has a long hydrocarbon chain and a polar group $(-COO^-)$ at one end.

## Assertion & Reason

**1.** (a) Both assertion and reason are true and reason is the correct explanation of assertion.

The surface of a solid (or liquid) tends to attract and retain other molecules when it is brought in contact with a gas or a solution.

**2.** (e) Assertions is false but reason is true.

The enthalpy of chemisorption is of the order of $200\ kJmol^{-1}$ while for physical adsorption it is of the order of $20\ kJmol^{-1}$.

**3.** (a) Both assertion and reason are true and reason is the correct explanation of assertion .

**4.** (c) Assertion is true but reason is false.

Freundlich adsorption isotherm gives an empirical relation ship between the quantity of gas adsorbed by unit mass of solid adsorbent and pressure at a particular temperature.

**5.** (d) Both assertion and reason are false.

There are reactions in which one of the products acts as catalyst (autocatalysis) and no catalyst is added.

**6.** (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

ZSM − 5 converts alcohols directly into gasoline (petrol) by dehydrating them so that a mixture of hydrocarbons is formed.

**7.** (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

If the dispersion medium is separated from the dispersed phase, the lyophilic sol can be reconstituted by simply remixing with the dispersion medium. That is why these sols are also called reversible sols.

**8.** (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

The size of colloidal particles is large enough to scatter light while particles of a true solution are too small to scatter light.

**9.** (a) Both assertion and reason are true and reason is the correct explanation of assertion.

The impact of the molecules of the dispersion medium on the colloidal particle are unequal leading to zig-zag motion *i.e.,* Brownian movement.

10. (a) Both assertion and reason are true and reason is the correct explanation of assertion.
According to Hardy – Schulze rule : Coagulating power of an electrolyte is directly proportional to the fourth power of the valency of the ions causing coagulation.

11. (a) Both assertion and reason are true and reason is the correct explanation of assertion.
Soap coats the drops of an emulsion and checks them from coming together and the emulsion is thus stabilised.

12. (a) It is fact that deep electric shock causes death of an animal and the reason for this is that blood is coagulated by electric shock. Therefore, here both assertion and reason are true.

13. (a) A catalyst is more effective in finely divided form because finely divided form has more surface area. Therefore there is an increase in active centres on the surface.

14. (c) $NH_3$ absorbs more readily over activated charcoal than $CO_2$ it is correct. The reason is the polar nature of $NH_3$ due to which it readily absorb. Hence assertion is true but reason is false.

15. (a) The sky appears blue because the colloidal particles of dust, dirt in air scatter blue light to the maximum extent. Here both assertion and reason are correct and reason is the correct explanation of assertion.

16. (d) The assertion that physical absorption of molecules takes place on surface only is false. Actually absorption takes place on the whole body. In physical absorption the bonds of absorption molecules are not broken. Hence, both assertion and reason are false.

17. (b) Here both assertion and reason are correct but reason is not a correct explanation of assertion. Micelle is formed if molecules with polar and nonpolar ends assemble in bulk to give nonpolar interior and polar exterior.

18. (a) Both assertion and reason are true and reason is the correct explanation of assertion. Scattering of light is the main phenomenon of colloidal particles. In which colloidal particles scatter a particular wavelengths light.

19. (c) It is true that if we increase the surface area the rate of evaporation also increase as evaporation is always takes place from the surface. But if the intermolecular attraction is stronger than the rate of evaporation is slower.