Solved Examples

JEE Main/Boards

Example1: What are the physical states of dispersed phase and dispersion medium of froth?

Sol: Froth is a small mass of bubbles in liquid.
Dispersed phase   : Gas
Dispersion medium   : Liquid

Example 2: Define the term 'Tyndall effect'.

Sol: The scattering of light by colloidal particles is known as Tyndall effect.

Example 3: What is meant by the term peptization?

Sol: The process of conversion of a freshly prepared precipitate into a colloidal solution by adding a suitable electrolyte is called peptization.

Example 4: Explain the following terms with suitable example (i) Alcohol (ii) Serosol and (iii) Hydrosol.

Sol: (i) Alcohol: It is a colloidal dispersion having alcohol as the dispersion medium e.g. collodion (a colloidal sol of cellulose nitre in ethyl alcohol.)

(ii) Serosol: It is a colloidal dispersion of a liquid in a gas e.g. fog.

(iii) Hydrosol: It is a colloidal sol of a solid in water as the dispersion medium e.g. starch sol or gold sol.

Example 5: The movement of sol particles under an applied electric field is called:

(A) Electro deposition   (B) Electrodialysis

(C) Electro-osmosis (D) Electrophoresiss

Sol: (D) Colloidal Particles carry charge (positive or negative) and thus on application of electric field they move towards opposite electrodes and the phenomenon is known as cataphores is or electrophoresis.

Example 6: At CMC, the surfactant molecules undergoes:

(A) Association   (B) Aggregation

(C) Micelle formation   (D) All of these

Sol: (D) All are same processes.

Example 7: A catalyst:

(A) Alter the state of equilibrium

(B) Decreases the activation energy

(C) Increases collision frequency

(D) Increases the average kinetic energy of reacting species.

Sol: (B) Catalyst shows exothermic adsorption of reactant molecules and thus energy of activation is lowered.

Example 8: Plots of $\log\left(\dfrac{x}{m}\right)$ vs. log C showing a straight line parallel to X-axis reveals that:

(A) n = 0   (B) $\dfrac{1}{n} = 0$

(C) C = 0   (D) log C = constant

Sol: (B) $\dfrac{x}{m} = K \cdot C^{1/n}$

Example 9: Which characteristic is not correct for physical adsorption?

(A) Adsorption is spontaneous

(B) Both enthalpy and entropy change of adsorption are negative

(C) Adsorption on solid is reversible

(D) Adsorption increases with increase in temperature

Sol: (D) Physical adsorption is non-directional, reversible, multilayers exothermic process where adsorbent are held by physical forces such as van der waal forces.

Example 10: The minimum energy level necessary to permit a reaction to occur is:

(A) Internal energy   (B) Threshold energy

(C) Activation energy   (D) Free energy

Sol: (B) The minimum energy required to permit a reaction to occur is called as Activation Energy.

JEE Advanced/Boards

Example 1: A negatively charged yellow sol of As_2S_3 on mixing with a +vely charged $Fe(OH)_3$ red sol in equivalent amount give rise to colorless solution. Why?

Sol: Mutual coagulation leaves behind colorless Liquid which is water. The negative charge on As_2S_3 and positive charge on $Fe(OH)_3$ neutralizes each other causes mutual coagulation and thus dispersed particles of As_2S_3 and $Fe(OH)_3$ are settled down leaving water, which is colorless.

Example 2: 0.1 M $AlCl_3$ solution is more effective than 0.1 M NaCl solution in coagulating As_2S_3 sol while 0.1 M $AlCl_3$ is less effective than 0.1 M Na_3PO_4 solution in coagulating ferric oxide

Sol: As_2S_3 is a negatively charged sol and thus effective ions are Al^{3+} and Na^+ whereas Fe_2O_3 is a positively charged sol and the effective ions and Cl^- and PO_4^{3-}. More is the valence of effective ion, more is its coagulating power. Thus, Al^{3+} is more effective than Na^+ and PO_4^{3-} is more effective than Cl^-

Example 3: Action of soap is due to emulsification and micelle formation. Comment.

Sol: Soap molecule has water soluble head and oil soluble tail. The soap molecules get adsorbed on the dirty (oily) surface through the tail and try to emulsify it. Soap micelles do solubilize the insoluble dirt/greasy material.

Example 4: The average molecular weight of colloidal particles is determined by:

(A) Tyndall effect

(B) Osmotic pressure measurement

(C) Victor Meyer's method

(D) None of the above

Sol: (B) The osmotic pressure measurements gives average molecular weight of colloidal particles.

Example 5: Acid deposits on pans can be removed by boiling pans with washing soda. Explain.

Sol: The basic reaction behind this process is saponification.

Na_2CO_3 (washing soda) on hydrolysis forms NaOH which on boiling with fat give rise to saponification.

RCOOR + NaOH → RCOONa + ROH
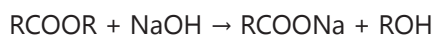
A part of fat is thus used and rest fat is removed by the soap so formed.

Example 6: Which of the following is not correct about colloids?

(A) The $[H^+]$ at which colloids particles do not carry charge is called isoelectric point of colloid

(B) At isoelectric point of colloidal state possess minimum stability

(C) At isoelectric point sol particles possess no electrophoretic motion

(D) Silicic acid sol have minimum stability at its isoelectric point.

Sol: (D) It is an exception and the silicic acid sol possess maximum stability.

Example 7: Why a finely divided substance is more effective as an adsorbent?

Sol: Finely divided substances have very large specific surface area and therefore provide more sites for adsorption.

Example 8: Show that if a cube of 1 cm^3 is broken into smaller cubes such that each side is divided just in the middle. How many cubes will be formed? Also calculate the total surface area of such cubes.

Sol: First calculate the surface area of one cube of edge length of (0.5 cm) now by calculating the volume of one cube find out the number of cubes formed by a cube of 1 cm now by using volume and no of cubes calculate the new surface area.

Surface area of cube = $6a^2$

a = 1

Total surface area of cube of $1cm^2$ = 6×1^2 = 6 cm^2

Total surface are of one cube of 1/2 cm edge

$$= 6 \times \frac{1}{2} \times \frac{1}{2} = 1.5$$

No of cubes x Volume of 1 cube of ½ edge length $(1/2)^3$ cm = Volume of 1 cube of 1 cm edge length $(1)^3$

n x 0.125 = 1

n = 1/0.125

n = 8

Let each side be halved, than total number of cubes formed of edge length of each cube $\frac{1}{2}$ cm are 8.

Thus surface area of 8 cubes $= 8 \times 6 \times \dfrac{1}{2} \times \dfrac{1}{2} = 12$ cm².

Example 9: Why it is advantageous to use a catalyst for a reaction having endothermic nature?

Sol: For an endothermic reaction (ΔH = +ve) and thus heat is required to get better yield which raises the cost appreciably. In presence of catalyst, less heat is required to start a reaction.

Example 10: What role does adsorption play in heterogeneous catalysis?

Sol: Heterogeneous catalysis generally employs a solid adsorbent and the reactants are mostly gases. The reactions occurs at the surface of the catalyst where the reactant molecules (adsorbates) get chemisorbed. Due to adsorption, chances of effective collisions in reactant molecule increases.

JEE Main/Boards

Exercise 1

Q.1 Why is ferric chloride preferred over Potassium chloride in case of a cut leading to Bleeding?

Q.2 What causes Brownian movement in a colloidal solution?

Q.3 Which has a higher enthalpy of adsorption, physisorption or chemisorptions?

Q.4 Mention two ways by which lyophilic colloids can be coagulated.

Q.5 What is an emulsion?

Q.6 What is physical adsorption?

Q.7 What is meant by chemical adsorption?

Q.8 What is desorption?

Q.9 How is adsorption of a gas related to its critical temperature?

Q.10 Why is a colloidal sol stable?

Q.11 Write two difference between sols and emulsions.

Q.12 Define ultrafiltration?

Q.13 Why do colloidal solutions exhibit Tyndall effect?

Q.14 Why artificial rain can be caused by throwing common salt on the clouds?

Q.15 What happens when an electric field is applied to a colloidal dispersion?

Q.16 Account for the following:

(i) Ferric hydroxide sol is positively charged.

(ii) The extent of physical adsorption decreases with rise in temperature.

(iii) A delta is formed at the point where the river enters the sea.

Q.17 Explain the following terms:

(i) Electro-dialysis

(ii) Phases of a colloidal solution

Q.18 What is meant by 'shape selective' catalysis?

Q.19 What is adsorption? How does adsorption of a gas on a solid surface very with (a) temperature and (b) pressure? Illustrate with the help of appropriate graphs.

Q.20 Explain what is observed when

(i) An electrolyte is added to ferric hydroxide Sol

(ii) An emulsion is subjected to centrifugation.

(iii) Direct current is passed through a colloidal Sol

Q.21 How do size of particles of adsorbent, pressure of gas and prevailing temperature influence the extent of adsorption of a gas on a solid?

Q.22 (a) In which of the following does adsorption take place and why?

(i) Silica gel placed in the atmosphere saturated with water.

(ii) Anhydrous $CaCl_2$, placed in the atmosphere saturated with water.

(b) How does BF_3 act as a catalyst in industrial process? Give an example of shape-selective catalysis.

Q.23 (i) What are micelles? How do they differ from ordinary colloidal particles? Give two examples of micelles forming substances.

(ii) State Hardy-Schulze rule.

Q.24 Describe the following types of colloids, giving an example for each:

(i) Multimolecular colloids

(ii) Macromolecular colloids

Q.25 Of physisorption and chemisorption which type of adsorption has a higher enthalpy of adsorption?

Q.26 Explain what is observed when

(i) KCl, an electrolyte, is added to hydrated ferric oxide sol

(ii) An electric current is passed through a colloidal solution.

(iii) A beam of light is passed through a colloidal solution.

Q.27 Describe the following:

(i) Tyndall effect

(ii) Shape-selective catalysis

Q.28 Coagulations of lyophobic sols can be carried out by?

Q.29 Describe a conspicuous change observed when

(i) A solution of NaCl is added to a sol of hydrated ferric oxide.

(ii) A beam of light is passed through a solution of NaCl and then through a sol

Q.30 What is meant by coagulation of a colloidal solution? Describe briefly any three methods by which coagulation of lyophobic sols can be carried out.

Exercise 2

Single Correct Choice Type

Q.1 Which gas will be adsorbed on a solid to greater extent?

(A) A gas having non polar molecule

(B) A gas having highest critical temperature

(C) A gas having lowest critical temperature

(D) A gas having highest critical pressure

Q.2 Which of the following factors affects the adsorption of a gas on solid?

(A) T_c (critical temp.)   (B) Temperature of gas

(C) Pressure of gas   (D) All of them

Q.3 The volume of gases NH_3, CO_2 and CH_4 adsorbed by one gram of charcoal at 298 K are in

(A) $CH_4 > CO_2 > NH_3$ (B) $NH_3 > CH_4 > CO_2$

(C) $NH_3 > CO_2 > CH_4$ (D) $CO_2 > NH_3 > CH_4$

Q.4 Platinum is not used as a catalyst in the

(A) Oxidation of CH_3OH to HCHO

(B) Oxidation of SO_2 to SO_3

(C) Combination of H_2 and I_2 to form HI

(D) Synthesis of NH_3 from N_2

Q.5 Which type of metals form effective catalysts?

(A) Alkali metals

(B) Transition metals

(C) Alkaline earth metals

(D) Radioactive metals

Q.6 The heat of physisorption lie in the range of

(A) $1 – 10$ kJ mol^{-1} (B) 20 to 40 kJ mol^{-1}

(C) 40 to 200 kJ mol^{-1} (D) 200 to 400 kJ mol^{-1}

Q.7 Adsorption is multilayer in case of

(A) Physical adsorption (B) Chemisorptions

(C) In both   (D) None of these

Q.8 Reversible adsorption is

(A) Chemical adsorption

(B) Physical adsorption

(C) Both (A) and (B)

(D) None of these

Q.9 Which of the following is not a gel?

(A) Cheese   (B) Jellies

(C) Curd   (D) Milk

Q.10 The amount of gas adsorbed physically on charcoal increases with increase of

(A) Temperature and pressure

(B) Temperature and decreases of pressure

(C) Pressure and decreases of temperature

(D) None of these

Q.11 An emulsion is a colloidal system of

(A) Two solids

(B) Two liquids

(C) One gas and one solid

(D) One gas and one liquid

Q.12 Which of the following is a lyophobic colloid?

(A) Gelatin   (B) Sulphur

(C) Starch   (D) Gum

Q.13 The nature of bonding forces in adsorption

(A) Purely physical such as Van Dar Waal's forces

(B) Purely chemical

(C) Both chemical and physical always

(D) None of these

Q.14 Which can adsorb larger volume of hydrogen gas?

(A) Colloidal solution of palladium

(B) Finely divided nickel

(C) Finely divided platinum

(D) Colloidal $Fe(OH)_3$

Q.15 Which statement is correct?

(A) A catalyst increases the rate of a reaction by decreasing the rate of backward reaction

(B) The reaction is fast if the activation energy of a reaction is low

(C) The activation energy of a forward reaction can never be smaller than that of the back ward reaction

(D) Reaction rate increases with temperature because the activation energy decreases at high temperature

Q.16 The Tyndall effect associated with colloidal particles is due to

(A) Presence of electrical charges

(B) Scattering of light

(C) Absorption of light

(D) Reflection of light

Q.17 Which one of the following is not applicable to chemisorptions?

(A) Its heat of adsorption is high

(B) It takes place at high temperature

(C) It is reversible

(D) It forms mono-molecular layers

Q.18 In the colloidal state the particle size ranges

(A) Below 1 nm

(B) Between 1 m to 100 nm

(C) More than 100 nm

(D) None of the above

Q.19 All colloids

(A) Are suspensions of one phase in another

(B) Are two-phase systems

(C) Contain only water-soluble particles

(D) Are true solutions

Q.20 Which is an example of auto-catalysis?

(A) Decomposition of $KClO_3 + MnO_2$ mixture

(B) The decomposition of nitroglycerine

(C) Breakdown of $_6C^{14}$

(D) Hydrogenation of vegetable oils using catalyst

Q.21 Colloids can be purified by

(A) Condensation   (B) Peptization

(C) Coagulation   (D) Dialysis

Q.22 Milk is an example of

(A) Emulsion   (B) Suspension

(C) Foam   (D) Sol

Q.23 Colloidal particles in a sol can be coagulated by

(A) Heating

(B) Adding an electrolyte

(C) Adding oppositely charged sol

(D) Any of the above methods

Q.24 Enzymes are

(A) Substances made by chemists to activate washing powder

(B) Very active vegetable catalysts

(C) Catalysts found in organisms

(D) Synthetic catalysts

Q.25 Fog is a colloidal system of

(A) Gas in liquid   (B) Liquid in gas

(C) Gas in gas   (D) Gas in solid

Q.26 Given below are a few electrolytes, indicate which one among them will bring about the coagulation of a gold sol quickest and in the least of molar concentration?

(A) NaCl   (B) $MgSO_4$

(C) $Al_2(SO_4)_3$ (D) $K_4[Fe(CN)_6]$

Q.27 When a lyophobic colloidal solution is observed, we can see

(A) Light scattered by colloidal particle

(B) Size of the colloidal particle

(C) Shape of the colloidal particle

(D) Relative size of the colloidal particle

Q.28 The process which is catalysed by one of the products formed during the reaction is known

(A) Auto-catalysis   (B) Anti-catalysis

(C) Negative catalysis   (D) Acid catalysis

Q.29 Colloidal solutions are classified on the basis of

(A) Molecular size

(B) Organic or inorganic

(C) Surface tension value

(D) pH value

Q.30 The minimum concentration of an electrolyte required to cause coagulation of a sol is called

(A) Flocculation value   (B) Gold number

(C) Protective value   (D) None of these

Q.31 Smoke precipitator works on the principle of

(A) Distribution law

(B) Neutralization of charge on colloids

(C) Le-Chaterlier's principle

(D) Addition of electrolytes

Q.32 The disperse phase in colloidal iron (III) hydroxide and colloidal gold is positively and negatively charged respectively. Which of the following is not correct?

(A) Magnesium chloride solution coagulates the gold more readily than iron (III) hydroxide Sol

(B) Sodium sulphate solution cause coagulation in both sols

(C) Mixing of the sols has no effect

(D) Coagulation in both sols can be brought about by electrophoresis.

Previous Years' Questions

Q.1 Which of the following statements is incorrect regarding physisorption   *(2009)*

(A) It occur because of Van der Waals forces

(B) More easily liquefiable gases are adsorbed readily

(C) Under high pressure it results into multi molecular layer on adsorbent surface.

(D) Enthalpy of adsorption (ΔH-adsorption) is known and positive

Q.2 Which one of the following characteristics is not correct for physical adsorption   *(2003)*

(A) Adsorption on solid is reversible

(B) Adsorption increases with increase in temperature

(C) Adsorption is spontaneous

(D) Both enthalpy and entropy of adsorption are negative

Q.3 The equation for Freundlich adsorption isotherm is *(2012)*

(A) $\dfrac{x}{m} = kp^{1/n}$

(B) $x = mkp^{1/n}$

(C) $\dfrac{x}{m} = kp^{-n}$

(D) All of these

Q.4 Which one of the following is not a colloid? *(1992)*

(A) Milk

(B) Blood

(C) Solution of urea

(D) Ice cream

Q.5 Choose the correct reason(s) for the stability of the lyophobic colloidal particles *(2012)*

(A) Preferential adsorption of ions of their surface from the solution

(B) Preferential adsorption of solvent on their surface from the solution

(C) Attraction between different particles having opposite charge on their surface

(D) Potential difference between the fixed layer and the diffused layer of opposite charges around the colloidal particles

Q.6 The given graphs/data I, II, III and IV represent general trends observed for different physisorption and chemisorptions processes under mild conditions of temperature and pressure. Which of the following choice(s) about I, II, III and IV is (are) correct. *(2012)*
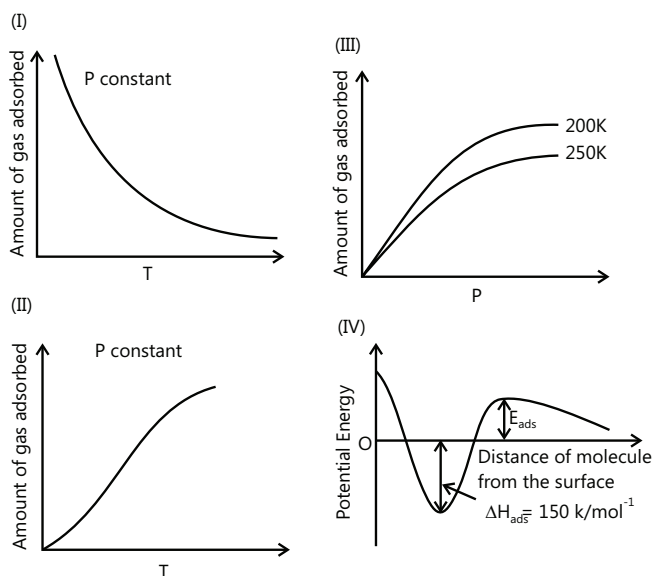
(A) I is Physisorption and II is chemisorption

(B) I is Physisorption and III is chemisorption

(C) IV is chemisorption and II is chemisorption

(D) IV is chemisorption and III is chemisorption

Q.7 Gold numbers of protective colloids A, B, C and D are 0.50, 0.01, 0.10 and 0.005, respectively. The correct order of their protective powers is *(2008)*

(A) D < A < C < B

(B) C < B < D < A

(C) A < C < B < D

(D) B < D < A < C

Q.8 Which of the following statements is incorrect regarding physisorption? *(2009)*

(A) It occurs because of Vander Waal's forces.

(B) More easily liquefiable gases are adsorbed readily.

(C) Under high pressure it results into multi molecular layer on adsorbent surface.

(D) Enthalpy of adsorption $\left(\Delta H_{adsorption}\right)$ is low and positive.

Q.9 According to Freundlich adsorption isotherm, which of the following is correct? *(2012)*

(A) $\dfrac{x}{m} \propto P^0$

(B) $\dfrac{x}{m} \propto P^1$

(C) $\dfrac{x}{m} \propto P^{1/n}$

(D) All the above are correct for different ranges of pressure

Q.10 The coagulating power of electrolytes having ions Na^+, Al^{3+} and Ba^{2+} for arsenic sulphide sol increases in the order: *(2013)*

(A) $Al^{3+} < Ba^{2+} < Na^+$

(B) $Na^+ < Ba^{2+} < Al^{3+}$

(C) $Ba^{2+} < Na^+ < Al^{3+}$

(D) $Al^{3+} < Na^+ < Ba^{2+}$

Q.11 3 g of activated charocoal was added to 50 mL of acetic acid solution (0.06N) in a flask. After an hour it was filtered and the strength of the fitrate was found to be 0.042 N. The amount of acetic acid adsorbed (per gram of charcoal) is: *(2015)*

(A) 18 mg

(B) 36 mg

(C) 42 mg

(D) 54 mg

Q.12 For a linear plot of log(x/m) versus log p in a Freundlich adsorption isotherm, which of the following statements is correct? (k and n are constants) *(2016)*

(A) 1/n appears as the intercept

(B) Only 1/n appears as the slope.

(C) log (1/n) appears as the intercept.

(D) Both k and 1/n appear in the slope term.

JEE Advanced/Boards

Exercise 1

Q.1 Give reason why a finely divided substance is more effective as an adsorbent.

Q.2 What are enzymes? Write in brief the mechanism of enzyme catalysis.

Q.3 What are emulsion? What are their different types? Give example of each type.

Q.4 Why are substances like platinum and palladium often used for carrying out electrolysis of aqueous solutions?

Q.5 Why are powdered substance more effective adsorbent that their crystalline forms?

Q.6 Why is it necessary to remove CO when ammonia is obtained by Haber's process?

Q.7 What is the role of desorption in the process of catalysis?

Q.8 Why is ferric chloride preferred over potatassium chloride in case of a cut leading to bleeding?

Q.9 What is the 'coagulation' process?

Q.10 Which will be adsorbed more readily on the surface of charcoal and why-NH_3 or CO_2?

Q.11 How is adsorption of a gas related to its critical temperature?

Q.12 What does you mean by activity of catalysis?

Q.13 What happens when gelatin is added to gold sol?

Exercise 2

Single Correct Choice Type

Q.1 Which equation represents Freundlich adsorption isotherm (physical adsorption is basis of this theory)?

(A) $\dfrac{x}{m} = K(P)^{1/n}$ Where x is amount of gas adsorbed on mass 'm' at pressure P

(B) $\log \dfrac{x}{m} = \log K + \dfrac{1}{n}\log P$

(C) $\dfrac{x}{m} = KP$ at low pressure and $\dfrac{x}{m} = K$ at high pressure

(D) All of these

Q.2 Emulsifier is an agent which

(A) Accelerates the dispersion

(B) Homogenizes an emulsion

(C) Stabilizes an emulsion

(D) Aids the flocculation of an emulsion

Q.3 The process which is catalysed by one of the products formed during the reaction is known

(A) Auto-catalysis   (B) Anti-catalysis

(C) Negative catalysis   (D) Acid catalysis

Q.4 The electrical charge on a colloidal particle is indicated by

(A) Brownian movement   (B) Electrophoresis

(C) Ultra microscope   (D) Molecular sieves

Q.5 Among the following, the surfactant that which will from micelles in aqueous solution at the lower molar concentration at ambient conditions is

(A) $CH_3(CH_2)_{15}N^+(CH_3)_3Br^-$

(B) $CH_3(CH_2)_{11}OSO_3^-Na^+$

(C) $CH_3(CH_2)_6COO^-Na^+$

(D) $CH_3(CH_2)_{11}N^+(CH_3)_3Br^-$

Comprehension Type

Paragraph 1: In macromolecular type of colloids, the dispersed particles are themselves large molecules (usually polymers) . Since these molecules have dimensions comparable to those of colloidal particles, their dispersions are called macromolecular colloids. Most lyophilic sols belong to this category. There are certain colloids which behave as normal strong electrolytes at low concentrations, but exhibit colloidal properties at higher concentrations due to the formation of aggregated particles. These are known as micelles or associated colloids. Surface active agents like soaps and synthetic detergents belong to this class.

Critical micelle concentration (CMC) is the lowest concentration at which micelle formation appear. CMC increases with the total surfactant concentrations. At concentration higher than CMC, they from extended parallel sheets known as lamellar micelles which resemble biological membranes. With two molecules thick, the individual molecule is perpendicular to the sheets such that hydrophilic groups are on the outside in aqueous solution and on the inside is a non-polar medium.

In concentrated solutions, micelles take the form of long cylinders packed in hexagonal arrays and are called lytotropic mesomorphs.

In an aqueous solution (polar medium), the polar group points towards the periphery and the hydrophobic hydrocarbon chain point towards the center forming the core of the micelle.

Micelles from the ionic surfactants can be formed only above a certain temperature called the Kraft temperature. They are capable of forming ions. Molecules of soaps and detergents consist of lyophilic as well as lyophilic parts which associate together to form micelles. Micelles may contain as many as 100 molecules or more.

Q.6 Select incorrect statement(s):

(A) Surface active agent like soaps and synthetic detergents are micelles

(B) Soaps are emulsifying agents

(C) $C_{17}H_{35}$ (hydrocarbon part) and $-COO-$ (carboxylate) part of stearate ion ($C_{17}H_{35}COO-$) both are hydrophobic

(D) All are incorrect statements

Q.7 Which part of the soap (RCOO–) dissolves grease and forms micelle?

(A) R part (called tail of the anion)

(B) – COO – part (called head of the anion)

(C) Both (A) and (B)

(D) None of these

Q.8 In multimolecular colloidal sols, atoms or molecules are held together by:

(A) H-bonding   (B) Van der Waals forces

(C) Ionic bonding   (D) Polar covalent boding

Q.9 Cleansing action of soap occurs because:

(A) Oil and grease can be absorbed into the hydrophobic centers of soap micelles and washed away

(B) Oil and grease can be absorbed into hydrophilic centers of soap micelles acid washed away

(C) Oil and grease can be absorbed into both hydrophilic and hydrophobic centers but not washed away

(D) Cleansing action is not related to micelles

Paragraph 2: The protective power of the lyophilic colloids is expressed in terms of gold number a term introduced by Zsigmondy. Gold number is the number of milligram of the protective colloid which prevent the coagulation of 10 mL of red gold sol. When 1 mL of a 10 percent solution of sodium chloride is added to it. Thus, smaller the gold number of lyophilic colloid, the greater is the protective power.

Q.10 On addition of one mL of solution of 10% NaCl to 10 mL of red gold sol in presence of 0.025 g of starch, the coagulation is just prevented. The gold number of starch is

(A) 0.025   (B) 0.25   (C) 2.5   (D) 25

Q.11 Which of the following statement(s) is/are correct

(A) Higher the gold number, more protective power of colloid

(B) Lower the gold number, more the protective power

(C) Higher the coagulation value, more the coagulation power

(D) Lower the coagulation value, higher the coagulation power

Q.12 Gold number gives an indication of

(A) Protective nature of colloids

(B) Purity of gold in suspension

(C) The charge on a colloidal solution of gold

(D) g-mole of gold per liter

Paragraph 3: Whenever a mixture of gases is allowed to come in contact with a particular adsorbent under the same conditions, the stronger adsorbate is adsorbed to greater extent irrespective of its amount present, e.g. H_2O is adsorbed to more extent on silica gel than N_2 and O_2. This shows that some adsorbates are preferentially adsorbed. It is also observed that preferentially adsorbable adsorbents can displace a weakly adsorbed substance from the surface of an adsorbent.

Q.13 Which of the following gases is adsorbed to maximum extent:

(A) He   (B) Ne   (C) Ar   (D) Xe

Q.14 Which of the gas can displace remaining all the gases.

(A) O_2 (B) N_2 (C) CO   (D) H_2

Q.15 When temperature is increased

(A) Extent of adsorption increases

(B) Extent of adsorption decreases

(C) No effect on adsorption

(D) Extent of adsorption first decreases, then increases

Assertion Reasoning Type

These questions consist of two statements each, printed as assertion and reason, while answering these questions you are required to choose any one of the following responses.

(A) If assertion is true but the reason is false

(B) If assertion is false but the reason is true

(C) If both assertion and reason are true and the reason is a correct explanation of assertion

(D) If both assertion and reason are true but reason is not a correct explanation of assertion.

Q16 Assertion: For adsorption ΔG, ΔH, ΔS all have –ve values

Reason: Adsorption is a spontaneous exothermic process in which randomness decreases due to force of attraction between adsorbent and adsorbate.

Q.17 Assertion: A gas with higher critical temperature gets adsorbed to more extent than a gas with lower critical temperature.

Reason: The easily liquefiable gases get adsorbed to more extent.

Q.18 Assertion: The micelle formed by sodium stearate in water has – COO– groups at the surface.

Reason: Surface tension of water is reduced by the addition of stearate.

Q.19 Assertion: Isoelectric point is pH at which colloidal can move towards either of electrode.

Reason: At isoelectric point, colloidal particles become electrically neutral.

Previous Years' Questions

Q.1 When the temperature is increased, surface tension of water   *(2002)*

(A) Increases   (B) Decreases

(C) Remains constant   (D) Shows irregular behavior

Q.2 Rate of physisorption increases with   *(2003)*

(A) Decrease in temperature

(B) Increase in temperature

(C) Decrease in pressure

(D) Decrease in surface area

Q.3 Spontaneous adsorption of a gas on solid surface is an exothermic process because   *(2004)*

(A) ΔH increases for system   (B) ΔS increases for gas

(C) ΔS decreases for gas   (D) ΔG increases for gas

Q.4 As gas is adsorbed on surface of solid, entropy decreases, i.e. $\Delta S < 0$. Therefore, for $\Delta G < 0$, ΔH must be negative. Lyophilic sols are   *(2005)*

(A) Irreversible sols

(B) Prepared from inorganic compounds

(C) Coagulated adding electrolytes

(D) Self-stabilizing

Q.5 Among the following, the surfactant that will form micelles in aqueous solution at the lowest molar concentration at ambient condition, is   *(2008)*

(A) $CH_3(CH_2)_{15}N^+(CH_3)_3Br^-$ (B) $CH_3(CH_2)_{11}OSO_3^-N^+$

(C) $CH_3(CH_2)_6COO^-N^+$ (D) $CH_3(CH_2)_{11}N^+(CH_3)_3Br^-$

Q.6 Among the electrolytes Na_2SO_4, $CaCl_2$, $Al_2(SO_4)_3$ and NH_4Cl, and NH_4Cl, the most effective coagulating agent for Sb_2S_3 sol is   *(2009)*

(A) Na_2SO_4 (B) $CaCl_2$ (C) $Al_2(SO_4)_3$ (D) NH_4Cl

Q.7 The correct statement(s) pertaining to the adsorption of a gas on a solid surface is (are)   *(2011)*

(A) Adsorption is always exothermic

(B) Physisorption many transform into chemisorption at high temperature

(C) Physisorption increases with increasing temperature but chemisorption decreases with increasing temperature

(D) Chemisorption is more exothermic than physisorption, however it is very slow due to higher energy of activation.

Assertion and Reasoning Type

Read the following questions and answer as per the direction given below:

(A) Statement-I is true: statement-II is a correct explanation of statement-I.

(B) Statement-I is true; statement-II is true; statement-II is not the correct explanation of statement-I

(C) Statement-I is true; statement-II is false.

(D) Statement-I is false, statement-II is true

Q.8 Statement-I: Micelles are formed by surfactant molecules above the critical micelle concentration (CMC).

Statement-II: The conductivity of a solution having surfactant molecules decreases sharply at the CMC. *(2007)*

Q.9 Methylene blue, from its aqueous solution, is adsorbed on activated charcoal at 250C. For this process, the correct statement is *(2013)*

(A) The adsorption requires activation at 25^oC.

(B) The adsorption is accompanied by a decrease in enthalpy.

(C) The adsorption increases with increase of temperature.

(D) The adsorption is irreversible

Q.10 When O_2 is adsorbed on a metallic surface, electron transfer occurs from the metal to O_2. The true statement(s) regarding this adsorption is(are) *(2015)*

(A) O_2 is physisorbed

(B) Heat is released

(C) Occupancy of $k\pi_{2p}^*$ of O_2 is increased

(D) Bond length of O_2 is increased

Q.11 Choose the correct reason(s) for the stability of the **lyophobic** colloidal particles. *(2012)*

(A) Preferential adsorption of ions on their surface from the solution

(B) Preferential adsorption of solvent on their surface from the solution

(C) Attraction between different particles having opposite charges on their surface

(D) Potential difference between the fixed layer and the diffused layer of opposite charges around the colloidal particles

MASTERJEE Essential Questions

JEE Main/Boards

Exercise 1

Q.3	Q.9	Q.13	Q.17
Q.19	Q.24	Q.31	

Exercise 2

Q.3	Q.12	Q.15	Q.26
Q.31			

Previous Years' Questions

Q.6

JEE Advanced/Boards

Exercise 1

Q.2	Q.4	Q.13

Exercise 2

Q.1	Q.5	Q.7	Q.10-12

Previous Years' Questions

Q.2	Q.6	Q.19

Answer Key

JEE Main/Boards

Exercise 2

Single Correct Choice Type

Q.1 B	**Q.2** D	**Q.3** C	**Q.4** D	**Q.5** B	**Q.6** B
Q.7 A	**Q.8** B	**Q.9** D	**Q.10** C	**Q.11** B	**Q.12** B
Q.13 B	**Q.14** A	**Q.15** B	**Q.16** B	**Q.17** C	**Q.18** B
Q.19 B	**Q.20** B	**Q.21** D	**Q.22** A	**Q.23** D	**Q.24** C
Q.25 B	**Q.26** C	**Q.27** A	**Q.28** A	**Q.29** A	**Q.30** A
Q.31 B	**Q.32** C				

Previous Years' Querstions

Q.1 D	**Q.2** B	**Q.3** D	**Q.4** C	**Q.5** A, D	**Q.6** A, C
Q.7 C	**Q.8** D	**Q.9** D	**Q.10** B	**Q.11** A	**Q.12** B

JEE Advanced/Boards

Exercise 2

Single Correct Choice Type

Q.1 D	**Q.2** C	**Q.3** A	**Q.4** B	**Q.5** A

Comprehension Type

Q.6 A, D	**Q.7** A	**Q.8** B	**Q.9** A	**Q.10** D
Q.11 B, D	**Q.12** A	**Q.13** D	**Q.14** C	**Q.15** B

Assertion Reasoning Type

Q.16 C	**Q.17** C	**Q.18** A	**Q.19** B

Previous Years' Questions

Q.1 B	**Q.2** A	**Q.3** C	**Q.4** D	**Q.5** A	**Q.6** C
Q.7 A,B,D	**Q.8** B	**Q.9** B	**Q.10** B,C,D	**Q.11** A, D	

Solutions

JEE Main/Boards

Exercise 1

Sol 1: As the charge of Fe^{3+} is high, it's coagulation power will be high. So, it can stop bleeding.

Sol 2: The Brownian movement is due to the collision between the particles of colloid & the medium of the solution.

Sol 3: Chemisorption because it involves breaking & forming of bonds. Physisorption just depends on weak Vander Waals forces.

Sol 4: We can coagulate lyophilic colloids by

• adding on electrolyte. (it reacts with colloids)

• adding a suitable solvent.

Sol 5: Emulsion is a mixture of two or more liquids which are normally immiscible. Ex. Milk.

It's a colloid of a liquid in another liquid.

Sol 6: It's a kind of adsorption in which adsorbate is held by weak Vander Waal's forces to the medium (adsorbent) .

Sol 7: If there is bond formation (chemical reaction) between adsorbate & the medium, then it's chemical adsorption.

Sol 8: Desorption is the reverse of adsorption. It's a process of removing an adsorption from some medium.

Sol 9: If T_C of a gas is high, then it can be liquified easily, so greater is the extent of adsorption (because of high Van der Waals force) . If T_C is low, the given gas is a bad adsorbate.

Sol 10: Colloidal sol is stable because of the like charged particles. So, they do not form large particles. Sol is solids dispersed in liquid.

Sol 11: (i) Sols are solids in liquids, where as emulsions are liquids in liquids.

(ii) Sols are more stable compared to emulsions.

Sol 12: Ultra filtration is a type of filtration in which purification is carried out through special filters or semipermeable membranes. Generally, they allow passage of electrolyte but not colloid particles.

Sol 13: The size of particles is greater than the wavelength of visible light. So, colloid particles scatter light which is Tyndall effect.

Sol 14: Clouds are colloids of water droplet in air. Adding salt coagulates the water droplets. So they form bigger drops. So, it comes down as rain.

Sol 15: The oppositely charged go to separate electrodes and get coagulated there.

Sol 16: (i) Fe^{+3} is the preferential adsorbate. So, it's positively charged Sol

(ii) Physical adsorption decreases with increase in T due to increase in the energy of particles, they escape Van der Waals forces.

(iii) It's due to possible formation of colloid at the point of mixing.

Sol 17: (i) Electro-dialysis : It's the process of transporting salt ions from one solution to other through ion-exchange membrane under a potential difference.

(ii) (a) Dispersal phase : - It's the component present in small proportions and is just like a solute in a solution. It's also called the 'Internal phase'.

(b) Dispersion medium : - It's generally the component present in excess and is just like a solvent in a solution. It's also called the 'External phase'.

Sol 18: Shape selectivity of a catalyst depends upon the pore structure of the catalyst.

Depending on the size of the reactant and product molecules when compared to the size of cages or pores of the zeolite, reactions proceed in a specific manner.
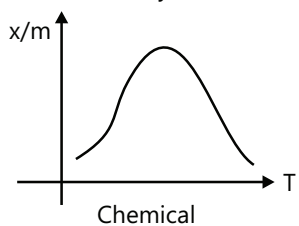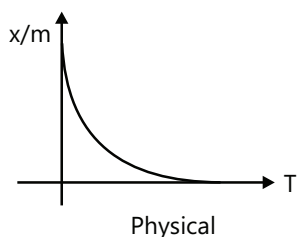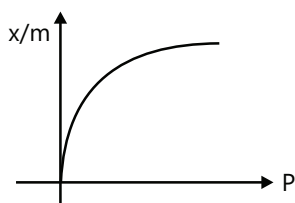
Sol 19:
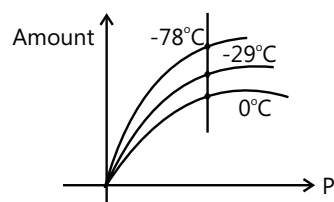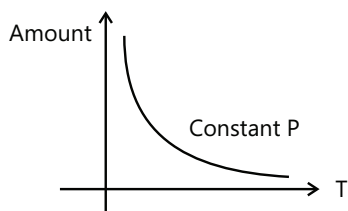
Sol 20: (i) It leads to coagulation as oppositely charged electrolyte particles get attracted to the sol particles.

(ii) It leads to separation of dispersed phase & dispersion medium.

(iii) Colloid particles will be accumulated at electrodes.

Sol 21: In physisorption, the size is an important factor because it determines Van der Waals forces.
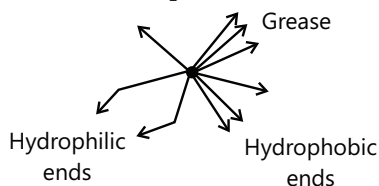

Physical

Chemical

Sol 22: (a) (i) Silica gel – adsorption

(ii) Anhydrous $CaCl_2$ – Absorption

(b) Due to the presence of empty orbital in B.

Ba, Mg, B, Ga, P in zeolites.

Sol 23: (i) A micelle is an aggregate of surfactant molecules dispersed in a liquid colloid. The hydrophobic end dissolves in the grease where as hydrophilic end dissolves in H_2O.

(ii) Hardy-Schulze Rule – Greater is the valency of the coagulating ion, greater is its power to bring coagulation.

And the effective ions of the electrolyte in bringing about coagulation are those which carry opposite charge to that of colloid particles.

Sol 24: (i) Multimolecular colloids: - They are formed by aggregates of a large number of atoms or molecules. E.g. Sols of Gold, Sulphur etc.

(ii) Macromolecular colloids: - They are molecules of very large size. E.g. Polymers like rubber, starch etc.

Sol 25: Chemisorption have higher activation energy and enthalpy of adsorption.

Sol 26: (i) The sol coagulates due to addition of electrolyte.

(ii) The positive and negative sol particles deposit at respective electrodes.

(iii) We observe Tyndall effect i.e. light gets scattered.

Sol 27: (i) Tyndall effect: - Tyndall scattering, is light scattering by particles in a colloids or particles is a fine suspension. Individual particles of colloid reflect and scatter light of wavelength (in same order as particle sizes).

(ii) A catalytic reaction which depends upon the active site and pore structure of catalyst and not on the size of reactant and product is known as shape selective catalysis.

Sol 28: Coagulation of hydrophobic ions can be done by using method of neutralising ions.

Sol 29: (i) It will lead to coagulation as NaCl acts as electrolyte. and $FeCl_3$ comes as precipitate.

(ii) If beam of light is passed through NaCl solution. The intensity decreases as NaCl (aq) is a true solution.

It does not show Tyndall effect.

But when light is passed through sol, we observe scattering (Tyndall effect).

Sol 30: Coagulation is the process which involves precipitation of a colloidal solution by addition of excess of electrolyte.

It can be caused by

• Electrophoresis

• Prolonged dialysis

• Addition of two sols (Mutual precipitation)

Exercise 2

Single Correct Choice Type

Sol 1: (B) A gas with high critical temperature (T_c) can be liquefied easily. So, it's adsorbed on a solid to a greater extent.

Sol 2: (D) Adsorption of a gas depends on

- T_c of gas
- Temperature
- Pressure

Sol 3: (C) $NH_3 > CO_2 > CH_4$ (ease of liquefaction)

It's because of their T_c.

$T_{C_{NH_3}} > T_{C_{CO_2}} > T_{C_{CH_4}}$

Sol 4: (D) Pt is not use in synthesis of NH_3. N_2, H_2 are not easily liquifiable.

Sol 5: (B) Transition metals form effective catalyst due to high inter-atomic spaces.

Sol 6: (B) The heat of physisorption is quite low. It's in the range of 20-40 kJ/mole.

Sol 7: (A) Physical adsorption can be multi-layered because of Van der Waals forces.

Sol 8: (B) Physical adsorption is reversible but not chemical. It's because chemisorption has high activation energy.

Sol 9: (D) Gels – Solid in liquid (jelly type). Milk is an emulsion, rest all are gels.

Sol 10: (C) Increases with P, decreases with T.

Sol 11: (B) Emulsion is a colloidal system of 2 liquids.

Sol 12: (B) Sulphur does not dissolve in water. It's a lyophobic colloid.

Sol 13: (B) Physical – Van der Waals. Chemical – Chemical bonds.

Sol 14: (A) Colloidal solution of Pd because Pd has highly affinity towards H and colloid solution will have higher Pd surface.

Sol 15: (B) The reaction is fast, if activation energy is low. Catalyst reduces activation energy.

Activation energy need not be inversely proportion to temperature.

Sol 16: (B) Scattering of light.

Sol 17: (C) Chemisorption is not reversible. Other statements are true about chemisorption.

Sol 18: (B) In colloids, size of particles is nearly wavelength of visible light. i.e. 1 nm – 100 nm range.

Sol 19: (B) Colloids are 2 phase system. They are different from suspensions.

Sol 20: (B) Decomposition of nitro glycerine is auto-catalysis. So it's used in explosive, TNT.

Sol 21: (D) Colloids can be purified by dialysis.

Sol 22: (A) Milk–Emulsion. (Oil in water)

Sol 23: (D) Adding oppositely charged Sol. Heating and adding an electrolyte can coagulate sols.

Sol 24: (C) Enzymes are naturally occurring catalysts. (Present in organisms) .

Sol 25: (B) Fog – Liquid in gas (water vapour in atmosphere)

Sol 26: (C) Gold sol in negative. So Al^{3+} will be the best coagulating agent.

Sol 27: (A) We can observe scattering of light due to larger size of particles.

Sol 28: (A) Auto-catalysis as we need very less amount of catalyst but the reaction goes quickly.

Sol 29: (A) Colloids are classified on the basis of their particle size.

Sol 30: (A) Flocculation value is the minimum concentration of an electrolyte required to cause coagulation.

Sol 31: (B) Smoke precipitation works on neutralisation of charge on colloids. It uses the force of an induced electrostatic charges.

Sol 32: (C) Mixing of sols will lead to coagulation. Electrophoresis can coagulate both.

$MgCl_2$ will coagulate gold sol quickly because Mg^{2+} has higher charge than Cl^-. Mg^{+2} coagulates negatively charged Sol

Previous Years' Questions

Sol 1: (D) Since adsorption is exothermic process so ΔH of adsorption is always negative.

Sol 2: (B) Adsorption increases with increase in temperature

Sol 3: (D) $\frac{x}{m} = kp^{1/n}$ or $x = m.kp^{1/n}$

or $x / m = kp^{-n}$

All of these equation represent Freundlich adsorption isotherm.

Sol 4: (C) Solution of urea is not a colloid.

Sol 5: (A, D)

(A) Due to preferential adsorption of common ion

(B) Incorrect

(C) Incorrect (due to repulsion, not due to attraction)

(D) The layer of oppositely charged particles around any colloidal particles will decrease the potential energy of system.

Sol 6: (A, C) In Physisorption, on increasing temperature at constant pressure, adsorption decreases while in chemical adsorption on increasing temperature due to requirement of activation energy adsorption will increases at same pressure. So, I is physisorption while II is chemisorption.

III is physical adsorption as on increasing temperature, extent of adsorption is decreasing. IV is representing enthalpy charge (which is high) during chemical adsorption (due to bond formation) So, is valid for chemical adsorption. So, answer is (A) and (C).

Sol 7: (C) Higher the gold number lesser will be the protective power of colloid.

Sol 8: (D) Enthalpy of adsorption regarding physisorption is not positive and it is negative.

Sol 9: (D) $\frac{x}{m} \propto P^1$; $\frac{x}{m} \propto P^{1/n}$ are true at low and moderate pressures.

Sol 10: (B) According to Hardy Schulze rule, greater the charge on cation, greater is its coagulating power for negatively charged solution. So, order of coagulating power: $Na^+ < Ba^{2+} < Al^{3+}$.

Sol 11: (A)

Initial m moles of $CH_3COOH = 0.06 \times 50$

Final m moles of $CH_3COOH = 0.042 \times 50$

Hence, mass of CH_3COOH adsorbed per gram of

charcoal $= \dfrac{(0.06 - 0.042) \times 50 \times 10^{-3} \times 60 \times 10^3}{3} = 18$ mg

Sol 12: (B) According to the Freundlich adsorption isotherm

$\dfrac{x}{m} = kP^{1/n}$

$\log \dfrac{x}{m} = \log K + \dfrac{1}{n} \log P$

JEE Advanced/Boards

Exercise 1

Sol 1: Finely divided substance has more surface area than normal crystals. So, adsorption will be more effective.

Sol 2: Enzyme:-They are complex organic compounds present in living beings inside the human body (or other organisms) and act as catalyst in many processes.

They are also called Bio-Catalyst. Its mechanism is similar to other catalysis. By providing an alternative reaction route, the enzyme reduces the energy required to reach the highest energy transition state of the reaction.

Sol 3: Emulsion are colloids of liquid in liquid.

- Oil in water type – Ex. Milk

- Water in oil type – Ex. Butter.

Sol 4: There are 2 main reasons:

- They are chemically inert.

- They are good catalyst due to high inter atomic spaces. Their affinity towards hydrogen is very high.

Sol 5: Powdered substances have very high surface area compared to crystals. So, adsorption on powdered substance is effective.

Sol 6: CO acts as poison in Haber's process. Poison is a negative catalyst i.e. it reduces the rate of reaction.

Sol 7: The products after reaction must be desorbed from the catalyst so that further reaction can take place.

Sol 8: Fe^{+3} has higher coagulating power compared to K^+, So, it can stop bleeding by coagulating blood around the wound.

Sol 9: It's the process of setting down of colloid particles.

Sol 10: NH_3 has a higher T_C than CO_2. So it is easily liquefiable.

$\therefore NH_3$ will be adsorbed more readily.

Sol 11: More is the T_C of a gas, more is the easiness to liquefy the gas. So, more is the extent of adsorption.

Sol 12: Activity is the ability of a catalyst to drive the reaction in forward direction.

It depends on many factors like surface area, temperature etc.

Sol 13: Gelatin has a low gold number, so even adding small amounts of gelatin will stabilise it. It will act as a lyophilic colloid.

Exercise 2

Single Correct Choice Type

Sol 1: (D) $\dfrac{x}{m} = k(P)^{\frac{1}{n}} \Rightarrow \log\left(\dfrac{x}{m}\right) = \dfrac{1}{n}\log P + \log K.$

At high P

$\dfrac{x}{m} \approx K$

At low P

$\dfrac{x}{m} \approx KP'$

Sol 2: (C) Emulsifier is a substance used to stabilise emulsions.

Sol 3: (A) Auto-catalysis as we need very less amount of catalyst but the reaction goes quickly.

Sol 4: (B) Electrophoresis depends on electric charge. Rest, all methods depends on size of particles.

Sol 5: (A) To form micelle at very low concentration, it must be highly insoluble in water. $CH_3(CH_2)_{11}OSO_3^-, CH_3(CH_2)_6COO^-$ has charged ends. N^+ in other 2 structure is crowded, so it's interaction with H_2O will be less. So $CH_3(CH_2)_{15}N^+(CH_3)_3Br^-$ will need minimum conc. as its H.C. length is high.

Comprehension Type

Sol 6: (A, D) COO^- is hydrophilic part. Soaps are emulsifying agents.

Sol 7: (A) R part is hydrocarbon part. It dissolves in grease and forms micelle.

Sol 8: (B) In multi-molecular colloids, atoms or molecules are held together by weak Van der Waals forces.

Sol 9: (A) Cleansing action of soap is due to attraction between hydrophobic part of soap & grease (oil) .

Sol 10: (D) 0.025 g – 25 mg
$\therefore$ Gold number = 25

Sol 11: (B, D) Lower the gold number, more is the protective power as lesser the amount of substance required to prevent coagulation. Similarly, lower is coagulation value, higher is coagulation power.

Sol 12: (A) Protective nature of colloids.

Sol 13: (D) Xe will be adsorbed to maximum extent because of its high T_C compared to other elements in it's group.

Sol 14: (C) CO. As its the most easily liquefiable gas.

Sol 15: (B) Adsorption is inversely proportional to temperature.

Assertion Reasoning Type

Sol 16: (C) In adsorption, ΔH is –ve (adsorption is exothermic) ΔS is also negative as freedom of adsorbent decrease.

Sol 17: (C) If T_C of a gas is high, its easily liquefiable. So, it can be adsorbed easily.

Sol 18: (A) Adding detergents reduces the surface tension of water. COO^- interacts with polar H_2O molecules.

Sol 19: (B) Assertion is false, isoelectric point is the pH at which particle is electrically neutral (may be Zwitter ions). A is false.

Previous Years' Questions

Sol 1: (B) As temperature increases, surface tension of liquid decreases.

Sol 2: (A) It is an exothermic process. According to Le-Chatelier's principle, lowering temperature drive the process in forward direction.

Sol 3: (C) $\Delta G = \Delta H - T\Delta S$

Sol 4: (D) Lyophilic sols are reversible, not easily coagulated because it is self-stabilizing.

Sol 5: (A) Larger the hydrophobic fragment of surfactant, easier will be the micellization, smaller the critical micelle concentration. Therefore, $CH_3(CH_2)_{15}N^+(CH_3)_3Br^-$ will have the lowest critical micelle concentration.

Sol 6: (C) Sb_2S_3 is a negative (anionic) Sol According to Hardy Schulze rule, greater the valency of cationic coagulating agent, higher its coagulating power. Therefore, $Al_2(SO_4)_3$ will be the most effective coagulating agent in the present case.

Sol 7: (A, B, D) (A) In the process of adsorption, a bond is formed between adsorbate and adsorbent, hence always exothermic.

(B) Physisorption required very low activation energy while chemisorption require high activation energy. Therefore, a physisorption may transform into chemisorption but only at high temperature.

(C) It is wrong statement as at higher temperature, physically adsorbed substance starts desorbing.

(D) In physical adsorption, van der Waal's force hold the adsorbate and adsorbent together which is a weak electrostatic attraction. In chemisorption, strong chemical bond binds the adsorbate to the adsorbent. Therefore, chemisorption is more exothermic than physical adsorption.

Sol 8: (B) Both statements are independently correct but statement-II does not explain statement-I. Critical micelle concentration is the minimum concentration of surfactant at which micelle formation commences first. At critical micelle concentration, several molecules of surfactant coalesce together to form one single micelle molecule. This decreases the apparent number of molecule suddenly lowering conductivity sharply.

Sol 9: (B) Adsorption of methylene blue on activated charcoal is physical adsorption hence it is characterised by decrease in enthalpy.

Sol 10: (B, C, D) Adsorption of O_2 on metal surface is exothermic. During electron transfer from metal to O_2 electron occupies π_{2p}^* orbital of O_2.

Due to electron transfer to O_2 the bond order of O_2 decreases hence bond length increases.

Sol 11: (A, D) Lyophobic colloids are stable due to preferential adsorption of ions on their surface from solution and potential difference between the fixed layer and the diffused layer of opposite charges around the colloidal particles that makes lyophobic sol stable.