CHAPTER

05

Surface Chemistry

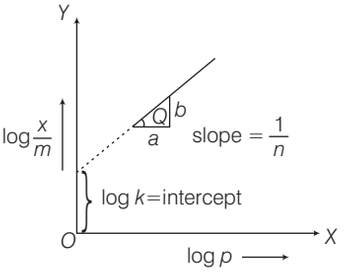
A Quick Recapitulation of the Chapter

1. **Adsorption** is the phenomenon of attracting and retaining the molecules of a substance on the surface of a solid resulting into a higher concentration on the surface than in the bulk. It is a surface phenomena.
2. For adsorption, ΔH, ΔG and ΔS, all are negative, i.e. it is an exothermic process which occurs with decrease in entropy.
3. When adsorption and absorption occur side by side it is known as **sorption**.
4. The extent of adsorption of a gas on a solid depends on nature of gas, pressure of the gas and temperature of the gas.
5. In **physisorption**, particles of the adsorbate are held to the surface of adsorbent by weak van der Waals' forces. It is non-specific, reversible and multimolecular in nature. ΔH is 20-40 kJ mol^{-1}. It occurs at low temperature.
6. In **chemisorption**, particles of the adsorbate are held to the surface of adsorbent by chemical forces. It is specific, reversible and unimolecular in nature. ΔH is 40 – 400 kJ mol^{-1}. High temperature is favourable for it.
7. The relationship between extent of adsorption (x/m) and pressure of the gas at constant temperature is known as **adsorption isotherm**.

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

where, m = mass of adsorbent
x = mass of the gas adsorbed
p = pressure
k = constant
n = integer

8. A graph of $\log \frac{x}{m}$ is plotted against $\log p$.
   The slope of line and its y-axis intercept correspond to $\frac{1}{n}$ and $\log k$ respectively.



9. A substance that can influence the rate of a chemical reaction by lowering the activation energy of the reactants but itself is not consumed and remains unchanged is known as a catalyst and the phenomenon is known as **catalysis**.
10. Catalysis can be of two types:
    (i) **Homogeneous catalysis** In it both reactants and catalysts are present in the same phase.
    (ii) **Heterogeneous catalysis** In it both reactants and catalysts are present in different phase.
11. **Enzymes** are specific biological catalyst that possess well defined active sites. The action of enzymes in living system is to enhance the rate of biochemical reactions, e.g. hydrolysis of urea by urease enzyme.
12. A colloid is a heterogeneous system in which one substance is dispersed a very fine particles in another substance called dispersion medium.

13. Depending upon the phases of dispersed phase and dispersion medium, colloids are of following types:

Dispersed phase	Dispersion medium	Types of colloid	Examples
Solid	Solid	Solid sol	Some coloured glasses, gem stones
Solid	Liquid	Sol	Paints, cell fluids
Solid	Gas	Aerosol	Smoke, dust
Liquid	Solid	Gel	Cheese, butter, jellies
Liquid	Liquid	Emulsion	Milk, hair cream
Liquid	Gas	Aerosol	Fog, mist, cloud, insecticide sprays
Gas	Solid	Solid sol	Pumice stone, foam rubber
Gas	Liquid	Foam	Froth, whipped cream, soap lather

14. Based on the nature of interaction between dispersed phase and dispersion medium, colloidal sols are divided into two categories:
    (i) **Lyophilic colloids** Strong interactions with the dispersion medium and also called as **reversible colloids**.
    (ii) **Lyophobic colloids** No interactions with the dispersion medium and also called as **irreversible colloids**.
15. Based on the type of particles of the dispersed phase colloids are classified as
    (i) **Multimolecular colloids** It contains aggregates of atoms or small molecules (diameter<1 nm), e.g. gold sol and sulphur sol.
    (ii) **Macromolecular colloids** Particle size > > that of colloidal particles (most lyophilic sols belong to this category).
    (iii) **Associated colloids** Substance at low concentrations behave as a normal strong electrolyte and but a high concentration exhibit colloidal properties also called **micelles**.
16. The formation of micelles takes place above a particular temperature known as **Kraft temperature** (T_k) and above a particular concentration known as **Critical Micelle Concentration** (CMC).
17. When light passes through a colloidal sol, its path become visible due to scattering of light by particles. It is called **Tyndall effect** and the illuminated path of the beam is called **Tyndall cone**.
18. Movement of colloidal particles at random in *zig-zag* motion is known as **Brownian movement**. This movement is due to the bombardment of dispersion medium particles over dispersed phase particles. It helps in providing stability to colloidal sol by not allowing them to settle down.
19. The coagulating behaviour of electrolyte is governed by **Hardy-Schulze rule**. It states that,
    (i) the ions having opposite charge to sol particles cause coagulation.
    (ii) coagulating power of an electrolyte is directly proportional to the fourth power of the valency of the ions causing the coagulation.
20. **Electrophoresis** is the migration of colloidal particles toward the oppositely charged electrodes under the influence of applied electric field.

Objective Questions Based on NCERT Text

Topic 1
Adsorption

1. The true statement among the following is
(a) to represent an interface, the bulk phases are separated by a bracket
(b) gases have only a single interface due to their complete miscibility
(c) the area of interface depends upon the size of particles of bulk phase
(d) All of the above

2. Clean solid materials are needed to be stored in the vacuum because
(a) they will react to form complex compound
(b) they will be covered by vapour and CO_2 gases
(c) they will be covered by molecules of major air components like O_2 and N_2
(d) None of the above

3. Which of the following statements is not correct?
(a) The species which accumulates at the surface of a substance is called adsorbate
(b) Adsorbent is the material at the surface of which adsorption takes place
(c) When adsorption and absorption occur simultaneously, the process is called sorption
(d) Desorption is the process of addition of absorbed molecules to the surface

4. The statement not showing difference between adsorption and absorption is
(a) adsorption is the accumulation of a substance only at the surface but absorption involves distribution of the substance in the bulk
(b) adsorption occurs instantaneously, whereas absorption occurs slowly
(c) only gases are adsorbed whereas solids and liquids are absorbed
(d) water vapours are absorbed by anhyd. $CaCl_2$ but adsorbed by silica gel

5. A substance is a better adsorbent in its finely powdered form as compared to crystalline form because
(a) adsorption is an exothermic process
(b) in the state the adsorbent becomes inert and does not react with adsorbate
(c) adsorption is a surface phenomenon
(d) adsorption varies directly with size of particles of adsorbent

6. The process by which sites of adsorbent are made free so that more adsorbate can occupy them is called
(a) sorption (b) desorption
(c) unbalanced distribution (d) dissociation

7. Which of the following processes will be observed, when a chalk stick is dipped in the solution of ink?
(a) Adsorption (b) Absorption
(c) Desorption (d) Both (a) and (b)

8. In case of adsorption,
(a) a particle present in the bulk experience an unbalanced force
(b) unbalanced forces are responsible for the interaction between adsorbate and adsorbent
(c) extent of adsorption increases with decrease of surface area per unit mass of adsorbent at a given temperature and pressure
(d) All of the above

9. Which of the following is not true? At the time of adsorption
(a) residual attractive forces decreases
(b) surface energy decreases
(c) heat releases
(d) heat is absorbed

10. Methylene blue, from its aqueous solution, is adsorbed on activated charcoal at 25° C . For this process the correct statement is **(JEE Adv. 2014)**
(a) the adsorption requires activation at 25° C
(b) the adsorption is accompanied by a decrease in enthalpy
(c) the adsorption increases with increase of temperature
(d) the adsorption is irreversible

11. Which of the following statements is correct for the spontaneous adsorption of a gas? **(CBSE AIPMT 2015)**
(a) ΔS is negative and therefore, ΔH should be highly positive
(b) ΔS is negative and therefore, ΔH should be highly negative
(c) ΔS is positive and therefore, ΔH should be negative
(d) ΔS is positive and therefore, ΔH should also be highly positive

12. Adsorption attains the equilibrium when
(a) $T\Delta S = \Delta H$
(b) $\Delta H = +$ ve
(c) $\Delta G = -$ ve or + ve
(d) $\Delta S = -$ve and $\Delta H = +$ve

13. The incorrect statement regarding types of adsorption is
(a) adsorption due to weak van der Waals' forces is called physisorption
(b) chemisorption due to involvement of high energy of activation is called activated adsorption
(c) physisorption and chemisorption may occur simultaneously
(d) in case of chemisorption, only covalent bonds are formed between adsorbate and adsorbent

14. Adsorption of dihydrogen takes place on the nickel surface. Which of the following processes is involved in the above statement?
(a) Chemisorption (b) Physisorption
(c) Physisorption followed by chemisorption
(d) Chemisorption followed by physisorption

15. Which of the following is not the characteristic of physisorption?
(a) Lack of specificity
(b) Reversible nature
(c) High specificity
(d) Nature of adsorbate

16. Enthalpy of adsorption is quite low in case of physisorption because of
(a) strong bonding forces
(b) weak van der Waals' forces
(c) mechanical forces
(d) H-bonding

17. Which of the following is not correct about the physisorption?
(a) It generally occurs at low temperature
(b) It increases with decrease in temperature
(c) It is an exothermic process
(d) It increases with decrease in pressure if a gas is adsorbed

18. Which of the following is the characteristic of chemisorption?
(a) Reversible nature (b) High specificity
(c) Lack of specificity (d) Weak van der Waals' forces

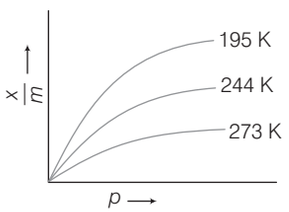
19. The incorrect statement about chemisorption is
(a) chemisorption is shown by only those gases which react with the adsorbent
(b) enthalpy of chemisorption is high, i.e. 80-240 kJ mol^{-1}
(c) it is favoured by low temperature
(d) None of the above

20. Which of the following is not a point of difference between physisorption and chemisorption?
(a) Magnitude of chemisorption increases but of physisorption decreases with rise in temperature
(b) Chemisorption is an irreversible process whereas physisorption is reversible in nature
(c) Activation energy is high for physisorption and low for chemisorption
(d) Physisorption results in the formation of multimolecular layer, while only unimolecular layer is formed in case of chemisorption

21. Usually chemisorption is favourable at
(a) high temperature and low pressure
(b) low temperature and low pressure
(c) high temperature and high pressure
(d) low temperature and high pressure

22. Activation of adsorbent means its absorbing power is increased by
(a) making the surface rough
(b) dipping the surface in acid to make it smooth
(c) dissolving it in water
(d) All of the above

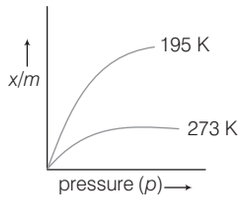
23.



Above graph represents the
(a) absorption isotherm
(b) adsorption isotherm
(c) adsorption isobars
(d) adsorption isosteres

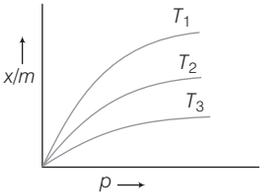
24. If x is the amount of adsorbate and m is the amount of adsorbent, which of the following relations is not related to adsorption process? **(CBSE AIPMT 2011)**
(a) $\frac{x}{m} = p \times T$
(b) $\frac{x}{m} = f(p)$ at constant T
(c) $\frac{x}{m} = f(T)$ at constant p
(d) $p = f(T)$ at constant $\left(\frac{x}{m}\right)$

25.



What does the graph of these curves conclude?
(a) At constant pressure, physisorption increases with increase in temperature
(b) At variable pressure, physisorption increases with increase in temperature
(c) At constant pressure, physisorption decreases with increase in temperature
(d) At variable pressure, physisorption decreases with increase in temperature

26. Freundlich adsorption isotherm is represented at temperature T_1, T_2 and T_3.



Arrange the temperature in the increasing order.
(a) $T_1 < T_2 < T_3$ (b) $T_3 < T_2 < T_1$
(c) $T_2 < T_3 < T_1$ (d) $T_3 < T_1 < T_2$

27. In the curve of Freundlich adsorption equation, if the slop of the plot is zero, then extent of adsorption is
(a) directly proportional to the pressure of gas
(b) inversely proportional to the pressure of gas
(c) proportional to square root of the pressure of gas
(d) independent of pressure of gas

28. In Freundlich adsorption isotherm, the value of $\frac{1}{n}$ is
(a) between 0 and 1 in all cases **(CBSE AIPMT 2012)**
(b) between 2 and 4 in all cases
(c) 1 in case of physical adsorption
(d) 1 in case of chemisorption

29. When pressure is low, the fraction of the surface covered during adsorption follows:
(a) Zero order kinetics (b) First order kinetics
(c) Second order kinetics (d) Fractional order kinetics

30. Gas mask is usually used for breathing in coal mine because it contains
(a) activated charcoal (b) high vacuum
(c) more about of pure oxygen (d) All of these

31. Which of the following is/are generally used for the removal of the coloured impurities from the solutions?
(a) Charcoal (b) Silica gel
(c) Both (a) and (b) (d) Anhyd. $CaCl_2$

Topic 2
Catalysis

32. Which of the following substance acts as a catalyst for the following reaction?

$$2KClO_3 \longrightarrow 2KCl + 3O_2$$

(a) MnO_2 (b) O_2
(c) HCl (d) All of these

33. The incorrect statement related to catalyst is
(a) this term was introduced by Berzelius
(b) promoters decrease the rate of a reaction while poison increase it
(c) it alters the rate of reaction without being consumed
(d) in Haber's process of synthesis of ammonia iron is a catalyst

34. Hydrolysis of methyl acetate is catalysed by H^+ ions furnished by HCl. It is an example(s) of
(a) heterogeneous catalysis (b) homogeneous catalysis
(c) Both (a) and (b) (d) None of these

35. Which of the following reactions is not an example of homogeneous catalysis process?

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

(b) $CH_3COOH(l) + H_2O(l) \xrightarrow{HCl(l)} CH_3COOH(aq) + CH_3OH(aq)$

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

(d) $C_{12}H_{22}O_{11}(aq) + H_2O(l) \xrightarrow{H_2SO_4(l)} C_6H_{12}O_6(aq) + C_6H_{12}O_6(aq)$

36. Which of the following are the examples of heterogeneous catalysis?
(a) Haber's process
(b) Ostwald's process
(c) Oxidation of SO_2 into SO_3 in presence of Pt
(d) All of the above

37. The catalytic activity of a catalyst is localised
(a) inside the catalyst
(b) on the surface of the catalyst
(c) no particular region
(d) inside as well surface of the catalyst

38. Which of the following statement is true about mechanism involved in the adsorption theory of heterogeneous catalysis?
(a) Diffusion of reactants take place inside the catalyst
(b) During adsorption amount of the catalyst decreases
(c) Chemical reactions happen on the surface of catalyst
(d) Adsorption of products take place on the surface of a catalyst

39. Modern adsorption theory does not explain the action of
(a) catalytic promoters (b) catalytic poisons
(c) process of catalysis (d) Both (a) and (b)

40. The activity of a catalyst depends upon the strength of
(a) chemisorption (b) physisorption
(c) solution (d) None of these

41. The correct statement about solid catalyst is
(a) equal amounts of catalyst and reactants are required
(b) its chemical activity does not depend upon extent of chemisorption
(c) here, desorption is not important for being a good catalyst
(d) in some cases different product may be obtained by using different catalysts and same reactant

42. The reactions taking place in zeolites depend upon
(a) the size of reactant and product molecules
(b) shape of reactant and product molecules
(c) pores and cavities of the zeolites
(d) All of the above

43. The incorrect statement about zeolites is
(a) they have open structure of silica in which trivalent aluminium ions are substituted by a fraction of Si-atom
(b) they are aluminosilicates having three dimensional porous structure
(c) they are synthetic microporous aluminosilicates that do not exist naturally
(d) their shape selectivity depends upon the pore and cavity size

44. Which of the following catalyst, catalyse the numerous reactions that occur in the bodies of animal and plants to maintain the life process?
(a) Electrolytes (b) Vitamins
(c) Enzymes (d) Antibiotic

45. The incorrect statement regarding enzymes is
(a) these are complex nitrogen organic compound
(b) these are generally proteinous molecules
(c) solution of enzymes in water is actually true solution
(d) these are also called biochemical catalyst

46. Which one of the following statements is incorrect about enzyme catalyst? **(CBSE AIPMT 2012)**
(a) Enzymes are mostly proteinous in nature
(b) Enzyme action is specific
(c) Enzymes are denaturated by UV-rays, at high temperature
(d) Enzymes are least reactive of optimum temperature

47. The enzyme invertase converts the cane sugar into
(a) glucose (b) fructose
(c) glucose + fructose (d) None of these

48. $C_6H_{12}O_6(aq) \longrightarrow 2C_2H_5OH(aq) + 2CO_2(g)$
Which of the following enzymes is involved in the above catalytic reaction?
(a) Invertase (b) Zymase
(c) Urease (d) Maltase

49. Enzymes are highly active at
(a) optimum pH and high temperature
(b) optimum temperature and very high pH
(c) optimum temperature and optimum pH
(d) low temperature and high pressure

50. The incorrect statement about enzyme catalysis is
(a) enzymes are required in very minute amounts
(b) enzymes acitivity is maximum at optimum pH, which is in between 5-7
(c) enzyme activity is maximum in the temperature range of 50-60°C
(d) presence of co-enzymes results in increased enzyme activity

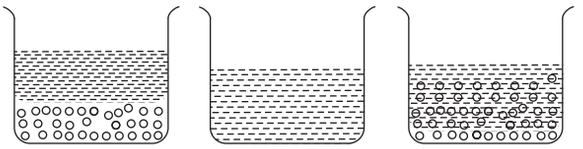
51. Activators are generally
(a) metal ions (b) non-metal ions
(c) metalloids ions (d) All of these

52. Functional groups present on the surface cavities (active site) of enzyme are
(a) $—NH_2$ (b) —COOH (c) —OH (d) All of these

53. Select the incorrect statement.
(a) Non-protein part present alongwith enzyme increases the catalytic activity
(b) Inhibitors reduce the enzyme activity by interacting with the active functional groups of the enzyme surface
(c) Activity of enzymes can be described by lock key model
(d) None of the above

Topic 3
Classification and Preparation of Colloids

54.



True statement is
(a) in case of *A* the particle size lies in the range of 1 to 100 nm
(b) *B* and *C* are always homogeneous in natural phase
(c) *B* contain two phases, disperse phase and dispersion medium
(d) in *C* particles have an enormous surface area per unit mass

55. Select the statement which is not true?
(a) A colloid is a heterogeneous system
(b) The substance which is dispersed in another substance is called dispersed phase
(c) Depending upon the shape of particles, solution may be true solution or colloid or suspension
(d) The dispersed phase of colloid may contain a single macromolecule or an aggregate of many atom, ions or molecule

56. Colloids are classified on the basis of the
(a) physical state of dispersed phase and dispersion medium
(b) nature of interaction between dispersed phase and dispersion medium
(c) types of particles in the dispersed phase
(d) All of the above

57. Which property of colloidal solutions is independent of charge on the colloidal particles? **(CBSE AIPMT 2015)**
(a) Coagulation (b) Electrophoresis
(c) Electroosmosis (d) Tyndall effect

58. Which of the following statements is not true?
(a) Gels represent a mixture of liquid in solid
(b) Depending upon the medium like water, alcohol or gas the colloids are called aquasol or hydrosol, alcosol or aerosol respectively
(c) Milk is a colloidal solution of solid in liquid
(d) Biological fluids are generally aqueous sols

59. Select the correct statement.
(a) Smoke and fog are aerosol in which solid is dispersed in gas
(b) Solid sol is formed when solid or gas is dispersed in a solid
(c) Cheese, butter and jellies are the examples of sol
(d) Hair cream is an example of gel

60. Lyophilic colloids are called reversible colloids because
(a) they are prepared by special reversible reaction
(b) they can be again prepared by mixing residue in dispersion medium even after drying
(c) they can be easily precipitated from the colloidal system
(d) one formed, the dispersion medium and the dispersed phase cannot be separated

61. Lyophobic colloids are not stable because
(a) they coagulate by heating them with the electrolytes
(b) they coagulate by freezing them with the electrolytes
(c) they do not coagulate by freezing them with the electrolytes
(d) they do not coagulate by heating them with the electrolytes

62. The protecting power of lyophilic colloidal sol is expressed in terms of **(CBSE AIPMT 2012)**
(a) coagulation value
(b) gold number
(c) critical micelle concentration
(d) oxidation number

63. Which of the following is not correctly method?
(a) Sulphur sol — Macromolecular colloid
(b) As_2S_3 sol — Lyophobic colloid
(c) Gelatin — Lyophilic colloid
(d) Nylon sol — Macromolecular colloid

64. A large number of atoms or molecules of a substance aggregate together to form species having size in the colloidal range, these species are called
(a) multimolecular colloids (b) macromolecular colloids
(c) solid sol (d) emulsion

65. Gold sols and sulphur sols are the examples of
(a) multimolecular colloids
(b) macromolecular colloids
(c) associated colloids
(d) All of these

66. Which of the following colloids resemble to the true solutions?
(a) Micelles (b) Macromolecular colloids
(c) Lyophobic colloids (d) All of these

67. The formation of micelles takes place above the particular range of temperature termed as
(a) critical temperature
(b) Kraft temperature
(c) CMC
(d) boiling point

68. Soaps and synthetic detergents belong to the class of
(a) macromolecular colloids
(b) associated colloids
(c) multimolecular colloids
(d) Both (b) and (c)

69. Which of the following is major component of the bar soaps?
(a) $CH_3(CH_2)_{16}COO^-Na^+$
(b) $CH_3^-(CH_2)_{60}COO^-Na^+$
(c) $CH_3 — CH_2 — COO^-Na^+$
(d) $CH_3 — (CH_2)_{15}CH(COO^-Na^+)(COO^-Na^+)$

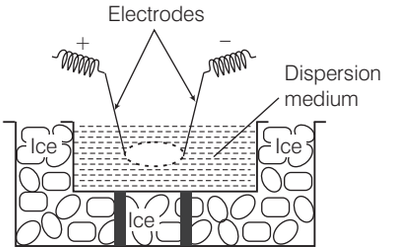
70. Starch is an example of which of the following types of colloid?
(a) macromolecular colloid
(b) associated colloid
(c) molecular colloid
(d) electrolytic solution

71. Which of the following method(s) is/are used for the preparation of colloids?
(a) Bredig's arc method (b) Peptisation
(c) Chemical method (d) All of these

72. Which type of the chemical reaction(s) is/are involved in the formation of colloids by the chemical method?
(a) Only oxidation
(b) Only reduction
(c) Double decomposition
(d) All of the above

73. Which of the following reaction is not involved in the formation of the colloids?
(a) $As_2O_3 + 3H_2S \longrightarrow As_2S_3(sol) + 3H_2O$
(b) $2AuCl_3 + 3HCHO + 3H_2O \longrightarrow 2Au\,(sol) + 3HCOOH + 6HCl$
(c) $ZnSO_4 + H_2SO_4 \longrightarrow ZnSO_4 + H_2$
(d) $FeCl_3 + 3H_2O \longrightarrow Fe(OH)_3(sol) + 3HCl$

74. Identify the method of preparation of the colloids which is shown in the given figure.



(a) Chemical method (b) Peptisation
(c) Bredig's arc method (d) All of these

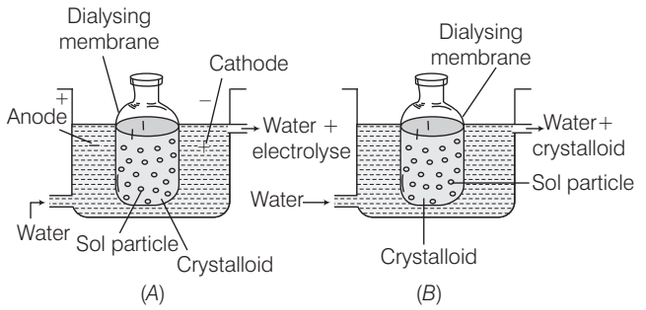
75. Which of the following processes is involved in Bredig's arc method?
(a) Only dispersion
(b) Only condensation
(c) Dispersion as well as condensation
(d) Diffusion

76. The process of converting a precipitate into colloidal sol is termed as
(a) dialysis (b) peptisation
(c) catalysis (d) ultrafiltration

77. Purification of the colloidal solution is carried out by
(a) dialysis (b) electrodialysis
(c) ultrafiltration (d) All of these

78. Which of the following is not true about dialysis?
(a) Semipermeable membrane is used in the dialysis
(b) Semipermeable membrane allows the passage of the particles
(c) Purification of blood takes place by the dialysis
(d) Colloidal solutions play not any role in the dialysis

79. What does the figure (A) and (B) represent?



	A	*B*
(a)	Dialysis	Electrolysis
(b)	Electrodialysis	Dialysis
(c)	Ultrafiltration	Dialysis
(d)	Dialysis	Ultrafiltration

80. The incorrect statement about dialysis is
(a) electrolyte particles being smaller in size can pass through the semipermeable membrane
(b) it is done by using a dialyser
(c) artificial blood purifying machine work in this principle
(d) None of the above

81. The false statement about ultrafiltration is
(a) it involves the use of some special type of filters, called ultrafilters
(b) the pore size of ultrafilters is larger than that of the normal filters
(c) it is a slow process
(d) pore size of normal filter paper can be changed by impregnating it with colloidion solution

Topic 4

Properties of Colloids (Including Coagulation)

82. The value of which of the following property is higher for true solution than colloidal solution?
(a) Vapour pressure (b) Osmotic pressure
(b) Freezing point (d) All of these

83. When the light is subjected on the colloidal solution it appears clear but when viewed at the right angle to the passage of light it show a mild to strong opalescence. This effect is termed as
(a) Tyndall (b) interference
(c) Brownian (d) fission

84. Tyndall effect is observed only when
(a) the diameter of the dispersed particles is not much smaller than the wavelength of light used
(b) there is high difference between the refractive indices (μ) of the dispersion medium and dispersed phase
(c) refractive indices (μ) of both dispersed medium and dispersed phase are equal to each other
(d) Both (a) and (b)

85. Which of the following microscopes is/are the based on the principle of Tyndall effect?
(a) Ultramicroscope (b) Inframicroscope
(c) Electron microscope (d) All of these

86. Select the incorrect statement about ultramicroscope?
(a) The focus of the light is set at right angles to the beam
(b) It shows the colloidal particles, such as their size and shape
(c) Light scattered by the colloidal particles can be observed by it
(d) It was prepared by Zsigmondy in 1903

87. The colour of colloidal solution depends upon
(a) wavelength of light
(b) size of the particles
(c) nature of the particles
(d) All of the above

88. Finest gold sol is red in colour, as size of the particles increases, it appears purple, then blue and finally golden".
What conclusion can be drawn from the above observation?
(a) Wavelength of scattered light depend upon size of particle
(b) Wavelength of scattered light does not depend upon size of particle
(c) Wavelength of scattered light depend upon the viscosity of the solution
(d) None of the above

89. Brownian motion depends upon
(a) size of the colloidal particles
(b) viscosity of the solution
(c) nature of colloids
(d) Both (a) and (b)

90. Why Brownian movement is responsible for the stability of sols?
(a) Brownian movement has a stirring effect
(b) Brownian movement has a Tyndall effect
(c) Brownian movement has a magnetic effect
(d) Brownian movement has an electric effect

91. Which of the following is an example of the negatively charged sols?

(a) $FeCl_3$ + NaOH

(b) $FeCl_3$ + hot water

(c) When Ag^+ is absorbed by AgI in solution of $AgNO_3$ and KI

(d) All of the above

92. Haemoglobin is the

(a) positively charged sol (b) negatively charged sol

(c) neutral charged sol (d) None of these

93. As_2S_3, starch and gold sols are the examples of

(a) positively charged sols

(b) negatively charged sols

(c) neutral charged sols

(d) All of the above

94. Which of the following is the most acceptable reason to explain the charge on sol particles?

(a) Electron capture by sol particles during electrodispersion

(b) Preferential adsorption of ions from solution

(c) Formulation of electrical double layer

(d) None of the above

95. The continuous *zig-zag* motion of colloidal particles is due to

(a) large size of colloid particles because of which they keep colloiding and settling down

(b) attractive forces between dispersed phase and dispersion medium

(c) unbalanced bombardment of particles by molecules of the dispersion medium

(d) conversion currents formed by sol

96. Select the correct statement.

(a) Treatment of $AgNO_3$ with excess of KI results in the formation of positively charged sol

(b) Treatment of excess of $AgNO_3$ with KI results in the formation of negatively charged sol

(c) Adding of excess of hot water to $FeCl_3$, results in the formation of a positively charged sol

(d) All of the above

97. The potential difference between the fixed layer and diffused layer of opposite charges in the colloidal system is known as

(a) zeta potential (b) gravitational potential

(c) standard potential (d) ionic potential

98. Which of the following is/are responsible to prevent the aggregation of colloidal solution for their stability?

(a) Attractive force (b) Repulsive force

(c) Zeta potential (d) Both (a) and (b)

99. Which of the following is not true about electrophoresis?

(a) Positively charged particles move towards cathode

(b) Negatively charged particles move towards anode

(c) Positively charged particles move towards anode

(d) Existence of charge on colloidal particles is confirmed by electrophoresis

100. When electrophoresis is prevented by the suitable mean then it is observed that the dispersion medium begins to move in an electric field.
This phenomenon is termed as

(a) reverse electrophoresis

(b) electroosmosis

(c) reverse osmosis

(d) osmosis

101. Which of the following statements is false among the following?

(a) The process of settling down of the colloidal particles is called coagulation

(b) Persistant dialysis results in coagulation of colloidal sol

(c) According to Hardy-Schulze law, greater is the valence of flocculating ion added, less will be its tendency to caused coagulation

(d) For a positive sol, the order of flocculating power is
$$K_3[Fe(CN)_6] > K_2SO_4 > KCl$$

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

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

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

103. For coagulation of a positive sol, the flocculating power of anions are in the order of

(a) $Cl^- > SO_4^{2-} > PO_4^{3-}$

(b) $PO_4^{3-} > Cl^- > SO_4^{2-}$

(c) $PO_4^{3-} = Cl^- = SO_4^{2-}$

(d) $PO_4^{3-} > SO_4^{2-} > Cl^-$

104. Which of the following electrolytes will have the maximum coagulating value for $Fe_2O_3 \cdot xH_2O / OH^-$ sol?

(a) $MgSO_4$ (b) $Al_2(SO_4)_3$

(c) NaCl (d) $BaSO_4$

105. Which of the following factors is/are responsible for the stability of lyophilic sols?

(a) Charge of colloidal particles

(b) Solvation of colloidal particles

(c) Both (a) and (b)

(d) Activation of colloidal particles

106. Which of the following colloids are called protective colloids?
(a) Lyophilic colloids
(b) Lyophobic colloids
(c) Hydrophobic colloids
(d) All of the above

107. Lyophilic sols are more stable than lyophobic sols because
(a) lyophobic sols are extensively solvated
(b) lyophilic sols are extensively solvated
(c) lyophilic sols are negatively charged
(d) lyophilic sols are reversible in nature

Topic 5
Emulsions and Application of Colloids

108. 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
(a) suspension (b) solution
(c) emulsion (d) All of these

109. Milk and vanishing cream are the examples of
(a) o/w type emulsion
(b) w/o type emulsion
(c) o/o type emulsion
(d) Both (a) and (b)

110. Butter and cream are the examples of
(a) w/o type emulsion
(b) o/w type emulsion
(c) Both (a) and (b)
(d) None of these

111. Choose the correct statement.
(a) Emulsion of water in oil type are generally unstable and sometimes form two separate layers on standing
(b) Emulsifying agent are added to prepare the emulsion
(c) Emulsion show Brownian motion but not the Tyndall effect because the particles of dispersed phase are very small
(d) Heating, freezing or centrifuging results in breaking of emulsion into its constituent

112. Which of following is/are the main emulsifying agent(s) for o/w emulsions?
(a) Proteins
(b) Gums
(c) Soaps
(d) All of the above

113. Emulsifying agent(s) used for w/o type of emulsion is/are
(a) long chain of alcohol
(b) lamp blacks
(c) heavy metal salts of fatty acid
(d) All of the above

114. Select the incorrect statement.
(a) Human protects fertile soil from coagulation
(b) Being colloidal in nature, soil absorb moisture and nourishing material
(c) Below dew point moisture of air containing dust particles condenses into fine droplets
(d) Clouds are aerosols having small droplets of water suspended in air

115. How does a delta form at the meeting place of sea and river water?
(a) The electrolyte present in sea water coagulate the clay
(b) The electrolyte present in sea water has no role
(c) The electrolyte present in river water coagulate the clay
(d) Both (a) and (c)

116. Smoke is precipitated by the
(a) cottrell precipitator (b) colloidal precipitator
(c) natural precipitator (d) Planck's precipitator

117. Alum is added to the water containing suspended impurities so that
(a) it becomes colloidal in nature
(b) the colloidal solution formed do not form precipitates
(c) suspended impurities gets coagulated
(d) impurities of metals like Mg, Ca etc., can be removed

118. Medicines are more effective in their colloidal form because
(a) in such condition, these gets easily precipitated in the blood
(b) in this state, these are more stable
(c) in this state, they have large surface area and hence, easily assimilated
(d) All of the above

119. Which of the following is/are colloidal in nature?
(a) Animal hides
(b) Medicines
(c) Photographic plates and films
(d) All of the above

Special Format Questions

I. More Than One Correct Option

120. The correct statements about physical adsorption are
(a) adsorption is spontaneous
(b) it is reversible in nature
(c) change in enthalpy as well as change in entropy are negative
(d) degree of adsorption increases with rise in temperature

121. The incorrect statements about chemisorption are
(a) it is reversible in nature
(b) it is more at low temperature
(c) it depends upon the nature of gas
(d) it does not involve activation energy

122. Which of the following statements is/are correct?
(a) Adsorption always led to a decrease in enthalpy of the system
(b) Adsorption arises due to unbalanced or residual attractive force of atoms or molecule or the surface
(c) Adsorption increases with rises in temperature
(d) Adsorption decreases the surface energy

123. The correct statements about catalyst are
(a) they participate in the reaction but recovered at the end
(b) they have no effect on free energy change
(c) enthalpy of reaction decreases in the presence of catalyst
(d) it alters the mechanism of reaction

124. The correct statements about enzymes are
(a) they are proteins
(b) they can catalyse any reaction
(c) their activity is maximum at 27°C
(d) they are biological catalyst found in organisms

125. The properties of hydrophilic sols are
(a) high concentration of dispersed phase can be easily attained
(b) coagulation is reversible
(c) viscosity and surface tension are nearly as that of water
(d) charge on the particles (i.e. +ve, – ve or 0) depend upon the pH of the medium

126. The examples of lyophilic sols are
(a) milk (b) gum
(c) fog (d) blood

127. The examples of aerosols are
(a) whipped cream
(b) cloud
(c) fog
(d) soap lather

128. The correct statements about micelle are
(a) these are associated colloids
(b) their formation is exothermic
(c) they can be formed only above a certain temperature, called the Kraft's temperature
(d) At critical micelle concentration, several properties of solution of surfaces like surface tension, osmotic pressure etc. changes

129. Which of the following are true about the emulsion?
(a) Emulsion can be broken into constituent liquids by heat, freezing
(b) Emulsion of oil in water is generally unstable
(c) Emulsion do not show the Tyndall effect
(d) They show Brownian motion

130. Which of the following are not true about the emulsifying agent?
(a) Proteins, gums and soaps are principal emulsifying agents for o/w emulsion
(b) It forms an interfacial film between suspended particles and the medium
(c) Emulsifying agent is used for the coagulation of colloidal sols
(d) Lamp blacks and long chain of alcohols are the examples of the emulsifying agent

131. Which of the following are true about tanning?
(a) Tanning results in the hardening of leather
(b) In process of tanning, a hide is soaked in tanning
(c) Any salts can be used in the place of tanning
(d) Chromium salts are used in place of tanning

II. Statement Based Questions

132. The area of interface depends upon the
I. size of the particles of bulk phases.
II. size of the particles of other than bulk phases.
III. shape of the particles of bulk phases.
Which of the above statements is/are correct? Choose the correct option.
(a) Only I (b) Only II (c) Only III (d) I and III

133. Some phenomena are given below.
I. Corrosion
II. Electrode process
III. Catalysis
IV. Crystallisation
Which of the above phenomena take place at the interface or surface? Choose the correct option.
(a) I and III (b) I, II and III
(c) I, II, III and IV (d) II and III

134. I. In adsorption process, the value of ΔH is always negative.
II. During adsorption, surface area of adsorbent decreases.
Which of the above statements is/are true? Choose the correct option.
(a) Only I (b) Only II
(c) I and II (d) None of these

135. Which of the following observations are true in case of adsorption from the solution phase?
I. The extent of adsorption decreases with an increase of temperature.
II. The extent of adsorption depends upon the concentration of the solute in solution.
III. The extent of adsorption increases with the decrease in surface area of adsorbent.
Select the correct option.
(a) I and III (b) I, II and III
(c) II and III (d) I and II

136. Which of the following statement is incorrect regarding physisorption?
I. Enthalpy of adsorption ($\Delta H_{\text{adsorption}}$) is low and positive.
II. It occurs due to van der Waals' forces.
III. More easily liquifiable gases are adsorbed readily.
IV. During adsorption unimolecular layer is formed.
Select the correct option.
(a) I and II (b) II and III
(c) III and IV (d) I and IV

137. Which of the following statements are true about zeolite?
I. They are microporous structure of aluminosilicates.
II. Catalytic activity depends upon the pores and cavities of the zeolites.
III. Zeolites are not found in nature.
IV. ZSM-5 is a zeolite.
Identify the correct option.
(a) I and III (b) I, II and III
(c) I, II and IV (d) I and IV

138. Some of the statements are given below regarding the enzymes.
I. Enzymes are biological catalysts that possess active site.
II. Active site of enzymes has no role for catalytic reaction.
III. Enzymes are biological catalysts those cannot be poisoned.
IV. Enzyme functions normally at optimum temperature and optimum pH.
Identify the correct statements. Choose the most appropriate option.
(a) I, II and III (b) II, III and IV
(c) I and IV (d) II and III

139. The characteristics of an enzyme are given below.
I. Enzymes are highly efficient.
II. Enzymes are highly specific in nature.
III. At optimum pH, they are less active.
IV. Enzyme activity is increased by the activator and co-enzymes.
Which of the above statements are correct?
(a) I, II and III (b) I, II and IV
(c) II, III and IV (d) II and III

140. Which of the following statements are true?
I. Soap molecules form micelle around the oil droplet.
II. Polar group of soap molecules interact with water.
III. The negatively charged sheath around the micelles prevent further aggregation.
IV. Hydrophobic group of the soal molecule intract with water.
Select the correct option.
(a) I, III and IV (b) I, II and IV
(c) I, II and III (d) III and IV

III. Assertion-Reason Type Questions

■ **Direction** (Q. Nos. 141-152) *In the following questions a statement of Assertion* (A) *followed by a statement of Reason* (R) *is given. Choose the correct answer out of the following choices.*
(a) Both A and R are correct and R is the correct explanation of A.
(b) Both A and R are correct but R is not the correct explanation of A.
(c) A is correct; R is incorrect.
(d) R is correct; A is incorrect.

141. **Assertion** (A) For adsorption, ΔG is negative.
Reason (R) Adsorption is an exothermic process accompanied by decrease in randomness.

142. **Assertion** (A) Physical adsorption of molecules on the surface requires activation energy.
Reason (R) In adsorption, sometimes the bonds of adsorbed molecules are broken.

143. **Assertion** (A) Coagulation power of Na_3PO_4 is more than NaCl.
Reason (R) Greater the valency of the flocculating ion added, greater the power of coagulation.

144. **Assertion** (A) Most of the medicines are more effective in the colloidal form.
Reason (R) Colloidal form exhibit large surface area and medicines which are easily assimilated in this form.

145. Assertion (A) A reaction cannot become fast by itself unless a catalyst is added.

Reason (R) A catalyst not always increases the rate of reaction.

146. Assertion (A) A gas with higher critical temperature is adsorbed more than a gas with lower critical temperature.

Reason (R) Higher critical temperature means that the gas is more easily liquefiable.

147. Assertion (A) Alcohols are dehydrated to hydrocarbon in the presence of acidic zeolite.

Reason (R) Zeolites are porous catalyst.

148. Assertion (A) The micelle formed by sodium stearate in water contains —COO^- groups at the surface.

Reason (R) Addition of stearate decreases the surface tension of water.

149. Assertion (A) NH_4Cl and *R*COONa are colloidal electrolytes.

Reason (R) Colloidal electrolytes behave as normal electrolytes at low concentration but form micelle above a specific concentration.

150. Assertion (A) Emulsification play a key role in the digestion of fat is intensive.

Reason (R) The emulsion formed is stablised by bile salt.

151. Assertion (A) AgI sol is prepared by adding $AgNO_3$ in excess of KI solution. The formed sol migrates towards anode under the influence of electric field.

Reason (R) Colloidal particles adsorb ions and thus becomes electrically charged.

152. Assertion (A) Lyophilic colloids are also called protective colloids.

Reason (R) The protecting power of lyophilic colloids is expensed in terms of gold number.

IV. Matching Type Questions

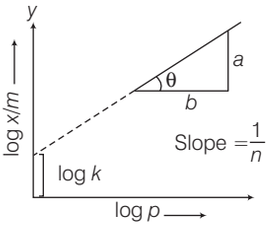
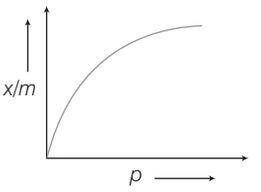
153. Match the Column I with the Column II and select the correct option from the codes given below.

Column I		Column II	
A.	Chemisorption	1.	Removal of adsorbed gases from adsorbent.
B.	Physisorption	2.	Adsorption and absorption take place simultaneously.
C.	Sorption	3.	Unimolecular layer formed.
D.	Desorption	4.	Multimolecular layer formed.

Codes

	A	B	C	D		A	B	C	D
(a)	4	1	2	3	(b)	3	4	2	1
(c)	1	2	3	4	(d)	2	3	4	1

154. Match the expression given in the Column I with the graphs or statement given in the Column II and select the correct option from the codes given below.

Column I	Column II
A. $\frac{x}{m}$ *vs* p	1. 
B. $\log \frac{x}{m}$ *vs* $\log p$	2. 
C. $\frac{x}{m} = kC^{1/n}$	3. Adsorption from solution phase

Codes

	A	B	C		A	B	C
(a)	1	2	3	(b)	2	1	3
(c)	3	1	2	(d)	3	2	1

155. Match the reactions given in the Column I and Column II and select the correct option from the codes given below.

Column I (Reactions)	Column II
A. $4NH_3(g) + 5O_2(g) \xrightarrow{Pt(s)} 4NO(g) + 6H_2O(g)$	1. Homogeneous catalysis
B. $N_2(g) + 3H_2(g) \xrightarrow{Fe(s)} 2NH_3(g)$	2. Haber's process
C. $2SO_2(g) + O_2(g) \xrightarrow{NO(g)} 2SO_3(g)$	3. Ostwald's process

Codes

	A	B	C		A	B	C
(a)	1	2	3	(b)	3	2	1
(c)	3	1	2	(d)	1	3	2

156. Match the Column I and Column II and select the correct option from the codes given below.

Column I		Column II	
A.	Invertase	1.	Yeast
B.	Zymase	2.	Maltose
C.	Diastase	3.	Soyabean
D.	Maltase	4.	Stomach
E.	Pepsin	5.	Melt

Codes

	A	B	C	D	E
(a)	1	1	5	1	4
(b)	1	2	3	3	2
(c)	1	2	1	1	4
(d)	1	4	3	2	4

157. Match the Column I with the Column II and select the correct option from the codes given below.

	Column I		Column II
A.	Solid sol	1.	Whipped cream
B.	Sol	2.	Paints
C.	Emulsion	3.	Gem stones
D.	Foam	4.	Milk

Codes

	A	B	C	D		A	B	C	D
(a)	1	2	4	3	(b)	3	2	4	1
(c)	3	2	1	4	(d)	1	2	3	4

158. Match the Column I with Column II and select the correct option from the codes given below.

	Column I		Column II
A.	Dispersion medium moves in an electric field.	1.	Osmosis
B.	Solvent molecules pass through semipermeable membrane towards solvent side.	2.	Electrophoresis
C.	Movement of charged colloidal particles under the influence of applied electric potential towards oppositely charged electrodes.	3.	Electroosmosis
D.	Solvent molecules pass through semipermeable membranes towards solution side	4.	Reverse osmosis

Codes

	A	B	C	D		A	B	C	D
(a)	1	2	3	4	(b)	3	4	2	1
(c)	3	4	1	2	(d)	4	3	1	2

159. Match the Column I and Column II and select the correct option from the codes given below.

	Column I		Column II
A.	Oil dispersed in H_2O	1.	Milk
B.	H_2O dispersed in oil	2.	Butter
		3.	Cream
		4.	Vanishing cream

Codes

(a) A–1, 2, B–3, 4 (b) A–1, 4, B–2, 3
(c) A–2, 3, B–1, 4 (d) A–1, 3, B–2, 4

160. Match the Column I with the Column II and select the correct option from the codes given below.

	Column I		Column II
A.	Argyrol	1.	Kalazar
B.	Antimony	2.	Intramuscular injection
C.	Colloidal gold	3.	Stomach disorders
D.	Milk of magnesia	4.	Eye lotion

Codes

	A	B	C	D
(a)	4	1	3	2
(b)	4	1	2	3
(c)	2	3	1	4
(d)	3	2	1	4

161. Match the Column I with Column II and select the correct option from the codes given below.

	Column I (Substances)		Column II
A.	Methylene blue	p.	Adsorbed on silica gel
B.	Water vapours	q.	Adsorbed on charcoal
C.	Hydrogen	r.	Absorbed on anhyd. $CaCl_2$
D.	Ammonia	s.	Adsorbed on Pt surface

Codes

	A	B	C	D
(a)	p,q	r,s	q,r	p,r
(b)	q	p	r,s	p,r
(c)	q	p,r	q,s	q
(d)	q	q,s	p,r	q

162. Match the Column I with Column II and select the correct option from the codes given below.

	Column I (Process)		Column II (Catalyst)
A.	Cracking of hydrocarbon	p.	Nickel
B.	Ostwald's process	q.	NO
C.	Manufacture of H_2SO_4	r.	Pt
D.	Catalytic converter	s.	NiO

Codes

	A	B	C	D
(a)	r	r	q,r	p
(b)	s	r,s	q,r	p
(c)	r,s	s,r	p,r	q
(d)	p,q	r,s	r	s

163. Match the colloids in Column I with their classification given in Column II.

	Column I		Column II
A.	Rain, cloud	p.	Gel
B.	Smoke	q.	Foam
C.	Butter	r.	Aerosol
D.	Soap	s.	Gas as dispersion medium

Codes

	A	B	C	D
(a)	r,s	r,s	p	q
(b)	r	r,s	p,q	r
(c)	r,p	p,r	s,r	p,s
(d)	p,q	p,r	r,s	s,t

164. Match the Columns I with Column II and select the correct option from the codes given below.

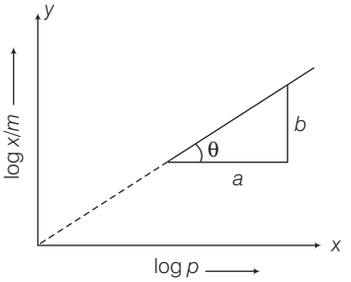
	Column I		Column II
A.	Coagulation	p.	Scattering of light
B.	Peptisation	q.	Purification of colloidal sol
C.	Tyndall effect	r.	Addition of electrolyte
D.	Dialysis	s.	Precipitation of colloidal solution

Codes

	A	B	C	D
(a)	q	r	s	p,s
(b)	r	s,p	q	r
(c)	r	p,q	s	r
(d)	r,s	r	p	q

V. Passage Based Questions

■ **Direction** (Q. Nos. 165-169) *Give the answers of the following questions on the basis of graph shown below.*



where, x = mass of gas which is adsorbed

m = mass of adsorbent

p = pressure

165. Above graph and its slope represents

(a) Freundlich isotherm, $\frac{1}{n}$

(b) Freundlich isobar, $\frac{1}{n}$

(c) Absorption isotherm, n^2

(d) Newton's isotherm, $\frac{1}{n^2}$

166. The intercept on the y-axis gives the vlaue of

(a) k (b) $\log k$

(c) $\log \frac{1}{k}$ (d) $2 \log k$

167. The factor $\frac{1}{n}$ can have value between

(a) 10-50 (b) 0-10

(c) 0-1 (d) 5-10

168. When $\frac{1}{n} = 0$, then adsorption

(a) depends upon pressure

(b) depends upon volume

(c) is independent of pressure

(d) is independent of volume

169. When $\frac{1}{n} = 1$, then adsorption varies

(a) directly with pressure

(b) directly with volume

(c) indirectly with pressure

(d) None of the above

■ **Direction** (Q. Nos. 170-171) *Give the answers to the following questions.*

Some catalytic reactions are as given below.

I. $CO(g) + 3H_2(g) \xrightarrow{Ni(s)} CH_4(g) + H_2O(g)$

II. $CO(g) + 2H_2(g) \xrightarrow{Cu/ZnO-Cr_2O_3} CH_3OH(g)$

III. $CO(g) + H_2(g) \xrightarrow{Cu(s)} HCHO(g)$

170. Which of the above reactions is/are a catalytic reaction?

(a) Only I (b) Only II

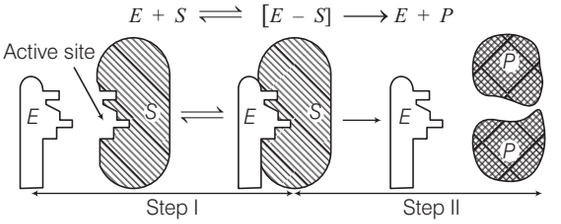
(c) Only III (d) I, II and III

171. Select the characteristic feature of the catalysis reaction as illustrated in the given reactions.

(a) Selectivity (c) Conductivity

(c) Poison (d) Speed of reaction

■ **Direction** (Q. Nos. 172-173) *Give the answers of the following questions on the basis of*



172. Above figure shows the

(a) mechanism of an enzyme catalysed reaction

(b) mechanism of crystallisation

(c) mechanism of corrosion

(d) mechanism of electrolysis

173. Which of the following is the slowest step?

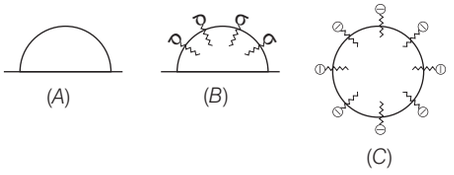
(a) Step I

(b) Step II

(c) Both steps take place with equal velocity

(d) None of the above

■ **Direction** (Q. Nos. 174-176) *Give the answers of following questions on the basis of the figure shown below.*

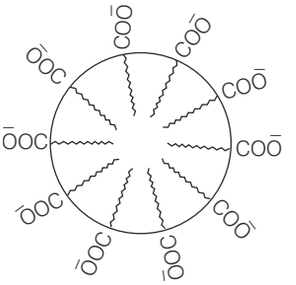


174. Figures (*A, B, C*) show the
(a) cleansing action of soaps
(b) cleansing action of detergents
(c) breaking of bond by the catalyst
(d) Both (a) and (b)

175. Figure *'B'* represents
(a) stearate ions arranging around grease droplet
(b) grease droplets arranging around stearate ions
(c) sometimes (a) and sometimes (b)
(d) None of the above

176. Figure *'C'* show the structure of
(a) aggregated colloids (b) macromolecular colloids
(c) (a) as well as (b) (d) multimolecular colloids

■ **Direction** (Q. Nos. 177-178) *Answers the following questions by considering the given figure.*



177. Above figure shows the structure of
(a) gold sol
(b) fogs
(c) ionic micelle
(d) lyophobic colloids

178. In ionic micelles
(a) centre core of micelle is hydrophilic in nature
(b) surface of micelle is hydrophobic in nature
(c) surface of micelle is hydrophilic in nature
(d) All of the above

NCERT & NCERT Exemplar Questions

NCERT

179. Give reason why a finely divided substance is more effective as an adsorbent?
(a) It has more surface area
(b) It has less surface area
(c) The number of active sites becomes more
(d) Both (a) and (c)

180. What are the factors which influence the adsorption of a gas on a solid?
(a) The nature of the gas (b) Surface area of adsorbent
(c) Activation of adsorbent (d) All of these

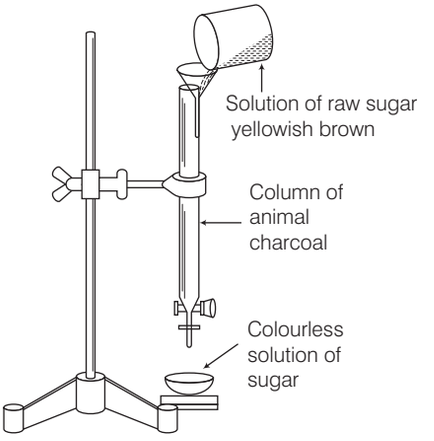
181. Why is adsorption always exothermic?
(a) Due to $\Delta H = (-)$ve (b) Due to $\Delta G = (+)$ve
(c) Due to $\Delta S = (-)$ve (d) Due to $\Delta H = (+)$ve

NCERT Exemplar

182. Which of the following process does not occur at the interface of phases?
(a) Crystallisation
(b) Heterogeneous catalysis
(c) Homogeneous catalysis
(d) Corrosion

183. Which of the following is an example of absorption?
(a) Water on silica gel
(b) Water on calcium chloride
(c) Hydrogen on finely divided nickel
(d) Oxygen on metal surface

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



(a) Absorption (b) Adsorption
(c) Coagulation (d) Emulsification

185. The term 'sorption' stands for ..... .
(a) absorption
(b) adsorption
(c) Both (a) and (b)
(d) desorption

186. At the equilibrium position in the process of adsorption ..... .
(a) $\Delta H > 0$ (b) $\Delta H = T\Delta S$
(c) $\Delta H > T\Delta S$ (d) $\Delta H < T\Delta S$

187. Which one of the following is not applicable to the phenomenon of adsorption?
(a) $\Delta H > 0$ (b) $\Delta G < 0$
(c) $\Delta S < 0$ (d) $\Delta H < 0$

188. Extent of adsorption of adsorbate from solution phase increases with ..... .
(a) increase in amount of adsorbate in solution
(b) decrease in surface area of adsorbent
(c) increase in temperature of solution
(d) decrease in amount of adsorbate in solution

189. Extent of physisorption of a gas increases with ..... .
(a) increase in temperature
(b) decrease in temperature
(c) decrease in surface area of adsorbent
(d) decrease in strength of van der Waals' forces

190. Which of the following is not a favourable condition for physical adsorption?
(a) High pressure
(b) Negative ΔH
(c) Higher critical temperature of adsorbate
(d) High temperature

191. Physical adsorption of a gaseous species may change to chemical adsorption with ..... .
(a) decrease in temperature
(b) increase in temperature
(c) increase in surface area of adsorbent
(d) decrease in surface area of adsorbent

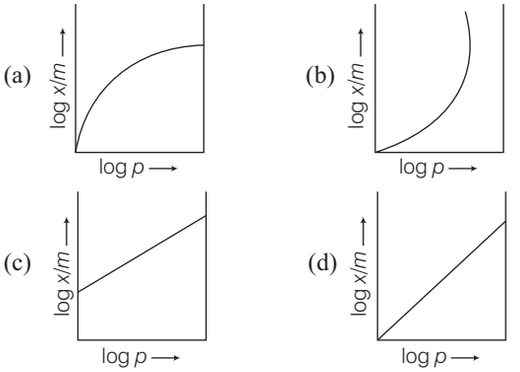
192. In physisorption adsorbent does not show specificity for any particular gas because ..... .
(a) involved van der Waals' forces are universal
(b) gases involved behave like ideal gases
(c) enthalpy of adsorption is low
(d) it is a reversible process

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

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

(a) CO_2 (b) SO_2 (c) CH_4 (d) H_2

194. Which of the following curves is in according with Freundlich adsorption isotherm?



195. In which of the following reactions heterogeneous catalysis is involved?

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

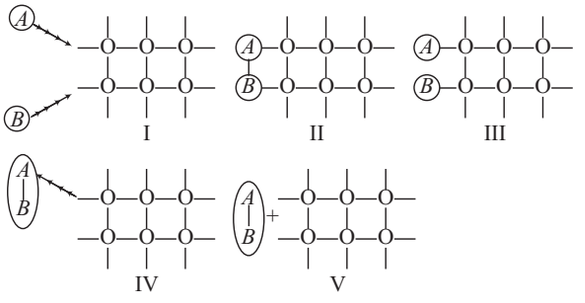
(II) $2SO_2(g) \xrightarrow{Pt(s)} 2SO_3(g)$

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

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

(a) II and III (b) II, III and IV
(c) I, II and III (d) Only IV

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



(a) I→ II→ III→ IV→ V (b) I→ III→ II→ IV→ V
(c) I→ III→ II→ V→ IV (d) I→ II→ III→ V→ IV

197. At high concentration of soap in water, soap behaves as ..... .
(a) molecular colloid (b) associated colloid
(c) macromolecular colloid (d) lyophilic colloid

198. Which of the following will show Tyndall effect?
(a) Aqueous solution of soap below critical micelle concentration
(b) Aqueous solution of soap above critical micelle concentration
(c) Aqueous solution of sodium chloride
(d) Aqueous solution of sugar

199. Which of the following process is not responsible for the presence of electric charge on the sol particles?
(a) Electron capture by sol particles
(b) Adsorption of ionic species from solution
(c) Formation of Helmholtz electrical double layer
(d) Absorption of ionic species from solution

200. The values of colligative properties of colloidal solution are of small order in comparison to those shown by true solutions of same concentration because of colloidal particles ..... .
(a) exhibit enormous surface area
(b) remain suspended in the dispersion medium
(c) form lyophilic colloids
(d) are comparatively less in number

201. Method by which lyophobic sol can be protected.
(a) By addition of oppositely charged sol
(b) By addition of an electrolyte
(c) By addition of lyophilic sol
(d) By boiling

202. Freshly prepared precipitate sometimes gets converted to colloidal solution by ..... .
(a) coagulation
(b) electrolysis
(c) diffusion
(d) peptisation

203. Which of the following electrolytes will have maximum coagulating value for Ag/Ag^+ sol?
(a) Na_2S (b) Na_3PO_4
(c) Na_2SO_4 (d) NaCl

204. Which of the following processes is responsible for the formation of delta at a place where rivers meet the sea?
(a) Emulsification
(b) Colloid formation
(c) Coagulation
(d) Peptisation

205. Which of the following phenomenon occurs when a chalk stick is dipped in ink?
(a) Adsorption of coloured substance
(b) Adsorption of solvent
(c) Absorption and adsorption both of solvent
(d) Absorption of solvent

206. H_2 gas is adsorbed on activated charcoal to a very little extent in comparison to easily liquefiable gases due to ..... .
(a) very strong van der Waals' interaction
(b) very weak van der Waals' forces
(c) very low critical temperature
(d) very high critical temperature

207. Freundlich adsorption isotherm is given by the expression $\frac{x}{m} = kp^{1/n}$. Which of the following conclusions can be drawn from this expression?
(a) When $\frac{1}{n} = 0$, the adsorption is independent of pressure
(b) When $\frac{1}{n} = 0$, the adsorption is directly proportional to pressure
(c) When $n = 0$, $\frac{x}{m}$ *vs* p graph is a line parallel to x-axis
(d) When $n = 0$, plot of $\frac{x}{m}$ *vs* p is a curve

208. In a reaction, catalyst changes ..... .
(a) physically (b) qualitatively
(c) chemically (d) quantitatively

209. Which of the following statements are correct about solid catalyst?
(a) Same reactants may give different products by using different catalysts
(b) Catalyst does not change ΔH of reaction
(c) Catalyst is required in large quantities to catalyse reactions
(d) Catalytic activity of a solid catalyst does not depend upon the strength of chemisorption

210. Which of the following options are correct?
(a) Micelle formation by soap in aqueous solution is possible at all temperatures
(b) Micelle formation by soap in aqueous solution occurs above a particular concentration
(c) On dilution of soap solution micelles may revert to individual ions
(d) Soap solution behaves as a normal strong electrolyte at all concentrations

211. What happens when a lyophilic sol is added to a lyophobic sol?
(a) Lyophobic sol is protected
(b) Lyophilic sol is protected
(c) Film of lyophilic sol is formed over lyophobic sol
(d) Film of lyophobic sol is formed over lyophilic sol

212. Which of the following colloids cannot be coagulated easily?
(a) Lyophobic colloids (b) Irreversible colloids
(c) Reversible colloids (d) Lyophilic colloids

213. Which of the following statements are correct?
(a) Mixing two oppositely charged sols neutralises their charges and stabilises the colloid
(b) Presence of equal and similar charges on colloidal particles provides stability to the colloids
(c) Any amount of dispersed liquid can be added to emulsion without destabilising it
(d) Brownian movement stabilises sols

214. Which of the following substances will precipitate the negatively charged emulsions?
(a) KCl (b) Glucose (c) Urea (d) NaCl

215. Which phenomenon occurs when an electric field is applied to a colloidal solution and electrophoresis is prevented?
(a) Reverse osmosis takes place
(b) Electroosmosis takes place
(c) Dispersion medium begins to move
(d) Dispersion medium becomes stationary

216. An emulsions cannot be broken by …… and …… .
(a) heating
(b) adding more amount of dispersion medium
(c) freezing
(d) adding emulsifying agent

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

	Column I		Column II
A.	Solid in liquid	1.	Foam
B.	Liquid in solid	2.	Sol
C.	Liquid in liquid	3.	Gel
D.	Gas in liquid	4.	Emulsion

Codes

	A	B	C	D		A	B	C	D
(a)	4	3	2	1	(b)	2	2	3	4
(c)	1	1	3	4	(d)	2	3	4	1

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

	Column I		Column II
A.	Butter	1.	Dispersion of liquid in liquid
B.	Pumice stone	2.	Dispersion of solid in liquid
C.	Milk	3.	Dispersion of gas in solid
D.	Paints	4.	Dispersion of liquid in solid

Codes

	A	B	C	D		A	B	C	D
(a)	1	2	3	4	(b)	4	3	1	2
(c)	4	3	2	1	(d)	4	2	1	3

219. Method of formation of solution is given in Column I, match it with the type of solution given in Column II.

	Column I		Column II
A.	Sulphur vapours passed through cold water.	1.	Normal electrolyte solution
B.	Soap mixed with water above critical micelle concentration.	2.	Molecular colloids
C.	White of egg whipped with water.	3.	Associated colloid
D.	Soap mixed with water below critical micelle concentration.	4.	Macromolecular colloids

Codes

	A	B	C	D		A	B	C	D
(a)	1	2	3	4	(b)	2	3	4	1
(c)	4	3	2	1	(d)	2	4	3	1

220. Match the statement given in Column I with the phenomenon given in Column II.

	Column I		Column II
A.	Dispersion medium moves in an electric field.	1.	Osmosis
B.	Solvent molecules pass through semipermeable membrane towards solvent side.	2.	Electrophoresis
C.	Movement of charged colloidal particles under the influence of applied electric potential towards oppositely charged electrodes.	3.	Electroosmosis
D.	Solvent molecules pass through semipermeable membranes towards solution side.	4.	Reverse osmosis

Codes

	A	B	C	D
(a)	1	2	3	4
(b)	3	2	4	1
(c)	3	4	2	1
(d)	4	3	2	1

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

	Column I		Column II
A.	Dialysis	1.	Cleansing action of soap
B.	Peptisation	2.	Coagulation
C.	Emulsification	3.	Colloidal sol formation
D.	Electrophoresis	4.	Purification

Codes

	A	B	C	D
(a)	3	4	2	1
(b)	4	3	2	1
(c)	1	2	3	4
(d)	4	3	1	2

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

	Column I		Column II
A.	Protective colloid	1.	$FeCl_3$ + NaOH
B.	Liquid-liquid colloid	2.	Lyophilic colloids
C.	Positively charged colloid	3.	Emulsion
D.	Negatively charged colloid	4.	$FeCl_3$ +hot water

Codes

	A	B	C	D
(a)	1	2	3	4
(b)	2	3	4	1
(c)	2	4	3	1
(d)	2	3	1	4

■ **Direction** (Q. Nos. 223-227) *In the following questions a statement of assertion* (A) *followed by a statement of reason* (R) *is given. Choose the correct answer out of the following choices.*

(a) Assertion and Reason both are correct and the Aeason is correct explanation of Assertion.

(b) Assertion and Reason both are correct but reason does not explain Assertion.

(c) Assertion is correct, but Reason is incorrect.

(d) Both Assertion and Reason are incorrect.

(e) Assertion is incorrect, but Reason is correct.

223. Assertion (A) Detergents with low CMC are more economical to use.

Reason (R) Cleansing action of detergents involves the formation of micelles. These are formed when the concentration of detergents becomes equal to CMC.

224. Assertion (A) An ordinary filter paper impregnated with collodion solution stops the flow of colloidal particles.

Reason (R) Pore size of the filter paper becomes more than the size of colloidal particle.

225. Assertion (A) Colloidal solution show colligative properties.

Reason (R) Colloidal particles are large in size.

226. Assertion (A) Colloidal solutions do not show Brownian motion.

Reason (R) Brownian motion is responsible for stability of sols.

227. Assertion (A) Coagulation power of Al^{3+} is more than Na^{+}.

Reason (R) Greater the valency of the flocculating ion added, greater is its power to cause precipitation (Hardy-Schulze rule) .

Answers

1.	(c)	**2.**	(c)	**3.**	(d)	**4.**	(c)	**5.**	(c)	**6.**	(b)	**7.**	(d)	**8.**	(d)	**9.**	(d)	**10.**	(b)	**11.**	(b)	**12.**	(a)	**13.**	(d)	**14.**	(c)	**15.**	(c)
16.	(b)	**17.**	(d)	**18.**	(b)	**19.**	(c)	**20.**	(c)	**21.**	(c)	**22.**	(a)	**23.**	(b)	**24.**	(c)	**25.**	(c)	**26.**	(a)	**27.**	(d)	**28.**	(a)	**29.**	(b)	**30.**	(a)
31.	(a)	**32.**	(a)	**33.**	(b)	**34.**	(b)	**35.**	(c)	**36.**	(d)	**37.**	(b)	**38.**	(c)	**39.**	(d)	**40.**	(a)	**41.**	(d)	**42.**	(d)	**43.**	(c)	**44.**	(c)	**45.**	(c)
46.	(d)	**47.**	(c)	**48.**	(b)	**49.**	(c)	**50.**	(c)	**51.**	(a)	**52.**	(d)	**53.**	(d)	**54.**	(d)	**55.**	(b)	**56.**	(d)	**57.**	(d)	**58.**	(c)	**59.**	(a)	**60.**	(b)
61.	(a)	**62.**	(b)	**63.**	(a)	**64.**	(a)	**65.**	(a)	**66.**	(b)	**67.**	(b)	**68.**	(b)	**69.**	(a)	**70.**	(a)	**71.**	(d)	**72.**	(d)	**73.**	(c)	**74.**	(c)	**75.**	(c)
76.	(b)	**77.**	(d)	**78.**	(d)	**79.**	(b)	**80.**	(d)	**81.**	(b)	**82.**	(d)	**83.**	(a)	**84.**	(d)	**85.**	(a)	**86.**	(b)	**87.**	(d)	**88.**	(a)	**89.**	(d)	**90.**	(a)
91.	(a)	**92.**	(a)	**93.**	(b)	**94.**	(b)	**95.**	(c)	**96.**	(c)	**97.**	(a)	**98.**	(b)	**99.**	(c)	**100.**	(b)	**101.**	(c)	**102.**	(b)	**103.**	(d)	**104.**	(b)	**105.**	(c)
106.	(a)	**107.**	(b)	**108.**	(c)	**109.**	(a)	**110.**	(a)	**111.**	(d)	**112.**	(d)	**113.**	(d)	**114.**	(a)	**115.**	(a)	**116.**	(a)	**117.**	(c)	**118.**	(c)	**119.**	(d)	**120.**	(abd)
121.	(ab)	**122.**	(abc)	**123.**	(abd)	**124.**	(acd)	**125.**	(abd)	**126.**	(abd)	**127.**	(bc)	**128.**	(acd)	**129.**	(abd)	**130.**	(abd)	**131.**	(abd)	**132.**	(a)	**133.**	(c)	**134.**	(a)	**135.**	(a)
136.	(d)	**137.**	(c)	**138.**	(c)	**139.**	(b)	**140.**	(c)	**141.**	(a)	**142.**	(d)	**143.**	(d)	**144.**	(b)	**145.**	(d)	**146.**	(a)	**147.**	(b)	**148.**	(a)	**149.**	(a)	**150.**	(a)
151.	(d)	**152.**	(a)	**153.**	(b)	**154.**	(b)	**155.**	(b)	**156.**	(a)	**157.**	(b)	**158.**	(b)	**159.**	(d)	**160.**	(b)	**161.**	(c)	**162.**	(a)	**163.**	(a)	**164.**	(d)	**165.**	(a)
166.	(b)	**167.**	(c)	**168.**	(c)	**169.**	(a)	**170.**	(d)	**171.**	(a)	**172.**	(a)	**173.**	(a)	**174.**	(d)	**175.**	(a)	**176.**	(a)	**177.**	(c)	**178.**	(c)	**179.**	(d)	**180.**	(d)
181.	(a)	**182.**	(c)	**183.**	(b)	**184.**	(b)	**185.**	(c)	**186.**	(b)	**187.**	(a)	**188.**	(a)	**189.**	(b)	**190.**	(d)	**191.**	(b)	**192.**	(a)	**193.**	(d)	**194.**	(c)	**195.**	(a)
196.	(b)	**197.**	(b)	**198.**	(b)	**199.**	(d)	**200.**	(d)	**201.**	(c)	**202.**	(d)	**203.**	(b)	**204.**	(c)	**205.**	(ad)	**206.**	(bc)	**207.**	(ac)	**208.**	(ab)	**209.**	(ab)	**210.**	(bc)
211.	(ac)	**212.**	(cd)	**213.**	(bd)	**214.**	(ad)	**215.**	(bc)	**216.**	(bd)	**217.**	(d)	**218.**	(b)	**219.**	(b)	**220.**	(c)	**221.**	(d)	**222.**	(b)	**223.**	(a)	**224.**	(c)	**225.**	(b)
226.	(e)	**227.**	(a)																										

Hints & Explanations

2. (*c*) Clean solid materials are needed to the stored in the vacuum because they will be covered by molecules of major air components like O_2 and N_2.

3. (*d*) The process of removing adsorbed substance from a surface on which it is adsorbed is called desorption.

7. (*d*) When a chalk stick is dipped in ink, the surface retains the colour of ink due to adsorption of coloured molecules while, the solvent of the ink goes deeper into the stick due to absorption.

9. (*d*) During adsorption, there is always a decrease in the residual forces of the surface, i.e. there is decrease in surface energy which appears as heat. Therefore, adsorption is an exothermic process.

i.e. $\Delta H = -$ve (always)

10. (*b*) Physical adsorption takes place with decrease in enthalpy, thus exothermic change. It is physical adsorption and does not require activation. Thus, (a) is incorrect.

Being physical adsorption $\Delta H < 0$ thus, (b) is correct. Exothermic reaction if favoured a low temperature thus (c) is incorrect. Physical adsorption is always reversible, thus (d) is incorrect.

11. (*b*) ΔS [change in entropy] and ΔH [change in enthalpy] are related by the equation

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

[Here, ΔG = change in Gibb's free energy]

For adsorption of a gas, ΔS in negative because randomness decreases. Thus, inorder to make ΔG negative.

[for spontaneous reaction], ΔH must be highly negative because reaction is exothermic.

Hence, for the adsorption of a gas, if ΔS is negative, therefore, ΔH should be highly negative.

12. (*a*) Adsorption attains the equilibrium, when $T\Delta S = \Delta H$

$\because$ At equilibrium $\Delta G = 0$

14. (*c*) Physisorption followed by chemisorption is involved in the adsorption of dihydrogen on the nickel surface.

15. (*c*) Characteristic of physisorption are lack of specificity, reversible nature, enthalpy of adsorption $\approx 20 - 40$ kJ.

16. (*b*) Physical adsorption is an exothermic process but its enthalpy of adsorption is quite low (20 to 40 kJ mol^{-1}). This is because the attraction between gas molecules and solid surface is only due to weak van der Waals' forces.

17. (*d*) Physisorption is an exothermic process. Enthalpy of an adsorption is low (20-40 kJ mol^{-1}). In this case, low temperature is favourable for adsorption i.e. It decreases with the increase of temperature,
$\Delta H = -$ (20 to 40 kJ mol^{-1}). It also decreases with decrease in pressure.

18. (*b*) Characteristics of chemisorption (i) high specificity (ii) irreversibility (iii) large surface area (iv) enthalpy of adsorption is high (80 – 240 kJ mol^{-1}).

19. (*c*) Chemisorption is an exothermic process and it is very slow process at low temperature on the account of high energy of activation. Therefore, with increase of temperature chemisorption increases usually high pressure is also favourable for chemisorption.

24. (*c*) $\frac{x}{m} = p \times T$ is the incorrect relation. The correct relation is amount of adsorption $\frac{x}{m} \propto \frac{p}{T}$.

26. (*a*) $\frac{x}{m}$ shows extent of adsorption. Extent of adsorption increases by decrease of temperature. Order of temperature

$$T_1 < T_2 < T_3$$

28. (*a*) In Freundlich adsorption isotherm,

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

where, x = amount of adsorbent

m = amount of adsorbate

The value of n is always greater than 1. So, the value of $1/n$ lies between 0 and 1 in all cases.

30. (*a*) 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.

32. (*a*) $2KClO_3 \xrightarrow{MnO_2} 2KCl + 3O_2$

When little amount of MnO_2 is added, the decomposition takes place at lower temperature and rate of reaction also increases. Amount of MnO_2 remains unchanged during the reaction. Hence, MnO_2 acts as a catalyst.

33. (*b*) Promoters enhance the activity of a catalyst, while poisons decrease the activity of a catalyst.

34. (*b*) Hydrolysis of methyl acetate is catalysed by H^+ ions furnished by HCl.

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

Both the reactants and the catalyst are in the same phase. So, it is an example homogeneous catalysis.

35. (*c*) Options (a, b, d) the reactants and the catalyst are in the same phase. So these are the example of homogeneous catalysis process. In option (c) the reactants and the catalyst are in the different phase. So, it is heterogeneous catalysis process.

36. (*d*) In Haber's process, Ostwald's process and oxidation of SO_2, into SO_3 in presence of Pt, the reactants and the catalyst are in different phases, so it represents the heterogeneous catalysis reaction.

42. (*d*) The reactions taking place in zeolites depend upon the shape and the size of reactant and product molecules. It also depend upon the pores and cavities of the zeolites.

46. (*d*) Most of the enzymes have proteinous nature. They are highly specific and get denaturated by high temperature of UV-rays . At optimum temperature, which is generally in between 25-35°C enzyme activity is maximum.

47. (*c*) Cane sugar $\xrightarrow{\text{Invertase}}$ Glucose + fructose

48. (*b*) $C_6H_{12}O_6(aq) \xrightarrow{\text{Zymase}} 2C_2H_5OH(aq) + 2CO_2(g)$

49. (*c*) Enzymes are highly active at optimum temperature and optimum pH.

51. (*a*) Metal ions act as activator.

55. (*b*) A colloid is a heterogeneous system in which one substance is dispersed as very fine particles in another substance called dispersion medium.

57. (*d*) Coagulation is generally brought about by the addition of electrolytes. When an electrolyte is added to a colloidal solution, the particles of the sol take up the ions which are oppositely charged. As a result their charge gets neutralised.

Electrophoresis The movement of colloidal particles under an applied electric potential is called electrophoresis.

Electroosmosis may be defined as a phenomenon in which the molecules of the dispersion medium are allowed to move under the influence of an electric field whereas colloidal particles are not allowed to move.

Tyndall effect is the scattering of light by sol particles, which cannot be affected by charge on them.

61. (*a*) Lyophobic sols are readily precipitated (or coagulated) on addition of small amounts of electrolytes or by heating, hence they are not stable.

62. (*b*) Lyophobic sols are unstable, so they are stabilised by adding some lyophilic colloids which protect them from precipitation. Thus, lyophilic colloids are called protecting colloids. Their protecting power is expressed in terms of gold number.

In other words, gold number can be defined as the minimum amount of lyophilic colloid in milligrams, which prevent the flocculation of 10 mL gold sol by the addition of 1 mL of 10% NaCl solution.

Note Lesser the gold number, higher is the protecting power.

66. (*b*) Macromolecular colloids are quite stable and resemble to the true solutions in many respects.

69. (*a*) Sodium stearate is a major component of many bar soap. Chemical formula of sodium stearate is $CH_3(CH_2)_{16}COO^-Na^+$.

72. (*d*) In chemical method, all types of chemical reactions, e.g. oxidation, reduction, double decomposition etc. are involved for the formation of colloids.

73. (*c*) $ZnSO_4 + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

This reaction does not involve in the formation of colloidal sols.

75. (*c*) **Bredig's arc method** involves the dispersion as well as condensation. Colloidal sols of metals such as gold, silver, platinum etc., can be prepared by this method.

In this method electric arc is struck between the **electrodes** of the metal immersed in the **dispersion medium.**

78. (*d*) Colloidal solutions play very important role in the process of dialysis.

84. (*d*) Tyndall effect is observed only when the following two conditions are satisfied.

(i) The diameter of the dispersed particles is not much smaller than the wavelength of the light used.

(ii) The refractive indices of the dispersed phase and the dispersion medium differ greatly in magnitude.

85. (*a*) Zsigmondy, in 1903 used Tyndall effect to set up an apparatus known as ultramicroscope.

87. (*d*) The colour of colloidal solution depends upon the wavelength of light which is scattered by the dispersed particles. The wavelength of light further depends on the size and nature of the particle.

88. (*a*) Larger size of particles, it scattered low wavelength of light as shown in the observation. So, (a) is correct option.

89. (*d*) Brownian motion is independent of the nature of colloid but depends on the size of the particles and viscosity of the solution.

91. (*a*) Mixture of $FeCl_3$ and NaOH form the negatively charged sol.

93. (*b*) As_2S_3, starch and gold sols are the examples of the negatively charged sols.

94. (*b*) The sol particles acquire positive or negative charge by preferential adsorption of the positive or negative ions.

98. (*b*) The presence of similar and equal charges on colloidal particles is largely responsible in providing stability to the colloidal solution, because the repulsive forces between charged particles prevent aggregation of colloidal system.

99. (*c*) Positively charged particles are repelled by the anode.

100. (*b*) It is observed that the dispersion medium begins to move in an electric field when electrophoresis is prevented. This phenomena is termed as electroosmosis.

102. (*b*) According to Hardy-Schulze rule, greater the charge ion oppositely charged ion, greater is its coagulating power. Since arsenic sulphide is a negatively charged sol thus, the order of coagulating power is $Na^+ < Ba^{2+} < Al^{3+}$.

103. (*d*) For positive sol, the flocculating power of anions are in the order

$$PO_4^{3-} > SO_4^{2-} > Cl^-$$

104. (*b*) $Fe_2O_3 \cdot xH_2O / OH^-$ sol

Negatively charged colloids

$$MgSO_4 \longrightarrow Mg^{2+}$$
$$Al_2(SO_4)_3 \longrightarrow Al^{3+}$$
$$NaCl \longrightarrow Na^+$$
$$BaSO_4 \longrightarrow Ba^{2+}$$

Order of coagulation power

$$Al^{3+} > Mg^{2+} = Ba^{2+} > Na^+$$

105. (*c*) There are two factors which are responsible for the stability of lyophilic sols. These factors are the charge and solvation of colloidal particles.

106. (*a*) Lyophilic colloids are called protective colloids because, when it is mixed with lyophobic colloids, it form a layer around lyophobic particles and thus, protect the lyophobic colloids from being coagulated.

115. (*a*) The electrolyte present in sea water coagulate the clay.

116. (*a*) Smoke is precipitated by the cottrell precipitator.

The smoke particles on coming in contact with cottrell precipitator plates, lose their charge and get precipitated.

120. (*a,b,d*) Adsorption is an exothermic process, as generally decreases with rise in temperature (but chemisorption increase with rise in temperature).

121. (*a,b*) Chemisorption is irreversible and involve high energy of activation. High temperature favours it. It depends upon the nature of gas.

123. (*a,b,d*) Catalyst does not affect ΔG and ΔH.

It participate in the reaction but recovered at the end. It alters the mechanism of reaction.

124. (*a,c,d*) Enzymes are specific in nature, so they catalyse only the specific reactions, generally the reaction occurring in living organism.

125. (*a,b,d*) Viscosity an surface tension of hydrophilic sols are different from that of water.

129. (*a,b,d*) Emulsion show the Tyndall effect.

130. (*a,b,d*) Emulsifying agents are not used for the coagulation of colloidal sols.

131. (*a,b,d*) Animal hides are colloidal in nature. A hide positively charged particles is soaked in tanning, which contains negatively charged colloidal particles, mutual coagulation takes place. This results in the hardening of leather. This process is termed as tanning.

132. (*a*) The interface is normally a few molecules thick but its area depneds on the size of the particles of bulk phases.

133. (*c*) Many important phenomena corrosion such as electrode processes, heterogeneous catalysis dissolution and crystallisation occur at interface.

134. (*a*) Adsorption is an exothermic process, ΔH = –ve.

Extent of adsorption increase with the increase of surface area per unit mass of the adsorbent.

136. (*d*) Adsorption is an exothermic process so ΔH is always negative. If results into multimolecular layers on adsorbent surface under high pressure.

137. (*c*) Zeolite are microporous structure of aluminosilicates. Catalytic activity depends upon the pores and cavities of the zeolites. Zeolites are also found in nature. ZSM-5 is an example of zeolite.

138. (*c*) **Enzyme** It is a biological catalyst. It possess active site (important role), at active site functional groups are present.

They can get poisoned. It normally function at optimum temperature and optimum pH. So, statement (I) and (IV) are correct.

139. (*b*) Less amount of enzymes are highly efficient for the enzymatic reaction. Enzymes are highly specific in nature.

At optimum temperature and optimum pH enzymes are highly active. Enzyme activity is increased by activator and co-enzyme.

140. (*c*) Soap molecules form micelle around the oil droplet. Polar group of soap molecules interact with water.The negatively charged sheath around the micelles prevent further aggregation.

141. (*a*) We know that, $\Delta G = \Delta H - T\Delta S$

Since, adsorption is exothermic, so $\Delta H = -\text{ve}$ further, it occurs with decrease in randomness, so $\Delta S = (-)\text{ve}$

$$\Delta G = -\text{ve} - T(-\text{ve}) = -\text{ve} + T$$

So, at low temperature $\Delta G = -\text{ve}$.

142. (*d*) No activation energy is required for physisorption. However, in case of chemisorption the bonds of adsorbed molecules break.

143. (*d*) $Na_2PO_4 \longrightarrow 3Na^+ + PO_4^{3-}$

$$NaCl \longrightarrow Na^+ + Cl^-$$

PO_4^{3-} and Cl^- have valency 3 and 1 respectively.

Order of coagulation power $\propto$ valency.

145. (*d*) A reaction may become faster by its own (autocatalysis). Further, a catalyst may increase or decrease the rate of reaction.

146. (*a*) More easily liquefiable gases are easily adsorbed and a gas having higher critical temperature is more easily liquefiable.

151. (*d*) $AgNO_3 + \underset{\text{Excess}}{KI} \longrightarrow [Ag]^+ I^-$ negative sol so moves towards cathode under the influence of electric field.

153. (*b*) A → 3, B → 4, C → 2, D → 1

154. (*b*) A → 2, B → 1, C → 3

155. (*b*) A → 3, B → 2, C → 1

156. (*a*) A → 1, B → 1, C → 5, D → 1, E → 4.

157. (*b*) A → 3, B → 2, C → 4, D → 1

158. (*b*) A → 3, B → 4, C → 2, D → 1.

159. (*d*) A → 1, 3; B → 2,4.

Examples of oil dispersed in water-milk, cream examples of H_2O dispersed in oil- butter, vanishing cream.

160. (*b*) A→4, B→1, C→2, D→3.

161. (*c*) A – q B – p,r C – q,s D – q

Methylene blue, hydrogen and ammonia are adsorbed by charcoal, while water vapours are adsorbed by silicagel or an $CaCl_2$. Pt also adsrob H_2 .

162. (*a*) A–r B–r C–q,r D–p

163. (*a*) A–r,s, B–r,s C–p D–q

164. (*d*) A–r,s, B–r C–p D–q

165. (*a*) The graph shows Freundlich isotherm and its slope represents, $\frac{1}{n}$.

166. (*b*) The intercept on the *y*-axis gives the value of log k.

167. (*c*) The factor $\frac{1}{n}$ can have values between 0 and 1 (probable range 0.1 to 0.5).

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

169. (*a*) When $\frac{1}{n} = 1$, then adsorption varies directly with pressure.

170. (*d*) $CO(g) + 3H_2(g) \xrightarrow{Ni\,(s)} CH_4(g) + H_2O(g)$

$CO(g) + 2H_2(g) \xrightarrow{Cu/ZnO - Cr_2O_3(s)} CH_3OH(g)$

$CO(g) + H_2(g) \xrightarrow{Cu\,(s)} HCHO(g)$

Here, Ni, Cu/ZnO–Cr_2O_3 and Cu are catalysts.

- Different catalysts act on same reactants give different products.

171. (*a*) The above equation shows the selectivity of the catalysis reaction.

172. (*a*) Figure shows mechanism of the enzyme catalysed reaction.

173. (*a*) $\underset{\text{Slow step}}{E + S} \rightleftharpoons \underset{\text{Fast step}}{[E - S]} \longrightarrow E + P$

174. (*d*) The given figure represent the cleansing action of soaps and detergents.

175. (*a*) Fig. *B* represents stearate ions arranging around grease droplet.

176. (*a*) Fig. *C* shows the aggregated colloids. The cleansing action of soap is due to the fact that soap molecules form micelle around the oil droplet in such a way that hydrophobic part of the stearate ions is in the oil droplet and hydrophilic part projects out of the grease droplet like the bristles.

Since, the polar groups can interact with water, the oil droplet surrounded by stearate ions is now pulled in water and removed from the dirty surface.

177. (*c*) Figure shows structure of ionic micelle.

178. (*c*) At critical micelle concentration, the anions (—COO^- which is hydrophilic in nature), pulled into the bulk of solution and aggregate to form a spherical shape with their hydrocarbon chains (which is hydrophobic in nature) pointing towards the centre of the sphere. An aggregate thus formed is known as ionic micelles.

179. (*d*) A finely divided substance is more effective as an adsorbent because

(i) it has more surface area so more adsorption occurs.

(ii) the number of active sites (active centres) becomes more and the extent of adsorption increases.

180. (*d*) The factors which influence the adsorption of a gas on a solid are as follows:

(i) the nature of the gas

(ii) surface area of adsorbent

(iii) pressure

(iv) temperature

(v) activation of adsorbent.

181. (*a*) When a gas is adsorbed on the surface of a solid its entropy decreases, i.e. ΔS is – ve. Now, $\Delta G = \Delta H - T\Delta S$ and for the process to be spontaneous, free energy change, ΔG must be negative.

As $T\Delta S$ is negative ΔG can be negative only if ΔH is negative. Hence, adsorption is always exothermic.

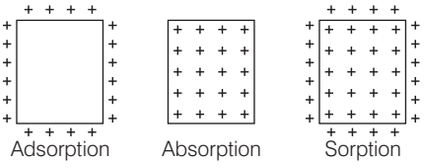
182. (*c*) Homogeneous catalysis does not occur at the interface of phases. As in case of homogeneous catalysis, reactant and catalyst have same phase and their distribution is uniform throughout.

183. (*b*) Absorption means penetration of adsorbate molecules into the bulk of the adsorbent e.g. water on calcium chloride. When water is spread over calcium chloride, water get penetrate into bulk of the calcium chloride.

184. (*b*) Above figure represent adsorption of yellowish brown colour of raw sugar by animal charcoal.

Here, aqueous solution of raw sugar is filtered by using animal charcoal. Yellowish brown colour of raw sugar is adsorbed and filterate is colourless which gives white colour on cystallisation. Hence, this phenomenon is adsorption.

185. (*c*) Sorption stands for both absorption and adsorption. We can understand this by using following figures:



186. (*b*) As we know that, at equilibrium $\Delta G = 0$

$$\Delta H - T\Delta S = 0$$

$$\Delta H = T\Delta S$$

Hence, at equilibrium enthalpy change is equal to product of temperature and entropy change.

187. (*a*) For phenomenon of adsorption $\Delta H < 0$, i.e. enthalpy change during phenomenon of adsorption is negative because during adsorption, there is always a decrease in residual forces of the surface which lead to decrease in surface energy that appears as heat.

So, adsorption is an exothermic process and $\Delta H < 0$.

188. (*a*) Extent of adsorption of adsorbate from solution phase increases with increase in amount of adsorbate in solution. As amount of adsorbate in the solution increases, interaction of adsorbate with adsorbent increases which lead to increase in extent of adsorption.

189. (*b*) Extent of physisorption of a gas increases with decrease in temperature. Because in physisorption particles are held to the surface by weak van der Waals' force of attraction hence on increasing temperature they get desorbed easily.

190. (*d*) Physisorption is a process in which adsorbate get adsorbed on the adsorbent surface by weak van der Waals' force of attraction.

On increasing temperature the interaction between adsorbate and adsorbent becomes weak and adsorbate particles get desorbed.

191. (*b*) On increasing temperature, physisorption changes to chemisorption. As temperature increases, energy of activation of adsorbate particles increases which lead to formation of chemical bond between adsorbate and adsorbent.

Hence, physisorption transform into chemisorption.

192. (*a*) In physisorption adsorbent does not show specificity for any particular gas because involved van der Waals' forces are universal. It means extent of van der Waals' interaction between adsorbate and adsorbent is constant for all gases.

193. (*d*) Lesser the value of critical temperature of gases lesser will be the extent of adsorption. Here, H_2 has lowest value of critical temperature, i.e. 33.

Hence, hydrogen gas shows least adsorption on a definite amount of charcoal.

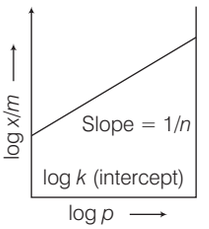
194. (*c*) According to the Freundlich adsorption isotherm

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

Taking log on both side $\log \frac{x}{m} = \left(\frac{1}{n}\right) \log\ p + \log\ k$

$$\uparrow \quad \uparrow \quad \uparrow \quad \uparrow$$
$$Y \quad = \quad m \quad x \quad + \quad C$$

On comparing it with equation of straight line and drawing the graph $\log \frac{x}{m}$ *versus* $\log\ p$, we get a straight line with intercept $\log\ k$ and slope of the straight line gives the value of $\frac{1}{n}$.



195. (*a*) Reaction in which catalyst is in different phase than other (reactants and products) is known as heterogeneous catalysis.

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

Here, reactant SO_2 and product SO_3 are in gaseous phase while platinum is in solid phase. So, this reaction represents a heterogeneous catalysis.

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

Similarly, here, reactant N_2 and H_2 and product NH_3 are in gaseous phase, while Fe is in solid phase. So, this reaction represents a heterogeneous catalysis. Whereas, in other reactions catalyst is in same phase with reactant(s) and product(s).

196. (*b*) Correct sequence is: I→ III → II→ IV→ V

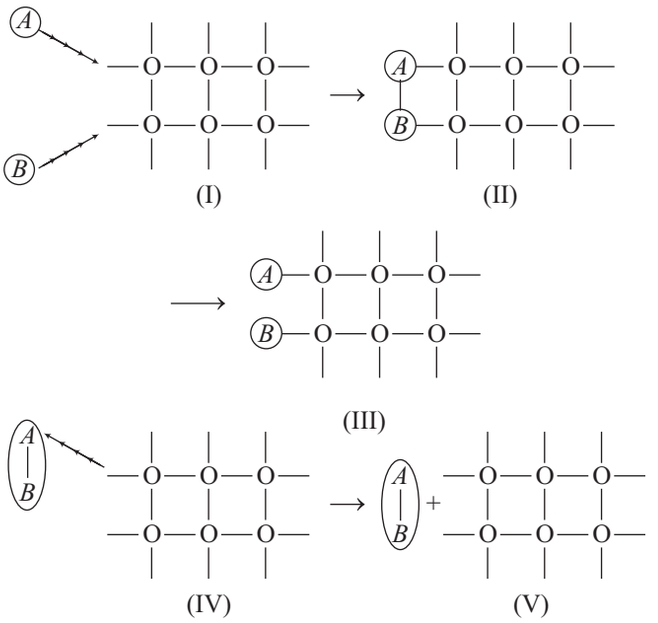
Each transformation denotes a meaningful process as follows

I → III adsorption of *A* and *B* on surface

III → II interaction between *A* and *B* to form intermediate

II → IV starting desorption of *A*—*B*

IV → V complete desorption



197. (*b*) **Associated colloid** At high concentration of soap in water, soap particles present in the solution get associated around and lead to formation of associated colloid.

198. (*b*) Aqueous solution of soap above critical micelle concentration lead to formation of colloidal solution.

Tyndall effect is a characteristic of colloidal solution in which colloidal particles shows a coloured appearance when sunlight passes through it and seen from the perpendicular side.

199. (*d*) Absorption of ionic species from solution is not responsible for the presence of electric charge on the sol particles. Charge on the sol particles is due to

(i) electrons capture by sol particles during electrodispersion of metal.

(ii) preferential adsorption of ionic species from solution.

(iii) formation of Helmholtz electrical double layer.

200. (*d*) The value of colligative properties of colloidal solution are of small order in comparison to those of true solution of same concentration because of colloidal particles are comparatively less in number.

This is due to slight large size of colloidal particles in comparison to particles present in true solution.

Size of colloidal particles is in between 1 nm to 1000 nm.

201. (*c*) Lyophobic sol can be protected by addition of lyophilic sol. As lyophobic sols are readily precipitated on addition of small amount of electrolytes or shaking, or heating hence they are made stable by adding lyophilic sol which stabilises the lyophobic sols.

202. (*d*) Freshly prepared precipitate sometimes gets converted to colloidal solution by peptisation. Peptisation is a process in which by addition of a suitable peptising agent precipitate gets converted into colloidal solution.

203. (*b*) According to Hardy-Schulze law, greater the charge on anion greater will be its coagulating power.

Electrolytes	Anionic part	Charge on anion
Na_2S	S^{2-}	2
Na_3PO_4	PO_4^{3-}	3
Na_2SO_4	SO_4^{2-}	2
NaCl	Cl^-	1

Here, PO_4^{3-} have highest charge. Hence, PO_4^{3-} have highest coagulating power.

204. (*c*) River water is a colloidal solution of clay and sea water contains various electrolytes. When river water comes in contact with sea water, then the electrolytes present in sea water coagulate the suspended colloidal particles which ultimately settles down at the point of contact.

205. (*a, d*) When a chalk stick is dipped in ink absorption as well as absorption both occurs. Adsorption of coloured substance and absorption of solvent takes place.

206. (*b, c*) H_2 gas is adsorbed on activated charcoal to a very little extent in comparison to easily liquefiable gases due to

(i) very weak van der Waals' forces and

(ii) very low critical temperature equal to 33 K.

207 (*a, c*) According to Freundlich adsorption isotherm

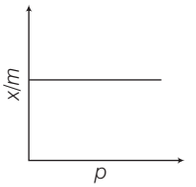
$$\frac{x}{m} \propto p^{\frac{1}{n}} \quad \Rightarrow \quad \frac{x}{m} = kp^{\frac{1}{n}}$$

(a) At $\frac{1}{n} = 0$ this equation becomes $\frac{x}{m} = kp^0 = k$

Extent of adsorption is independent of pressure.

(c) $\frac{x}{m} = kp^{\frac{1}{0}} = kp^{\infty}$

Hence, $\frac{x}{m}$ *vs* p graph can be plotted as



208. (*a, b*) In a reaction, catalyst, changes physically and qualitatively as it is unaltered during the reaction and remains quantitatively intact after completion of reaction and chemically does not change.

209. (*a, b*)

(a) Same reactants may give different products by using different catalysts. As different catalysts have different specific functions to mold the reaction towards specific product.

e.g. starting with H_2 and CO and using different catalysts, we get different products.

(i) $CO(g) + 3H_2(g) \xrightarrow{Ni} CH_4(g) + H_2O(g)$

(ii) $CO(g) + 2H_2(g) \xrightarrow[Cr_2O_3]{Cu/ZnO} CH_3OH(g)$

(iii) $CO(g) + H_2(g) \xrightarrow{Cu} HCHO(g)$

(b) Catalyst does not change ΔH of reaction as ΔH of reaction is difference between enthalpy of reactants and products. So, it does not change during catalysed reaction.

210. (*b, c*) **Micelle formation** some substances at low concentration behaves as a normal electrolytes but at higher concentration exhibit colloidal behaviour due to formation of micelles.

CMC (Critical Micelle Concentration) the concentration above which it behaves as a micelle known as critical micelle concentration (CMC).

e.g. soap solution in aqueous solution above particular concentration (called CMC = $10^{-4} - 10^3$ mol L^{-1}) forms soap micelles.

On dilution soap solution behaves as a normal electrolyte and after adding excess of water, intermolecular force of attraction between the soap particles decreases and soap solution micelles may revert to individual ions.

211. (*a, c*) Lyophobic sol is unstable in nature when lyophilic sol is added to lyophobic sol then lyophobic sol is protected because a film of lyophilic sol is formed over lyophobic sol.

212. (*c*, *d*) Lyophilic colloids (liquid loving colloids) which are also known as reversible colloid can not be coagulated easily. The stability of these colloids are due to

(i) charge on colloidal particles

(ii) solvation of colloidal particles.

213. (*b, d*) Presence of equal and similar charges on colloidal particles provides stability to colloids as repulsive forces between charge particles having same charge prevent them from colloiding when they come closer to each other.

214. (*a, d*) The droplets present in emulsion has negative charge. It can be precipitated by adding electrolyte such as KCl, NaCl etc. Since, glucose and urea do not produce ions on dissolving in water.

Hence, they are non-electrolyte and do not precipitate the negatively charged emulsion.

215. (*b, c*) The movement of colloidal particles under an applied electric potential is called electrophoresis . When this 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 as electroosmosis.

216. (*b*, *d*) Emulsions are liquid-liquid colloidal system. They can not be broken by adding more amount of dispersion medium and adding emulsifying agent as on adding more amount of dispersion medium they become dilute and on adding emulsifying agent they get stabilises.

217. (*d*) **A.** → (2) **B.** → (3) **C.** → (4) **D.** → (1)

218. (*b*) **A.** → (4) **B.** → (3) **C.** → (1) **D.** → (2)

A. Butter is an example of dispersion of liquid in solid.

B. Pumice stone is an example of dispersion of gas in solid in which gas bubbles are present within solid particles.

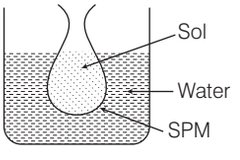
C. Milk is a dispersion of liquid to liquid in which fats and protein are dissolved in milk.

D. Paint is an example of solid in liquid.

219. (*b*) **A.** → (2) **B.** → (3) **C.** → (4) **D.** → (1)

220. (*c*) **A.** → (3) **B.** → (4) **C.** → (2) **D.** → (1)

221. (*d*) **A.** → (4) **B.** → (3) **C.** → (1) **D.** → (2)



Dialysis

A. Purification of colloid can be done by dialysis in which ions/particles are removed from solution through semipermeable membrane.

B. Peptisation is a process in which when small quantity of electrolyte (peptising agent) is added to precipitate. It leads to formation of colloidal solution.

C. The process of removing of oily or greasy dirt from the cloth is done by emulsification.

D. Process of setting of colloidal particle is called coagulation. Electrophoresis is a process in which on applying electric potential to the electrodes dipped in sol, the oppositely charged particles of colloidal solution move towards oppositely charged electrodes, get discharged and precipitated.

222. (*b*) **A.** → (2) **B.** → (3) **C.** → (4) **D.** → (1)

A. Lyophobic colloid (solvent heating colloid) are readily protected by small amount of electrolyte. These colloids are also stabilised by addition of lyophilic colloids which makes a protective layer around lyophobic sol.

Hence, lyophilic sol are known as protective colloid.

B. Liquid-liquid colloid is also known as emulsion, if they are partially miscible or immiscible liquids.

C. When $FeCl_3$ is added to hot water it lead to the formation of positively charged colloid.

D. When NaOH is added to $FeCl_3$ it lead to the formation of negatively charged colloid.

223. (*a*) Assertion and Reason both are correct and Reason is correct explanation of Assertion.

Detergents with low CMC are more economic to use as cleansing action of detergents involves the formation of micelles. These are formed when the concentration of detergent becomes equal to CMC. If CMC has lower value then it will form CMC easily and readily.

224. (*c*) Assertion is correct, but Reason is incorrect.

An ordinary filter paper impregnated with collodion solution stops the flow of colloidal particles because pore size of the filter paper becomes smaller than the size of colloidal particles.

225. (*b*) Assertion and Reason both are correct, but Reason is not correct explanation of Assertion.

Colloidal solutions show colligative properties as colloidal particles have large size so colloidal particles have small value of colligative properties because number of particles are small in comparison to normal solution.

226. (*e*) Assertion is incorrect, but Reason is correct.

Colloidal solutions show Brownian motion and this Brownian motion is responsible for stability of sols.

227. (*a*) Assertion and Reason both are correct and Reason is correct explanation of Assertion.

According to Hardy-Schulze law, greater the charge/valency on flocculating ion added, greater will be its power to cause precipitation.

Coagulating power $\propto$ valency of flocculating ion