SURFACE CHEMISTRY

FACT/DEFINITION TYPE QUESTIONS

1. Adsorbed acetic acid on activated charcoal is:
(a) adsorber (b) absorber
(c) adsorbent (d) adsorbate

2. Adsorption is always
(a) endothermic
(b) exothermic
(c) exothermic in case of physical and endothermic in case of chemical
(d) Either (a) or (b)

3. Which is not correct regarding the physical adsorption of a gas on surface of solid ?
(a) On increasing temperature, adsorption increases continuously
(b) Enthalpy and entropy changes are negative
(c) Adsorption is more for some specific substance
(d) Reversible

4. How many layers are adsorbed in chemical adsorption ?
(a) One (b) Two
(c) Many (d) Zero

5. Adsorption due to strong chemical forces is called
(a) Chemisorption (b) Physisorption
(c) Reversible adsorption (d) Both (b) and (c)

6. In physical adsorption, gas molecules are bound on the solid surface by
(a) chemical forces (b) electrostatic forces
(c) gravitational forces (d) van der Waal's forces

7. Which of the following statements is not correct ?
(a) Physical adsorption is due to van der Waal's forces
(b) Chemical adsorption first decreases with increase in temperature.
(c) Physical adsorption is reversible
(d) Adsorption energy for a chemical adsorption is generally greater than that of physical adsorption.

8. Adsorption of gases on solid surface is exothermic reaction because
(a) free energy increases (b) enthalpy is positive
(c) entropy increases (d) enthalpy is negative

9. The gas which is least adsorbed on charcoal (under identical conditions) is
(a) HCl (b) O_2
(c) CO_2 (d) NH_3

10. Adsorption is accompanied by
(a) decrease in enthalpy and increase in entropy
(b) increase in enthalpy and increase in entropy
(c) decrease in enthalpy and decrease in entropy
(d) increase in enthalpy and decrease in entropy

11. Choose the incorrect statement in respect of physisorption?
(a) It is not specific in nature
(b) It arises because of van der Waal's force
(c) It is reversible in nature
(d) Enthalpy of adsorption is in the range 80-240 kJ mol^{-1}

12. The term 'sorption' stands for _____.
(a) absorption
(b) adsorption
(c) both absorption and adsorption
(d) desorption

13. 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 Waal's forces.

14. 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.

15. 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

16. 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

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

18. 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.

19. For adsorption of a gas on a solid, the plot of log x/m vs log P is linear with slope equal to (n being whole number)
(a) k (b) $\log k$
(c) n (d) $\frac{1}{n}$

20. The adsorption of a gas on a solid surface varies with pressure of the gas in which of the following manner
(a) Fast → slow → independent of the pressure
(b) Slow → fast → independent of the pressure
(c) Independent of the pressure → fast → slow
(d) Independent of the pressure → slow → fast

21. If x is amount of adsorbate and m is amount of adsorbent, which of the following relations is not related to adsorption process ?
(a) $x/m = f(p)$ at constant T.
(b) $x/m = f(\mathrm{T})$ at constant p.
(c) $p = f(\mathrm{T})$ at constant (x/m).
(d) $\frac{x}{m} = p \times T$

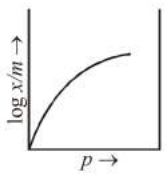
22. In Freundlich adsorption isotherm, the value of $1/n$ is :
(a) between 0 and 1 in all cases
(b) between 2 and 4 in all cases
(c) 1 in case of physical adsorption
(d) 1 in case of chemisorption

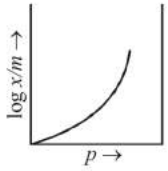
23. Which is adsorbed in maximum amount by activated charcoal ?
(a) N_2 (b) CO_2
(c) Cl_2 (d) O_2

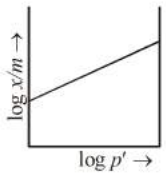
24. Freundlich equation for adsorption of gases (in amount of x g) on a solid (in amount of m g) at constant temperature can be expressed as
(a) $\log\frac{x}{m} = \log p + \frac{1}{n}\log K$ (b) $\log\frac{x}{m} = \log K + \frac{1}{n}\log p$
(c) $\frac{x}{m} \propto p^n$ (d) $\frac{x}{m} = \log p + \frac{1}{n}\log K$

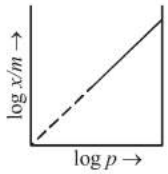
25. According to Freundlich adsorption isotherm, the amount of gas adsorbed at very high pressure
(a) reaches a constant limiting value
(b) goes on increasing with pressure
(c) goes on decreasing with pressure
(d) increase first and decreases later with pressure

26. Which is not correct regarding the adsorption of a gas on surface of solid?
(a) On increasing temperature, adsorption increases continuously
(b) Enthalpy and entropy changes are –ve
(c) Adsorption is more for some specific substance
(d) This Phenomenon is reversible

27. Which of the following curves is in accordance with Freundlich adsorption isotherm ?
(a) 

(b) 

(c) 

(d) 

28. Which of the following is related to adsorption?
(i) $\Delta H = -$ ve (ii) $\Delta S = -$ ve
(iii) $-T\Delta S = -$ ve (iv) $\Delta G = -$ ve
(a) (i), (ii) and (iv) (b) (ii) and (iii)
(c) (iii) only (d) (i), (iii) and (iv)

29. The role of a catalyst in a reversible reaction is to
(a) increase the rate of forward reaction
(b) decrease the rate of backward reaction
(c) alter the equilibrium constant of the reaction
(d) allow the equilibrium to be achieved quickly

30. Catalytic poisons act by :
(a) making the products chemically inactive.
(b) increasing the rate of the backward reaction.
(c) chemical combination with any one of the reactants.
(d) preferential adsorption on the catalyst surface.

31. A catalyst :
(a) lowers the activation energy
(b) changes the rate constant
(c) changes the product
(d) itself destroyed in the reaction

32. Active charcoal is a good catalyst because it
(a) is made up of carbon atoms.
(b) is very reactive.
(c) has more adsorption power.
(d) has inert nature toward reagents.

33. Which of the following kind of catalysis can be explained by the adsorption theory ?
(a) Homogeneous catalysis
(b) Acid - base catalysis
(c) Heterogeneous catalysis
(d) Enzyme catalysis

34. According to the adsorption theory of catalysis, the speed of the reaction increases because-
(a) Adsorption lowers the activation energy of the reaction
(b) The concentration of reactant molecules at the active centres of the catalyst becomes high due to strong adsorption
(c) In the process of adsorption, the activation energy of the molecules becomes large
(d) Adsorption produces heat which increases the speed of the reaction

35. Catalyst increases the rate of reaction by
(a) decreasing threshold energy
(b) decreasing activation energy
(c) increasing activation energy
(d) decreasing equilibrium constant

36. A catalyst can affect reversible reaction by
(a) changing equilibrium constant
(b) slowing forward reaction
(c) attaining equilibria in both directions
(d) None of these

37. Which one of the following is an example of homogeneous catalysis ?
(a) Haber's process of synthesis of ammonia
(b) Catalytic conversion of SO_2 to SO_3 in contact process
(c) Catalytic hydrogenation of oils
(d) Acid hydrolysis of methyl acetate.

38. Identify the correct statement regarding enzymes
(a) Enzymes are specific biological catalysts that cannot be poisoned.
(b) Enzymes are normally heterogeneous catalysts that are very specific in their action.
(c) Enzymes are specific biological catalysts that can normally function at very high temperatures (T ≈ 1000K).
(d) Enzymes are specific biological catalysts that possess well-defined active sites.

39. A biological catalyst is
(a) an enzyme (b) a carbohydrate
(c) an amino acid (d) a nitrogenous base

40. The action of enzymes in living system is to :
(a) supply energy to tissues
(b) enhance immunity
(c) circulate oxygen
(d) enhance the rate of biochemical reactions.

41. Hydrolysis of urea is an example of
(a) homogenous catalysis (b) heterogenous catalysis
(c) biochemical catalysis (d) zeolite catalysis

42. The efficiency of an enzyme in catalysing a reaction is due to its capacity
(a) to form a strong enzyme-substrate complex
(b) to decrease the bond energies of substrate molecule
(c) to change the shape of the substrate molecule
(d) to lower the activation energy of the reaction

43. What is the role of molybdenum in Haber's process for manufacture of ammonia?
(a) As catalytic poison (b) As a catalytic promoter
(c) As a catalyst (d) As a reactant

44. Which of the following step(s) is/are not involved in the mechanism of adsorption theory of heterogeneous catalyst?
(i) Diffusion of reactants to the surface of the catalyst.
(ii) Sorption of reactant molecules on the surface of the catalyst.
(iii) Occurrence of chemical reaction on the catalyst's surface through formation of an intermediate.
(iv) Desorption of reaction products from the catalyst's surface.
(v) Diffusion of reaction products away from the catalyst's surface.
(a) (i) only (b) (ii) and (iv)
(c) (ii) only (d) (i), (ii) and (v)

45. Which of the following equation does not represent homogeneous catalysis?
(a) $CH_3COOCH_3(l) + H_2O(l) \xrightarrow{H_2SO_4(l)} CH_3COOH(aq) + CH_3OH(aq)$
(b) $4NH_3(g) + 5O_2(g) \xrightarrow{Pt(s)} 4NO(g) + 6H_2O\ g(\ )$
(c) $2SO_2(g) + O_2\ (g\ ) \xrightarrow{NO(g)} 2SO_3(g)$
(d) Both (a) and (b)

46. Milk is a colloid in which a
(a) liquid is dispersed in a liquid
(b) solid is dispersed in a liquid
(c) gas is dispersed in a liquid
(d) sugar is dispersed in a liquid

47. Butter is a colloid formed when
(a) Fat is dispersed in water
(b) Fat globules are dispersed in water
(c) Water is dispersed in fat
(d) None of the above

48. The size of colloidal particles is between
(a) $10^{-7} - 10^{-9}$ cm (b) $10^{-9} - 10^{-11}$ cm
(c) $10^{-5} - 10^{-7}$ cm (d) $10^{-2} - 10^{-3}$ cm

49. An aerosol is a :
(a) dispersion of a solid or liquid in a gas
(b) dispersion of a solid in a liquid
(c) dispersion of a liquid in a liquid
(d) solid solution

50. An example of dispersion of a liquid in a gas is :
(a) milk (b) vegetable oil
(c) foam (d) mist

51. Alloy is an example of
(a) gel (b) solidified emulsion
(c) solid solution (d) sol

52. If dispersed phase is a liquid and the dispersion medium is a solid, the colloid is known as
(a) a sol (b) a gel
(c) an emulsion (d) a foam

53. Hair cream is an example of
(a) gel (b) sol
(c) aerosol (d) foam

54. Which one of the following is correctly matched?
(a) Emulsion-smoke (b) Gel-butter
(c) Aerosol-hair cream (d) Sol-whipped cream

55. Cheese is an example of
(a) solid sol (b) emulsion
(c) gel (d) foam

56. Which one of the following in not a colloidal solution?
(a) Smoke (b) Ink
(c) Blood (d) Air

57. Small liquid droplets dispersed in another liquid is called
(a) gel (b) suspension
(c) emulsion (d) true solution

58. When dispersed phase is liquid and dispersion medium is gas then the colloidal system is called
(a) Smoke (b) Clouds
(c) Jellies (d) Emulsions

59. Which one is a colloid?
(a) Sodium chloride (b) Urea
(c) Cane sugar (d) Blood

60. Suspensions are
(a) Visible to naked eye
(b) Not visible by any means
(c) Invisible under electron microscope
(d) Invisible through microscope

61. Cloud or fog is an example of colloidal system of
(a) Liquid dispersed in gas
(b) Gas dispersed in gas
(c) Solid dispersed in gas
(d) Solid dispersed in liquid

62. A colloid always :
(a) Contains two phases
(b) Is a true solution
(c) Contains three phases
(d) Contains only water soluble particles

63. Which one of the following is correctly matched ?
(a) Emulsion - curd (b) Foam - mist
(c) Aerosol - smoke (d) Solid sol - cake

64. At the critical micelle concentration (CMC) the surfactant molecules
(a) decompose
(b) dissociate
(c) associate
(d) become completely soluble

65. How non-polar and polar part in micelle are arranged ?
(a) Polar at outer surface and non-polar at inner surface
(b) Polar at inner surface and non-polar at outer surface
(c) Both polar and non-polar at inner surface
(d) Distributed all over the surface

66. Surface tension of lyophilic sols is
(a) lower than that of H_2O
(b) more than that of H_2O
(c) equal to that of H_2O
(d) either less or more than H_2O depending upon the nature of disperse phase

67. Which of the following is a lyophilic colloid ?
(a) Milk (b) Gum
(c) Fog (d) Blood

68. Lyophobic colloids are :
(a) gun proteins (b) protective colloids
(c) irreversible colloids (d) reversible colloids

69. Which one is an example of multimolecular colloid system
(a) Soap dispersed in water
(b) Protein dispersed in water
(c) Gold dispersed in water
(d) Gum dispersed in water

70. Example of intrinsic colloid is
(a) glue (b) sulphur
(c) Fe (d) As_2S_3

71. Associated colloid among the following is
(a) enzymes (b) proteins
(c) cellulose (d) sodium stearate

72. The formation of micelles takes place only above
(a) inversion temperature
(b) Boyle temperature
(c) critical temperature
(d) Kraft temperature

73. A precipitate is changed to colloidal solution by the following process :
(a) dialysis (b) ultrafiltration
(c) peptization (d) electrophoresis

74. Which of the following is used for neutralising charge on colloidal solution?
(a) Electrons
(b) Electrolytes
(c) Positively charged ions
(d) Compounds

75. Pure water can be obtained from sea water by
(a) Centrifugation (b) Plasmolysis
(c) Reverse osmosis (d) Sedimentation

76. Blood may be purified by
(a) Dialysis (b) Electro-osmosis
(c) Coagulation (d) Filtration

77. During dialysis
(a) only solvent molecules can diffuse
(b) solvent molecules, ions and colloidal particles can diffuse
(c) all kinds of particles can diffuse through the semi-permeable membrane
(d) solvent molecules and ions can diffuse

78. The electrolytic impurities of a sol can most easily be separated by
(a) dialysis (b) electrosmosis
(c) electrophoresis (d) electrodialysis

79. The formation of colloid from suspension is
(a) Peptisation (b) Condensation
(c) Sedimentation (d) Fragmentation

80. The separation of colloidal particles from particles of molecular dimensions is known as
(a) sedimentation (b) dispersion
(c) pyrolysis (d) dialysis

81. Which one of the following impurities present in colloidal solution cannot be removed by electrodialysis?
(a) Sodium chloride (b) Potassium sulphate
(c) Urea (d) Calcium chloride

82. The migration of dispersion medium under the influence of an electric potential is called :
(a) Cataphoresis (b) Electroosmosis
(c) Electrophoresis (d) Sedimentation

83. The movement of colloidal particles towards their respective electrodes in the presence of an electric field is known as :
(a) electrolysis (b) Brownian movement
(c) electrodialysis (d) electrophoresis

84. Peptization denotes
(a) Digestion of food
(b) Hydrolysis of proteins
(c) Breaking and dispersion into the colloidal state
(d) Precipitation of solid from colloidal dispersion

85. Colloidal gold is prepared by
(a) Mechanical dispersion (b) Peptisation
(c) Bredig's Arc method (d) Hydrolysis

86. Peptization involves
(a) precipitation of colloidal particles
(b) disintegration of colloidal aggregates
(c) evaporation of dispersion medium
(d) impact of molecules of the dispersion medium on the colloidal particles

87. Hardy-Schulze rule explains the effect of electrolytes on the coagulation of colloidal solution. According to this rule, coagulation power of cations follow the order
(a) $Ba^{+2} > Na^{+} > Al^{+3}$ (b) $Al^{+3} > Na^{+} > Ba^{+2}$
(c) $Al^{+3} > Ba^{+2} > Na^{+}$ (d) $Ba^{+2} > Al^{+3} > Na^{+}$

88. Tyndall effect is shown by
(a) sol (b) solution
(c) plasma (d) precipitate

89. The cause of Brownian movement is
(a) heat changes in liquid state
(b) convectional currents
(c) the impact of molecules of the dispersion medium on the colloidal particles.
(d) attractive forces between the colloidal particles and molecules of dispersion medium.

90. When a strong beam of light is passed through a colloidal solution, the light will
(a) be reflected (b) be scattered
(c) be refracted (d) give a rainbow

91. The simplest way to check whether a system is colloidal or not is by
(a) Tyndall effect (b) Brownian movement
(c) Electrodialysis (d) Measuring particle size

92. Which of the following is most effective in causing the coagulation of ferric hydroxide sol?
(a) KCl (b) KNO_3
(c) K_2SO_4 (d) $K_3[Fe(CN)_6]$

93. The ability of an ion to bring about coagulation of a given colloid depends upon
(a) its size
(b) the magnitude of its charge
(c) the sign of its charge
(d) both magnitude and sign of its charge

94. Which of the following electrolytes is least effective in coagulating ferric hydroxide solution?
(a) KBr (b) K_2SO_4
(c) K_2CrO_4 (d) $K_4[Fe(CN)_6]$

95. Which of the following acts as protective colloid?
(a) Silica gel (b) Gelatin
(c) Sodium acetate (d) None of these

96. Tyndall effect shown by colloids is due to :
(a) scattering of light by the particles
(b) movement of particles
(c) reflection of light by the particles
(d) coagulation of particles

97. Which of the following is not a property of colloidal solution?
(a) Heterogenity (b) Particle size > 100 nm
(c) Tyndall effect (d) Brownian movement

98. Which of the following is most powerful to coagulate the negative colloid?
(a) $ZnSO_4$ (b) Na_3PO_4
(c) $AlCl_3$ (d) $K_4[Fe(CN)_6]$

99. The charge on colloidal particles is due to
(a) presence of electrolyte
(b) very small size of particles
(c) adsorption of ions from the solution
(d) None of these

100. The ion that is more effective for the coagulation of As_2S_3 sol is
(a) Ba^{2+} (b) Na^{+}
(c) PO_4^{3-} (d) Al^{3+}

101. Which one of the following impurities present in colloidal solution cannot be removed by electrodialysis?
(a) Sodium chloride (b) Potassium sulphate
(c) Urea (d) Calcium chloride

102. Brownian movement is found in
(a) Colloidal solution (b) Suspension
(c) Saturated solution (d) Unsaturated solution

103. Random motion of colloidal particles is known as
(a) Dialysis (b) Brownian movement
(c) Electroosmosis (d) Tyndall effect

104. In which of the following Tyndall effect is not observed ?
(a) Suspensions (b) Emulsions
(c) Sugar solution (d) Gold sol

105. Which of the following is not 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

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

107. Which of the following colloid does not contain liquid as a dispersion medium?
(a) Sol (b) Gel
(c) Emulsion (d) Foam

108. Which of the following method is used for coagulation of the sol?
(a) By mixing two oppositely charged sols.
(b) By electrophoresis.
(c) By addition of electrolytes.
(d) All of the above.

109. Which of the following phenomenon occurs when the precipitate of $Mg(OH)_2$ attains blue colour in presence of magneson reagent?
(i) Absorption of solvent
(ii) Adsorption of coloured substance
(iii) Absorption and adsorption both of solvent
(iv) Adsorption of solvent
(a) (i) and (ii) (b) (ii) only
(c) (ii) and (iv) (d) (iii) only

110. Which of the following is not the condition for Tyndall effect?
(a) The refractive indices of dispersed phase and dispersion medium should differ greatly in magnitude.
(b) The diameter of the dispersed particles is not much smaller than the wavelength of light used.
(c) Tyndall effect is observed only when viewed from the direction of the passage of light.
(d) All of these are required conditions for Tyndall effect.

111. Which of the following is not emulsifying agent for W/O emulsion?
(a) Lampblack
(b) Long chain alcohol
(c) Proteins
(d) Heavy metal salts of fatty acids

112. Emulsions can be broken into constituent liquid by _____.
(a) heating (b) freezing
(c) centrifuging (d) All of these

STATEMENT TYPE QUESTIONS

113. Read the following statements regarding adsorption and choose the correct option.
(i) It is a surface phenomenon.
(ii) The material which is adsorbed is termed as adsorbate.
(iii) The material on the surface of which the adsorption takes place is called adsorbent.
(iv) Adsorption is a bulk phenomenon.
(a) Only (iv) is correct
(b) (i) and (ii) are correct
(c) (i), (ii) and (iv) are correct
(d) (i), (ii) and (iii) are correct

114. Read the following statements related to physisorption.
(i) Adsorbent shows preference for gases with high molecular weight.
(ii) Easily liquefiable gases gets readily adsorbed.
(iii) Adsorption varies with change in temperature and pressure.
(iv) Finely divided and solid metals adsorb gases equally.
(v) It is exothermic with low value of enthalpy of adsorption.
Which of the following is the correct code for the statements above ?
(a) TFFTF (b) FTTFT
(c) TFFTT (d) FTTTF

115. Read the following statements related to chemisorption
(i) It is highly specific.
(ii) It increases with increase in temperature and pressure.
(iii) It is reversible.
(iv) It increases with increase in surface area of adsorbent.
Which of the following is correct code for the statements above?
(a) TTFT (b) TFFT
(c) FTFT (d) FFTF

116. Which of the following statement(s) is/are correct about solid catalyst?
(i) Same reactants may give different product by using different catalysts.
(ii) Catalyst is required in large quantities to catalyse reactions.
(iii) Catalyst does not change ΔH of reaction.
(iv) Catalytic activity of a solid catalyst does not depend upon the strength of chemisorption.
(a) (i) and (iii) (b) (i) only
(c) (ii), (iii) and (iv) (d) (iii) and (iv)

117. Which of the following statement(s) is/are correct?
(i) Zeolites are good shape selective catalysts because of their honeycomb-like structures.
(ii) All zeolites are naturally occurring substance.
(iii) An important zeolite catalyst used in the petroleum industry in ZSM-5.
(a) (i) only (b) (ii) only
(c) (i) and (iii) (d) (ii) and (iii)

118. Read the following statements regarding enzyme catalysis
(i) Enzyme catalysis is highly specific in nature.
(ii) Enzyme catalysis to work effectively requires optimum temperature (298-310 K) and optimum pH (3-5)
(iii) Metal ions like Na^+, Mn^{2+}, Co^{2+}, Cu^{2+} etc. increases the activity of enzymes.
(iv) Catalyst used in Ostwald's process is platinised asbestos at 673 K.
(v) Catalyst used in contact process is platinised asbestos or V_2O_5 at 673-723 K.
Which of the following is the correct coding for the above statements?
(a) FTFTF (b) TFTFT
(c) TTFFF (d) FTTFT

119. Which of the following statements are correct?

(i) Gelatine sol if evaporated off it can be reobtained simply by mixing gelatine obtained on evaporation with suitable dispersion medium.

(ii) Metal sulphide sols need stabilising agents for their preservation

(iii) S_8 being a macromolecule forms macromolecular colloid.

(iv) Starch and proteins are natural whereas polythene and polystyrene are man-made macromolecules.

(v) Micelles are formed above kraft temperature at any concentration

(a) (i), (ii) and (iii) (b) (i), (ii) and (iv)

(c) (iii), (iv) and (v) (d) (ii), (iv) and (v)

120. Read the following statements

(i) Tyndall effect is used to distinguish between a colloidal and true solution.

(ii) Values of colligative properties are same for true and colloidal solutions.

(iii) Random bombardment of the colloidal particles by the molecules of the dispersion medium does not allow colloids to settle thereby providing stability to them.

(iv) Most acceptable phenomena to account for the charge of sol particles is electrodispersion.

Which of the following is the correct code for statements above?

(a) TFTF (b) TTFF

(c) FTFT (d) TFFT

MATCHING TYPE QUESTIONS

121. Match the columns

Column-I	Column-II
(A) $\frac{x}{m} = kc^{1/n}$	(p) Adsorption varies directly with pressure
(B) $\log\frac{x}{m} = \log k + \frac{1}{n}\log p$ $\left(\frac{1}{n} = 0\right)$	(q) Adsorption from solution phase
(C) $\log\frac{x}{m} = \log k + \frac{1}{n}\log p$ $\left(\frac{1}{n} = 1\right)$	(r) Freudlich isotherm cannot be explained
(D) $\frac{x}{m} = kp^{1/n}$ (high pressure)	(s) Adsorption is independent of pressure

(a) A – (q), B – (s), C – (p), D – (r)

(b) A – (q), B – (p), C – (s), D – (r)

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

(d) A – (r), B – (s), C – (p), D – (q)

122. Match the columns

Column-I (Biochemical reactions)	Column-II (Enzymes)
(A) $C_6H_{12}O_6(aq) \longrightarrow 2C_2H_5OH(aq) + 2CO_2(g)$	(p) Zymase
(B) $NH_2CONH_2(aq) + H_2O(l) \longrightarrow 2NH_3(g) + CO_2(g)$	(q) Pepsin
(C) Proteins $\longrightarrow$ Peptides	(r) Urease
(D) $C_{12}H_{22}O_{11}(aq) + H_2O(l) \longrightarrow C_6H_{12}O_6(aq) + C_6H_{12}O_6(aq)$	(s) Invertase

(a) A – (p), B – (r), C – (q), D – (s)

(b) A – (p), B – (q), C – (r), D – (s)

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

(d) A – (p), B – (r), C – (s), D – (q)

123. Match the columns

Column-I (Catalyst)	Column-II (Industrial product)
(A) V_2O_5	(p) High density poly-ethylene
(B) Ziegler-Natta	(q) Polyacrylonitrile
(C) Peroxide	(r) NH_3
(D) Finely divided Fe	(s) H_2SO_4

(a) A – (s), B – (p), C – (q), D – (r)

(b) A – (s), B – (r), C – (q), D – (p)

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

(d) A – (s), B – (q), C – (p), D – (r)

124. Match the columns

Column-I	Column-II
(A) Oil in water emulsion	(p) Clouds
(B) Aerosols containing small droplets of water suspended in air	(q) Vanishing cream
(C) When river water meets the sea water	(r) Smoke
(D) Colloidal solution of carbon, arsenic compounds, dust etc. in air	(s) Formation of delta

(a) A – (q), B – (p), C – (s), D – (r)

(b) A – (p), B – (q), C – (s), D – (r)

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

(d) A – (q), B – (p), C – (r), D – (s)

125. Match the columns

Column-I	Column-II
(A) As_2S_3 sol	(p) Bredig's Arc method
(B) $Fe(OH)_3$ sol	(q) Double decomposition
(C) Colloidal sols of metals like Au, Ag, Pt, etc.	(r) Peptization
(D) Conversion of freshly prepared precipitate into a colloidal sol	(s) Hydrolysis

(a) A – (q), B – (s), C – (r), D – (p)

(b) A – (q), B – (p), C – (s), D – (r)

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

(d) A – (q), B – (s), C – (p), D – (r)

126. Match the columns

Column-I	Column-II
(A) In this process molecules and ions diffuse through membrane outside and pure colloidal solution is left behind.	(p) Dialysis
(B) This process is used if the dissolved substance in the impure colloidal solution is only an electrolyte	(q) Ultrafilteration
(C) In this process ordinary filter paper is soaked into collodion (4% solution of nitrocellulose in a mixture of alcohol and ether)	(r) Electro-dialysis

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

127. Match the columns

Column-I	Column-II
(A) Sulphur vapours passed through cold water	(p) Normal electrolyte solution
(B) Soap mixed with water above critical micelle concentration	(q) Molecular colloids
(C) White of egg whipped with water	(r) Associated colloid
(D) Soap mixed with water below critical micelle concentration	(s) Macro molecular colloids

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

128. Match the columns

Column-I	Column-II
(A) Protective colloid	(p) $FeCl_3$ + NaOH
(B) Liquid - liquid colloid	(q) Lyophilic colloids
(C) Positively charged colloid	(r) Emulsion
(D) Negatively charged colloid	(s) $FeCl_3$ + hot water

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

129. Match the columns

Column-I	Column-II
(A) Dialysis	(p) Cleansing action of soap
(B) Peptisation	(q) Coagulation
(C) Emulsification	(r) Colloidal sol formatioin
(D) Electrophoresis	(s) Purification

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

130. Match the columns

Column-I	Column-II
(A) Butter	(p) dispersion of liquid in liquid
(B) Pumice stone	(q) dispersion of solid in liquid
(C) Milk	(r) dispersion of gas in solid
(D) Paints	(s) dispersion of liquid in solid

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

131. Match the columns

Column-I	Column-II
(A) Argyrol	(p) Kalazar
(B) Antimony	(q) Intramuscular injection
(C) Colloidal gold	(r) Stomach disorders
(D) Milk of magnesia	(s) Eye lotion

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

ASSERTION-REASON TYPE QUESTIONS

Directions : Each of these questions contains two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
(c) Assertion is correct, reason is incorrect
(d) Assertion is incorrect, reason is correct.

132. **Assertion :** The relation $\frac{x}{m} = k.p^{1/n}$ is known as Freundlich adsorption isotherm, where x is the mass of gas adsorbed by m grams of adsorbate, p is the equilibrium pressure, k and n are constants for given system and temperature.

Reason : When several substances have same value of $\frac{1}{n}$, the lines by which their adsorption isotherms can be represented will meet at a point.

133. **Assertion :** The enthalpy of physisorption is greater than chemisorption.

Reason : Molecules of adsorbate and adsorbent are held by van der Waal's forces in physisorption and by chemical bonds in chemisorption.

134. **Assertion :** According to Freundlich: $\frac{x}{m} = K.p^{1/n}$.

Reason : The isotherm shows variation of the amount of gas adsorbed by the adsorbent with temperature.

135. **Assertion:** Detergents with low CMC are more economical to use.

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

136. **Assertion:** An ordinary filter paper impregnated with collodion solution stops the flow of colloidal particles.

Reason: Pore size of the filter paper becomes more than the size of colloidal particle.

137. **Assertion :** The value of colligative properties are of small order for colloids as compared to true solution.

Reason : Number of particles in colloidal solution is comparatively smaller than true solutions.

CRITICAL THINKING TYPE QUESTIONS

138. Which of the following statements is incorrect regarding physisorptions?
   (a) More easily liquefiable gases are adsorbed readily.
   (b) Under high pressure it results into multimolecular layer on adsorbent surface.
   (c) Enthalpy of adsorption ($\Delta H_{adsorption}$) is low and positive.
   (d) It occurs because of van der Waal's forces.

139. Which is correct about physical adsorption?
   (a) High temperature and high pressure favour adsorption
   (b) High temperature and low pressure favour adsorption
   (c) Low temperature and high pressure favour adsorption
   (d) Low temperature and low pressure favour adsorption

140. 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) $\Delta H < 0$

141. Methylene blue, from its aqueous solution, is adsorbed on activated charcoal at 25°C. For this process, which of the following statement is correct ?
   (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

142. In the adsorption of a gas on solid, Freundlich isotherm is obeyed. The slope of the plot is zero. Then the extent of adsorption is
   (a) directly proportional to the pressure of the gas
   (b) inversely proportional to the pressure of the gas
   (c) directly proportional to the square root of the pressure of the gas
   (d) independent of the pressure of the gas

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

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

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

144. Which of the following statements regarding difference between adsorption and absorption is incorrect?
   (a) Adsorption is a surface whereas absorption is a bulk phenomena.
   (b) Water vapours are absorbed by anhydrous $CaCl_2$ but adsorbed by silica gel.
   (c) Adsorption and absorption take place individually. They can not occur simultaneously.
   (d) All of the above statements are correct.

145. Which of the following is not an application of adsorption?
   (a) In metallurgy for concentration of sulphide ores.
   (b) In heterogeneous catalysis involving solid catalyst.
   (c) In homogeneous catalysis.
   (d) Separation of inert gas.

146. Which of the following statements regarding catalyst is not true ?
   (a) A catalyst remains unchanged in composition and quantity at the end of the reaction
   (b) A catalyst can initiate a reaction
   (c) A catalyst does not alter the equilibrium in a reversible reaction
   (d) Catalysts are sometimes very specific in respect of reaction

147. Which of the following statements about a catalyst is true ?
   (a) A catalyst accelerates the reaction by bringing down the free energy of activation
   (b) A catalyst also takes part in the reaction mechanism
   (c) A catalyst makes the reaction more feasible by making the ΔG° more negative
   (d) A catalyst makes the equilibrium constant of the reaction more favourable for the forward reaction

148. Which one of the following, statements is incorrect about enzyme catalysis?
   (a) Enzymes are mostly protenious in nature.
   (b) Enzyme action is specific.
   (c) Enzymes are denaturated by ultraviolet rays and at high temperature.
   (d) Enzymes are least reactive at optimum temperature.

149. Given below, catalyst and corresponding process/reaction are matched. The one with mismatch is
   (a) $[RhCl(PPh_3)_2]$: Hydrogenation
   (b) $TiCl_4 + Al(C_2H_5)_3$: Polymerization
   (c) V_2O_5 : Haber-Bosch process
   (d) Nickel : Hydrogenation

150. Which one of the following statements is incorrect in the case of heterogeneous catalysis ?
(a) The catalyst lowers the energy of activation
(b) The catalyst actually forms a compound with the reactant
(c) The surface of the catalyst plays a very important role
(d) There is no change in the energy of activation.

151. In petrochemical industry alcohols are directly converted to gasoline by passing over heated
(a) Platinum (b) ZSM-5
(c) Iron (d) Nickel

152. Which of the following feature of catalysts is described in reactions given below?

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

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

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

(a) Activity (b) Selectivity
(c) Catalytic promoter (d) Catalytic poison

153. The dispersed phase and dispersion medium in soap lather are respectively
(a) gas and liquid (b) liquid and gas
(c) solid and gas (d) solid and liquid

154. Which of the following is not a colloid ?
(a) Chlorophyll (b) Smoke
(c) Ruby glass (d) Milk

155. Which of the following forms a colloidal solution in water ?
(a) NaCl (b) Glucose
(c) Starch (d) Barium nitrate

156. Which of the following forms cationic micelles above certain concentration?
(a) Sodium dodecyl sulphate
(b) Sodium acetate
(c) Urea
(d) Cetyl trimethyl ammonium bromide

157. Which of the following does not contain a hydrophobic structure ?
(a) Linseed oil (b) Lanolin
(c) Glycogen (d) Rubber

158. Which one of the following is an example for multimolecular colloid?
(a) Aqueous starch sol
(b) Aqueous enzyme sol
(c) Alcoholic polystyrene sol
(d) Aqueous sol of sodium laurylsulphate

159. Bredig arc method cannot be used to prepare colloidal solution of which of the following
(a) Pt (b) Fe
(c) Ag (d) Au

160. Colloidal solutions are not purified by
(a) Dialysis (b) Electrodialysis
(c) Ultrafiltration (d) Electrophoresis

161. Colloid of which one of the following can be prepared by electrical dispersion method as well as reduction method ?
(a) Sulphur (b) Ferric hydroxide
(c) Arsenious sulphide (d) Gold

162. Which of the following ions can cause coagulation of proteins ?
(a) Ag^+ (b) Na^+
(c) Mg^{2+} (d) Ca^{2+}

163. Which of the following will be most effective in the coagulation of $Al(OH)_3$ sol ?
(a) KCN (b) $BaCl_2$
(c) NaCl (d) $Mg_3(PO_4)_2$

164. Point out the false statement :
(a) The colloidal solution of a liquid in liquid is called gel
(b) Hardy Schulze rule is related with coagulation
(c) Brownian movement and Tyndall effect are shown by colloidal system
(d) Gold number is a measure of the protective power of lyophilic colloid

165. The disperse phase in colloidal iron (III) hydroxide and colloidal gold is positively and negatively charged, respectively. Which of the following statements is NOT correct?
(a) Coagulation in both sols can be brought about by electrophoresis
(b) Mixing the sols has no effect
(c) Sodium sulphate solution causes coagulation in both sols
(d) Magnesium chloride solution coagulates, the gold sol more readily than the iron (III) hydroxide sol.

166. A colloidal solution is subjected to an electric field. The particles move towards anode. The coagulation of same sol is studied using NaCl, $BaCl_2$ and $AlCl_3$ solutions. The order of their coagulation power should be –
(a) $NaCl > BaCl_2 > AlCl_3$ (b) $BaCl_2 > AlCl_3 > NaCl$
(c) $AlCl_3 > BaCl_2 > NaCl$ (d) $BaCl_2 > NaCl > AlCl_3$

167. Flocculation value of $BaCl_2$ is much less than that of KCl for sol A and flocculation value of Na_2SO_4 is much less than that of NaBr for sol B. The correct statement among the following is :
(a) Both the sols A and B are negatively charged.
(b) Sol A is positively charged arid Sol B is negatively charged.
(c) Both the sols A and B are positively charged.
(d) Sol A is negatively charged and sol B is positively charged.

168. In Brownian movement or motion, the paths of the particles are
(a) Linear (b) Zig-zag
(c) Uncertain (d) Curved

169. 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) are correct

170. ..... is a silver sol used as an eye lotion. Fill in the blank with an appropriate answer.

(a) Amytol (b) Argyrol

(c) Ciprofloxacin (d) Both (a) and (b)

171. 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.

172. Which of the following combinations of dispersed phase and dispersion medium will not form a colloid ?

(a) Dispersed phase – Solid, Dispersion medium – Solid.

(b) Dispersed phase – Solid, Dispersion medium – Gas.

(c) Dispersed phase – Gas, Dispersion medium – Gas.

(d) Dispersed phase – Liquid, Dispersion medium – Gas.

173. Which of the following statements is incorrect?

(a) Colloidal gold is used for intramuscular injection.

(b) Colloidal solution of latex is used in preparation of rubber.

(c) Photographic films are prepared by coating an emulsion of AgBr in gelatin over glass plate.

(d) Tannin used in leather industry contains positively charged colloidal particles.

174. Which of the following is not correctly matched ?

(a) Sulphur sol – Oxidation

(b) Gold sol – Double decomposition

(c) $Fe(OH)_3$ sol – Hydrolysis

(d) Both (b) and (c)

175. How many of the following are negatively charged sols?

Eosin dye, sol of charcoal, haemoglobin, $Al_2O_3.xH_2O$, As_2S_3, TiO_2.sol, copper sol

(a) 3 (b) 4

(c) 6 (d) All of these

HINTS AND SOLUTIONS

FACT/DEFINITION TYPE QUESTIONS

1. (d) The substance which is adsorbed is called adsorbate.

2. (b) Adsorption is an exothermic process.

3. (a) On increasing temperature physical adsorption of a gas on surface of solid decreases. Solid adsorb greater amount of gas at lower temperature.

4. (a) Chemical adsorption involves formation of monolayer.

5. (a) Chemisorption involves strong chemical forces.

6. (d) In physisorption, gas molecules are held on the solid surface by weak van der Waal's forces.

7. (b)

8. (d) Adsorption is accompanied by evolution of heat as the residual forces acting along the surface of adsorbent decrease i.e., adsorption is accompanied by decrease in enthalpy.

9. (b) The more readily soluble and easily liquefiable gases such as NH_3, HCl and SO_2 are adsorbed more than the so called permanent gases like O_2. This is due to the van der Waals or intermolecular forces which are involved in adsorption.

10. (c) Adsorption is an exothermic process i.e. DH of adsorption is always negative. When a gas is adsorbed, the freedom of movement of its molecules becomes restricted i.e. DS is negative. Hence adsorption accompanied by decrease in enthalpy as well as decrease in entropy of the system.

11. (d) The heat evolved in physisorption is quite low varying generally between 20-40 kJ mol^{-1}.

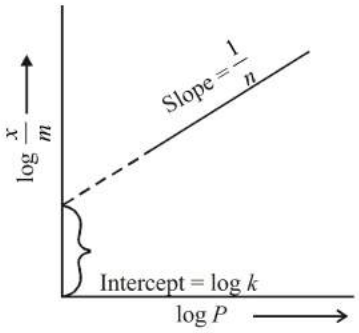
12. (c) **13. (b)** **14. (a)** **15. (d)** **16. (b)**

17. (a) **18. (b)**

19. (d) According to Freundlich adsorption isotherm.

At intermediate pressure, extent of adsorption

$$\frac{x}{m} = kP^{1/n} \text{ or } \log\frac{x}{m} = \log k + \frac{1}{n}\log P;$$



plot of $\log\frac{x}{m}$ vs log P is linear with slope = $\frac{1}{n}$

20. (a) Adsorption of a gas on solid is represented by following equilibria,

Gas (Adsorbate) + Solid (Adsorbent) $\rightleftharpoons$ Gas adsorbed on solid + Heat

Initially adsorption increases with increase in pressure at a particular temperature then got slow. After attaining equilibrium adsorption become independent of pressure.

21. (d)

22. (a) According to Freundlich adsorption isotherm

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

at low pressure $\frac{1}{n} = 1$

$\therefore \quad \frac{x}{m} \propto P^1$

at high pressure $\frac{1}{n} = 0$

$\frac{x}{m} \propto P^\circ$

i.e., the value of n varies between 0 to 1.

23. (b) The gases having higher values for critical temperature are easily liquified and are adsorbed to the greater extent. CO_2 has highest critical temperature of 304K.

24. (b) According to Freundlich equation.

$$\frac{x}{m} \propto p^{1/n} \text{ or } \frac{x}{m} = Kp^{1/n}$$

$$\text{or } \log\frac{x}{m} = \log Kp^{1/n} \text{ or } \log\frac{x}{m} = \log K + \frac{1}{n}\log p$$

25. (a) According to Freundlich adsorption isotherm

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

At very high pressure $x/m = kp^0$

26. (a) On increasing temperature adsorption of a gas on surface of solid decreases. Solid adsorb greater amount of substances at lower temperature.

27. (c)

28. (a) For adsorption to occur ΔG = –ve as in adsorption ΔH = –ve, ΔS = –ve. $-T\Delta S$ is positive for adsorption.

29. (d) For a reaction in equilibrium, the increase in rate of reaction in forward direction by catalyst increases the concentration of product(s) and thus the rate of backward reaction also increases with the same magnitude and allow the equilibrium to be achieved quickly.

30. **(d)** The catalytic poisons decrease the activity of the catalyst because they are preferentially adsorbed on the surface of catalyst.

31. **(a)** A catalyst increases the rate of reaction by decreasing the activation energy.

32. **(c)** Active charcoal has more adsorption power due to greater surface area.

33. **(c)** Adsorption theory is applied to heterogeneous catalysis.

34. **(a)** According to the adsorption theory of catalysis, the activity of catalysis is due to the presence of free valencies on its surface due to which surface of catalyst has chemical force of altraction. When a gas comes in contact with this surface molecules get attached attached through these valencies. Further the rate of reaction is always increases by decreases in activation energy. When any of the reactants is strongly adsorbed on the surface of catalyst, the rate becomes inversely proportional to the concentration of that reaction. The reaction is then said to be inhibited by such reactant. The lowering of activation energy always leads to the increase in speed of reaction.

35. **(b)** Catalyst decreases the activation energy of the reaction by forming an intermediate product. So no of molecules having activation energy increases hence rate of reaction increases.

36. **(c)** A catalyst can affect reversible reaction by attaining equilibria in both directions.

37. **(d)** In acid hydrolysis of methyl acetate all are present in one phase (liquid).

38. **(d)** Enzymes are specific biological catalysts possessing well - defined active sites.

39. **(a)** Enzymes are biological catalysts.

40. **(d)** Enzymes are biological catalysts and enhance the rate of biochemical reactions.

41. **(c)** Hydrolysis of urea can be represented as follows

$$H_2N-\underset{\underset{O}{\|}}{C}-NH_2 + H_2O \xrightarrow[(enzyme)]{Urease} 2NH_3 + CO_2$$

Since it involves biological catalyst (enzyme) so it is an example of biochemical catalysis.

42. **(d)** Efficiency of catalysing property of a catalyst is inversely proportional to activation energy.

43. **(b)** Molybdenum acts as a promoter for iron which is used as a catalyst in Haber's process.

44. **(c)** Second step involves adsorption of reactant molecules on the surface of the catalyst.

45. **(b)**

46. **(a)** Milk is a emulsion in which liquid is dispersed in liquid.

47. **(c)** In butter (liquid – solid) water is dispersed in fat.

48. **(c)** Size of colloidal particles is 10^{-5} - 10^{-7} cm.

49. **(a)**

50. **(d)** Mist is a colloid (aerosol) in which liquid is dispersed in gas.

51. **(c)** Alloy is an example of solid solution.

52. **(b)**

Colloid	Dispersed phase	Dispersion medium
Sol	Solid	Liquid
Gel	Liquid	Solid
Emulsion	Liquid	Liquid
Foam	Gas	Liquid

53. **(d)** Emulsions are liquid-liquid colloidal systems, Generally one of the two liquids is water.

54. **(b)** Butter is an example of gel.

55. **(c)** Cheese is a liquid dispersed in solid phase.

56. **(d)** Air is a homogeneous mixture of gases, mainly nitrogen and oxygen.

57. **(c)** When the dispersed phase and dispersion medium both are liquid, the colloidal system is called as an emulsion like milk, vasnishing cream etc.

58. **(b)** Cloud consists of fine droplets of water suspended in air.

59. **(d)** Blood is a –vely charged colloidal system. Rest of the compounds, i.e., NaCl, urea & cane sugar form true solution in water.

60. **(a)** Suspension particles are visible under a microscope and sometimes even to a naked eye.

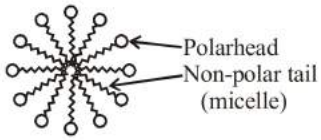
61. **(a)** Fog is a colloidal system consisting water droplets dispersed in air.

62. **(a)** A collidal solution is biphasic and heterogeneous. It is composed of two phases :
1. Dispersed phase; 2. Dispersion medium.

63. **(c)** Smoke is solid gas system, solid (D. P) and gas (D.M.)
Note : D.P. : Dispersed phase
D.M. : Dispersion medium

64. **(c)** The critical micelle concentration is the lowest concentration at which micelle formation appears when surfactants are present above that CMC, they can act as emulsifiers that will solubilise a compound which is normally insoluble in the solvent being used.

65. **(a)**



66. **(a)** Surface tension of lyophilic sols is lower than water (dispersion medium).

67. **(b)** Gum is lyophilic colloid.

68. **(c)** Lyophobic colloids are irreversible colloids. They are protected by lyophilic colloids.

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

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

71. **(d)** Sodium stearate is a soap. Soaps and detergents are surface agents which when dissolved in a medium, forms aggregated particles, called associated colloids.

72. **(d)** The formation of micelles takes place only above a particular temperature called kraft temperature (T_K).

73. **(c)**

74. **(b)** Electrolytes are used for neutralising charge on colloidal particles.

75. **(c)** The osmotic pressure of sea water is 25 atm at 15°C. When pressure greater than 26 atm is applied on sea water separated by a rigid emipermeable membrane, pure water is obtained.

76. **(a)** Blood is purified by dialysis.

77. **(d)** The use of membrane for separating colloidal particles is termed as dialysis. Hence it is clear that colloidal particle cannot pass through animal membrane. Hence only solvent molecules and ions (in case of electrodialysis) can diffuse.

78. **(d)** Electrolytic (Ionic) impurities can be most easily removed on application of electric field.

79. **(a)** Formation of colloid from suspension is known as peptization.

80. **(d)** The separation of colloidal particles of molecular dimension is known as dialysis. It is a purification method of colloid.

81. **(c)** Electrodialysis involves movement of ions towards oppositely charged electrodes.
Urea being a covalent compound does not dissociate to give ions and hence it cannot be removed by electrodialysis.However all the other given compounds are ionic which can undergo dissociation to give oppositely charged ions and thus can be separated.

82. **(b)** The motion of a liquid through a membrane under the influence of an applied electric field is known as electro-osmosis.

83. **(d)**

84. **(c)** Peptization comes under dispersion methods of preparation of colloids.

85. **(c)** Colloidal gold is prepared by Bredig's arc method.

86. **(b)** Peptisation is disintegration of colloidal aggregate.

87. **(c)** According to this law the coagulating effect of an ion on dispersed phase of opposite charge increases with the increase in valency of the ion. The precipitating power of Al^{3+}, Ba^{++}, Na^{+} ions is in order $Al^{3+} > Ba^{2+} > Na^{+}$.

88. **(a)** Tyndall effect is shown by sols.

89. **(c)** It is due to impact of molecules of dispersion medium on the colloidal particles.

90. **(b)** It is due to Tyndall effect.

91. **(a)** Tyndall effect is the simplest way to check colloidal system since path of light beam becomes visible due to scattering of light.

92. **(d)** $Fe(OH)_3$ is positive sol. $K_3[Fe(CN)_6]$ will provide $[Fe(CN)_6]^{3-}$ for coagulation having highest magnitude of –ve charge among given options.

93. **(d)** According to the Hardy schulze rule the coagulating effect of an ion on dispersed phase of opposite charge increases with the valency of the ion. Therefore more the charge on oppositely charged ion higher is the coagulation value.

94. **(a)** Smaller the charge on anion, lesser will be its coagulating power.
$\therefore$ KBr have Br^- with least charge of – 1 on Br thus KBr is least effective in coagulating $Fe(OH)_3$.

95. **(b)** **96.** **(a)**

97. **(b)** The size of colloidal particles is between 1 nm and 1000 nm i.e., it is not always greater than 100 nm. So (b) is not a property of colloidal solution. All others are the properties of colloidal solution.

98. **(c)** According to Hardy-Schulze rule "The amount of electrolyte required to coagulate a fixed amount of a sol depends upon the sign of charge and valency of the flocculating ion."
Thus, the coagulating power vary in the order.
$Al^{3+} > Zn^{++} > Na^{+}$

99. **(c)**

100. **(d)** A negative ion causes the precipitation of positively charged sol and *vice-versa*. Since As_2S_3 is a negative sol so more will be the positive charge on cation more effective it will be in causing coagulation of As_2S_3 sol. Among the given ions, Al^{3+} has the greatest valency and thus is the most effective coagulating agent.

101. **(c)** Electrodialysis involves movement of ions towards oppositely charged electrodes.
Urea being a covalent compound does not dissociate to give ions and hence it cannot be removed by electrodialysis.However all the other given compounds are ionic which can undergo dissociation to give oppositely charged ions and thus can be separated.

102. **(a)** Brownian movement is exhibited by colloidal system.

103. **(b)** Brownian movement is random motion.

104. **(c)** Sugar forms homogeneous solution hence no Tyndall effect is exhibited.

105. **(c)** Emulsion show the tyndal! effect. Refers to ans 280.

106. **(c)**

107. **(b)** For gel dispersed phase is liquid and dispersion medium is solid.

108. **(d)** **109.** **(c)** **110.** **(c)**

111. **(c)** Protein is an emulsifying agent for O/W emulsion.

112. **(d)**

STATEMENT TYPE QUESTIONS

113. **(d)** Adsorption is a surface phenomenon.

114. **(b)** Statements (i) and (iv) are incorrect. A given surface of an adsorbent does not show any preference for a particular gas as the van der Waal's forces are universal.
Finely divided metals are better adsorbent as compared to solid metals because they have large surface area and extent of adsorption increases with surface area.

115. **(a)** As chemisorption involves compound formation, it is usually irreversible in nature.

116. **(a)**

117. **(c)** Zeolites are found in nature as well as synthesised for catalytic selectivity.

118. (b) Optimum pH for the enzyme catalysis is 5-7. Catalyst used in Ostwald's process is platinised asbestos at 573 K.

119. (b) S_8 forms a multimolecular colloid. Micelles are formed above kraft temperature and above a particular concentration called Critical Micelle Concentration (CMC).

120. (a) Values of colligative properties for colloids are of small order as compared to values shown by true solution. Most acceptable phenomena to account for the charge of sol particles in preferential adsorption.

MATCHING TYPE QUESTIONS

121. (a) **122. (a)**

123. (a) (A) V_2O_5 is used as a catalyst during the preparation of H_2SO_4

(B) Ziegler-Natta is used as a catalyst during the preparation of HDPE.

(C) Peroxide is used as a catalyst during the preparation of polyacrylonitrile.

(D) Finely divided Fe is used as a catalyst during the preparation of ammonia.

124. (a) **125. (d)** **126. (a)** **127. (a)** **128. (c)**

129. (a) **130. (b)**

131. (d) Argyrol is used as an eye lotion.
Antimony is used in Kalazar.
Collidal gold is used in intramuscular injection.
Milk of magnesia is used in the stomach disorder.

ASSERTION-REASON TYPE QUESTIONS

132. (c) Assertion is true, reason is false. When several lines have the same value of $\frac{1}{n}$, then the lines by which their adsorption isotherms can be represented will be parallel and will not meet at a point.

133. (d) Assertion is false but Reason is true. The enthalpy of chemisorption is of the order of 40 - 400 $kJmol^{-1}$ while for physical adsorption it is of the order of 20 - 40 $kJmol^{-1}$.

134. (c) Assertion is true but Reason is false.
Freundlich adsorption isotherm gives an empirical relationship between the quantity of gas adsorbed by unit mass of solid adsorbent and pressure at a particular temperature.

135. (a) **136. (c)**

137. (a) Colligative properties depend upon number of particles.

CRITICAL THINKING TYPE QUESTIONS

138. (c) Adsorption is an exothermic process, hence ΔH will always be negative.

139. (c) Physical adsorption involves weak forces, physical in nature with small heat of adsorption. Thus low temperature and high pressure favours physical adsorption.

140. (a)

141. (b) The adsorption of methylene blue on activated charcoal is an example of physiosorption which is exothermic, multilayer and does not have energy barrier.

142. (d) Freundlich's isothermal adsorption equation can be given as

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

$$\log\frac{x}{m} = \log k + \frac{1}{n}\log p;\ \text{slope} = \frac{1}{n} = 0$$

$$\text{Thus, } \frac{x}{m} = kp^0$$

143. (d)

144. (c) Both adsorption and absorption can take place simultaneously. The term sorption is used to describe both the processes.

145. (c) Homogenous catalysis does not involves adsorption.

146. (b) A catalyst can not initiate a reaction.

147. (a)

148. (d) Enzymes are most reactive at optimum temperature. The optimum temperature for enzyme activity lies between 40°C to 60°C.

149. (c) V_2O_5 is used as catalyst in contact process of manufacturing H_2SO_4.

150. (c) The theory of heterogeneous catalysis is based upon the phenomenon of adsorption. The activity of catalyst is due to the presence of free valencies on its sufrace due to which surface of catalyst has force of attraction.

151. (b) ZSM-5 is a shape selective catalyst. Zeolites are good shape selective catalysts because of the honey comb like structure.

152. (b) Given reactions shows that the selectivity of different catalysts for same reactants is different.

153. (a) Soap lather is a colloid containing gas as a dispersed phase and liquid as a dispersion medium.

154. (a) Chlorophyll. Smoke is an example of solid-gas colloid system Ruby glass is an example of solid-solid colloid system. Milk is an liquid -liquid colloid system.

155. (c) Starch molecules have colloidal dimensions whereas NaCl, glucose and $Ba(NO_3)_2$ are crystalloids and soluble in water.

156. (d) Cetyl trimethyl ammonium bromide, $[C_{16}H_{33}(CH_3)_3N^+Br^-]$ is a cationic micelle.

157. (d) Linseed oil, lanolin and glycogen attract water hence contain a hydrophilic structure but rubber does not attract water and thus does not contain a hydrophobic structure.

158. (a) Multimolecular colloids consist of aggregates of atoms or small molecules. Sulphur sol is an example of multimolecular colloids

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

160. (d) Colloidal solutions are not purified by electrophoresis. Movement of colloidal particles under the influence of electric field is called electrophoresis. So, it can make easier. Electrophoresis is the property of colloids not the purification method.

161. (d) Gold by Bredig's method (Dispersion method) and by reduction method

$$AuCl_3 + \text{Tannic acid} \rightarrow \text{Gold sol}$$

162. (a) Proteins are coagulated by some heavy metal ions like Ag^+, Hg^{2+} and Pb^{2+}.

163. (d) $Al(OH)_3$ is a positive sol so salt having anion with maximum negative charged (i.e. phosphate ion) will be most effective in coagulation.

164. (a) Colloid of liquid in liquid is called emulsion. Colloid of liquid in solid is gel.

165. (b) When oppositely charged sols are mixed their charges are neutralised. Both sols may be partially or completely precipitated.

166. (c) As colloidal particles move towards anode so these particles are negatively charged and coagulated by cations of electrolyte.

According to Hardy Schulze rule,

Coagulation power $\propto$ charge of ion

$\therefore$ Order of coagulation power is $Al^{3+} > Ba^{2+} > Na^+$

167. (b) In first case the given compounds have same anion but different cations having different charge hence they will precipitate negatively charged sol i.e. 'A'.

In second case the given compounds have similar cation but different anion with different charge. Hence they will precipitate positively charged sol. i.e. 'B'.

168. (b) Brownian movement is zig zag motion of sol particles.

169. (a) **170. (a)** **171. (b)**

172. (c) A gas mixed with another gas forms a homogeneous mixture and hence is not a colloidal system.

173. (d) Tannin used in leather industry contains negatively charged colloidal particles.

174. (b) Gold sol is prepared by reduction as

$$2AuCl_3 + 3HCHO + 3H_2O \xrightarrow{\text{Reduction}} 2Au(sol) + 3HCOOH + 6HCl$$

175. (b) Eosin dye, sol of charcoal, As_2S_3 and copper sol are example of negatively charged sol.