SOLVED EXAMPLES

Ex. 1 Which of the following has minimum gold number ?

(A) Potato starch **(B)** Gum arabic **(C)** Gelatin **(D)** Albumin

Sol. **(C)**

Gelatin has minimum gold number.

Therefore, **(C)** is correct option.

Ex. 2 Which of the following are correctly matched ?

(A) Butter-gel **(B)** Milk-emulsion **(C)** Fog-aerosol **(D)** Dust-solid sol

Sol. (A, B, C) are correct matches.

Ex. 3 Explain the adsorption of nitrogen on iron.

Sol. When nitrogen gas is brought in contact with iron at 83 K, it is physisorbed on iron surface as nitrogen molecules, N2. As the temperature is increased the amount of nitrogen adsorbed decreases rapidly and at room temperature, practically there is no adsorption of nitrogen on iron. At 773 K and above, nitrogen is chemisorbed on the iron surface as nitrogen atoms.

Ex. 4 Which of the following is (are) lyophobic colloids ?

(A) Gold sol **(B)** As_2S_3 sol **(C)** Starch sol **(D)** $Fe(OH)_3$ sol

Sol. (ABD)

Gold sol, As_2S_3 and $Fe(OH)_3$ are lyophobic colloid.

Therefore, (A, B, D) are correct options.

Ex. 5 The presence of colloidal particles of dust in air imparts blue colour to the sky. This is due to

(A) Absorption of the light **(B)** Scattering of the light

(C) Reflection of the light **(D)** None of these

Sol. **(B)**

Due to scattering of the light.

Therefore, **(B)** is correct option.

Ex. 6 The volume of nitrogen gas U_m (measured at STP) required to cover a sample of silica gel with a mono-molecular layer is 129 $cm^3\ g^{-1}$ of gel. Calculate the surface area per gram of the gel if each nitrogen molecule occupies $16.2 \times 10^{-20}\ m^2$.

Ans. 561.8 cm^3

Sol. 22400 cm^3 of N_2 at STP contain = 6.022×10^{23} molecules

$\therefore$ 129 cm^3 of N_2 at STP will contain = $\frac{6.022 \times 10^{23} \times 129}{22400} = 3.468 \times 10^{21}$ molecules

Area occupied by a single molecule = $16.2 \times 10^{-20}\ m^2$

$\therefore$ Area occupied by 3.468×10^{21} molecules of nitrogen = $(16.2 \times 10^{-20}) \times (3.468 \times 10^{21})\ m^2 = 561.8\ m^2$.

Ex. 7 How do size of particles of adsorbent, pressure of gas and prevailing temperature influence the extent of adsorption of a gas on a solid ?

Sol. **(A)** Smaller the size of the particles of the adsorbent, greater is the surface area and hence greater is the adsorption

(B) At constant temperature, adsorption first increases with increase of pressure and then attains equilibrium.

(C) In physical adsorption, it decreases with increase of temperature bu in chemisorption, first it increases and then decreases.

Ex. 8 How is adsorption of a gas is related to its critical temperature ?

Sol. Higher is the critical temperature of a gas, greater the van der Waal's forces of attraction and hence greater is the adsorption.

Ex. 9 What happens when persistent dialysis of a colloidal solution is carried out.

Sol. The stability of a colloidal sol is due to the presence of a small amount of the electrolyte. On persistent dialysis, the electrolyte is completely removed. As a result, the colloidal sol becomes unstable and gets coagulated.

Ex. 10 What type of colloidal sols are formed in the following ?

(i) Through cooled water, vapours of sulphur are passed.

(ii) White of an egg is mixed with water.

Sol. (i) Sulphur molecules associate together to form molecular sols.

(ii) Macromolecular sol because protein molecules present in the white of the egg are macromolecules soluble in water.

Ex. 11 Physical adsorption is essentially quite appreciable :

(A) at room temperature **(B)** at higher temperature

(C) at lower temperature **(D)** none of these

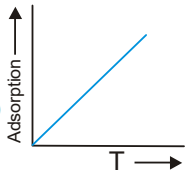
Sol. **(C)**

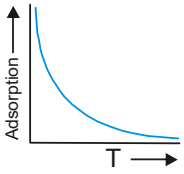
Rate of physical adsorption decreases with increase in temperature.

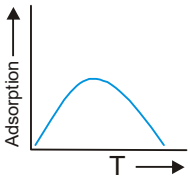
Therefore, **(C)** is correct option.

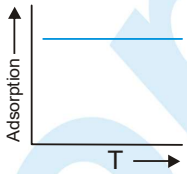
Exercise # 1 [Single Correct Choice Type Questions]

1. Following is the variation of physical adsorption with temperature:

(A) 

(B) 

(C) 

(D) 

2. Adsorption is the phenomenon in which a substance:

(A) accumulates on the surface of the other substance

(B) goes into the body of the other substances

(C) remains close to the other substance

(D) none of these

3. Finely divided catalyst has greater surface area and has greater catalytic activity than the compact solid. If a total surface area of 6291456 cm^2 is required for adsorption in a catalysed gaseous reaction, then how many splits should be made to a cube of exactly 1 cm in length to achieve required surface area. (Given : One split of a cube gives eight cubes of same size)

(A) 60 **(B)** 80 **(C)** 20 **(D)** 22

4. Which of the following statements about chemisorption is not applicable?

(A) It involves chemical forces between adsorbent and absorbate

(B) It is irreversible in nature

(C) It involves high heat of adsorption

(D) It does not require activation energy

5. Volume of N_2 at NTP required to form a mono layer on the surface of iron catalyst is 8.15 ml/gram of the adsorbent. What will be the surface area of the adsorbent per gm if each nitrogen molecule occupies 16×10^{-22} m^2.

(A) 16×10^{-16} cm^2 **(B)** 0.35 m^2/g **(C)** 39 m^2/g **(D)** 22400 cm^2

6. There is desorption of physical adsorption when:

(A) temperature is increased **(B)** temperature is decreased

(C) pressure is increased **(D)** concentration is increased

7. Softening of hard water is done using sodium aluminium silicate (zeolite). The causes :

(A) adsorption of Ca^{2+} and Mg^{2+} ions of hard water replacing Na^+ ions.

(B) adsorption of Ca^{2+} and Mg^{2+} ions of hard water replacing Al^{3+} ions

(C) both **(A)** and **(B)**

(D) none of these

8. The rate of chemisorption :

(A) decreases with increase of pressure **(B)** increases with increase of pressure

(C) is independent of pressure **(D)** is independent of temperature

9. Which one is false in the following statement ?
(A) A catalyst is specific in its action
(B) A very small amount of the catalyst alters the rate of a reaction
(C) The number of free vacancies on the surface of the catalyst increases on sub-division
(D) Ni is used as a catalyst in the manufacture of ammonia

10. A catalyst increases rate of reaction by :
(A) Decreasing enthalpy **(B)** Decreasing internal energy
(C) Decreasing activation energy **(D)** Increasing activation energy

11. Colloidal solution of gold prepared by different methods of different colours because of :
(A) different diameters of colloidal gold particles **(B)** variable valency of gold
(C) different concentration of gold particles **(D)** impurities produced by different methods

12. Peptisation is :
(A) conversion of a colloidal into precipitate form
(B) conversion of precipitate into colloidal sol
(C) conversion of metal into colloidal sol by passage of electric current
(D) conversion of colloidal sol into macromolecules

13. A colloidal solution can be purified by the following method :
(A) dialysis **(B)** peptization **(C)** filtration **(D)** oxidation

14. Bleeding is stopped by the application of ferric chloride. This is because:
(A) the blood starts flowing in opposite direction
(B) the blood reacts and forms a solid, which seals the blood vessel
(C) the blood is coagulated and thus the blood vessel is sealed
(D) the ferric chloride seals the blood vessel.

15. Which of the following ions is most effective in the coagulation of an arsenious sulphide solution ?
(A) K^+ **(B)** Mg^{2+} **(C)** Al^{3+} **(D)** C

16. Which of the following ions is most effective in the coagulation of ferric hydroxide solution ?
(A) Cl^- **(B)** Br^- **(C)** NO_2^- **(D)** SO_4^{2-}

17. Gold number of a lyophilic sol is such property that:
(A) the larger its value, the greater is the peptising power
(B) the lower its value, the greater is the peptising power
(C) the lower its value, the greater is the protecting power
(D) the larger its value, the greater is the protecting power

18. Protective sols are:
(A) lyophilic **(B)** lyophobic **(C)** both (A) and (B) **(D)** none of (A) and (B)

19. For the coagulation of 200 mL of As_2S_3 solution, 10 mL of 1 M NaCl is required. What is the coagulating value (number of milli moles of solute needed for coagulation of 1 liter of solution) of NaCl.
(A) 200 **(B)** 100 **(C)** 50 **(D)** 25

20. At CMC, the surfactant molecules :

(A) Decomposes **(B)** Become completely soluble

(C) Associate **(D)** Dissociate

21. Small liquid droplets dispersed in another liquid is called :

(A) Suspension **(B)** Emulsion **(C)** Gel **(D)** True solution

22. Some type of gels like gelatin loose water slowly. The process is known as :

(A) Syneresis **(B)** Thixotropy **(C)** Peptisation **(D)** Imbibition

23. Which of the following statements is not correct for a lyophobic solution ?

(A) It can be easily solvated

(B) It carries charges

(C) The coagulation of this sol is irreversible in nature

(D) It is less stable in a solvent

24. Which of the following statements is correct for a lyophilic solution ?

(A) It is not easily solvated

(B) It is unstable

(C) The coagulation of this sol is irreversible in nature

(D) It is quite stable in a solvent

25. Liquid-liquid sol is known as

(A) aerosol **(B)** foam **(C)** emulsion **(D)** gel

26. The pressure of the gas was found to decrease from 720 to 480 mm. When 5g of sample of activated charcoal was kept in a flask of one litre capacity maintained at 27°C. If the density of charcoal at 1.25 gm/mL. The volume of gas adsorbed per gm of charcoal at 480 mm of Hg is

(A) 80.03 mL **(B)** 32.20 mL **(C)** 100.08 mL **(D)** None of these

27. Coagulation value of the electrolytes $AlCl_3$ and NaCl for As_2S_3 sol are 0.093 and 52 respectively. How many times $AlCl_3$ has greater coagulating power than NaCl.

(A) 930 **(B)** 520 **(C)** 560 **(D)** None of these

28. Graph between log x/m and log p is a straight line inclined at an angle of 45°. When pressure is 0.5 atm and ln k = 0.693, the amount of solute adsorbed per gm of adsorbent will be :

(A) 1 **(B)** 1.5 **(C)** 0.25 **(D)** 2.5

29. The colloidal system consisting of a liquid adsorbate in a solid adsorbent is termed as :

(A) aerosol **(B)** foam **(C)** emulsion **(D)** gel

30. Which of the following statements is not correct ?

(A) A colloidal solution is a heterogeneous two-phase system

(B) Silver sol in water is an example of lyophilic solution.

(C) Metal hydroxides in water are examples of lyophobic solution

(D) Liquid-liquid colloidal solution is not a stable system

31. Size of colloidal particles may range from :

(A) 1 to 1000 nm **(B)** 10 to 100 pm **(C)** 1 to 100 μm **(D)** 1 to 10 mm

32. Which of the following statements is not correct?
(A) Peptization is the process by which certain substances are converted into the colloidal state.
(B) Metal sols of gold, silver and platinum can be prepared by Bredig's arc method.
(C) Impurities present in a solution makes it more stable.
(D) Dialysis is a process to remove impurities of ions and molecules from a solution.

33. Select correct statement (s) :
(A) hydrophilic colloid is a colloid in which there is a strong attraction between the dispersed phase and water
(B) hydrophobic colloid is a colloid in which there is a lack of attraction between the dispersed phase and water
(C) hydrophobic sols are often formed when a solid crystallises rapidly from a chemical reaction or a supersaturated solution
(D) all of the above

34. A reddish brown sol (containing Fe^{3+}) is obtained by:
(A) the addition of small amount of $FeCl_3$ solution to freshly prepared $Fe(OH)_3$ precipitate
(B) the addition of $Fe(OH)_3$ to freshly prepared $FeCl_3$ solution
(C) the addition of NH_4OH to $FeCl_3$ solution dropwise
(D) the addition of NaOH to $FeCl_3$ solution dropwise

35. Which of the following represents a multimolecular colloidal particles?
(A) Starch **(B)** A sol of gold **(C)** Proteins **(D)** Soaps

36. Which of the following anions will have minimum flocculation value for the ferric oxide solution ?
(A) Cl^- **(B)** Br^- **(C)** SO_4^{2-} **(D)** $[Fe(CN)_6]^{3-}$

37. Which of the following represents a macromolecular colloidal particles ?
(A) Solution of gold **(B)** Cellulose **(C)** Soaps **(D)** Synthetic detergents

38. Which is an example of coagulation?
(A) curdling of milk **(B)** purification of water by addition of alum
(C) formation of deltas at the river beds **(D)** All the three are example of coagulation

39. Gold number of some lyophilic sols are :

I	:	Casein	:	0.01
II	:	Haemoglobin	:	0.03
III	:	Gum arabic	:	0.15
IV	:	Sodium oleate	:	0.40

Which has maximum protective power :
(A) I **(B)** II **(C)** III **(D)** IV

40. Gold number Of haemoglobin is 0.03. Hence, 100 mL of gold sol will require haemoglobin so that gold is not coagulated by 1 mL of 10% NaCI solution :
(A) 0.03 mg **(B)** 30 mg **(C)** 0.30 mg **(D)** 3 mg

41. Smoke is a dispersion of :
(A) gas in gas **(B)** gas in solid **(C)** solid in gas **(D)** liquid in gas

42. Smoke has generally blue tinge. It is due to :
(A) scattering **(B)** coagulation **(C)** Brownian motion **(D)** electro-osmosis

43. Compared to common colloidal sols, micelles have :
(A) higher colligative properties **(B)** lower colligative properties
(C) same colligative properties **(D)** none of these

44. Which is not a purely surface phenomena :
(A) surface tension. **(B)** adsorption. **(C)** absorption. **(D)** none of these.

45. Arsenic (III) sulphide forms a sol with a negative charge. Which of the following ionic substances should be most effective in coagulating the sol ?
(A) KCl **(B)** $MgCl_2$ **(C)** $Al_2(SO_4)_3$ **(D)** Na_3PO_4

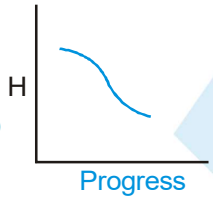
46. The stabilisation of a lyophobic colloid is due to :
(A) preferential adsorption of similar charged particle on colloids surface.
(B) the large electro-kinetic potential developed in the colloid.
(C) the formation of a covalent bond between two phases.
(D) the viscosity of the medium.

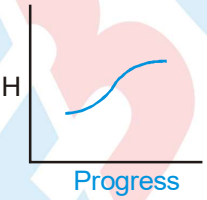
47. Which one of the following statements is false for hydrophilic sols ?
(A) they do not require electrolytes for stability
(B) their viscosity is of the order of that of water
(C) their surface tension is usually lower than that of dispersion medium.
(D) none of these

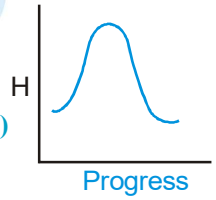
48. Which one of the following statements is correct:
(A) Brownian movement is more pronounced for smaller particles than for bigger ones
(B) Sols of metal sulphides are lyophilic
(C) Schulze-Hardy law states, the bigger the size of the ion, the greater is its coagulating power
(D) One would expect charcoal to adsorb hydrogen gas more strongly than chlorine.

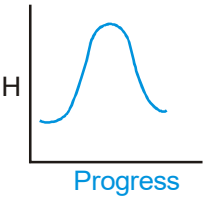
49. Soaking of sponge by water is an example of :
(A) Simple adsorption **(B)** Physical adsorption **(C)** Chemisorption **(D)** Absorption

50. Identify the appropriate graph between enthalpy and progress of physical adsorption.

(A) 

(B) 

(C) 

(D) 

51. Hydrolysis of ester in catalysed by acid. Rates of hydrolysis of ester were obtained initially and after 50% ester has been hydrolysed as R_0 and R_{50} then (same temp.)
(A) $R_0 = R_{50}$ **(B)** $R_0 < R_{50}$ **(C)** $R_0 > R_{50}$ **(D)** Cannot be determined

52. The potential difference between the fixed charged layer and the diffused layer having opposite charge is called :
(A) Water potential **(B)** Zeta potential **(C)** Electrode potential **(D)** None of these

53. Which one is not the characteristic of chemisorption :
(A) Multilayer adsorption **(B)** Exothermic nature
(C) Strong adsorption by adsorption sites **(D)** Irreversible

54. The solution in which the light is scattered by the particles is :
(A) Suspension **(B)** Colloidal solution **(C)** True solution **(D)** None of these

55. Blood is purified by :
(A) Dialysis **(B)** Electro-osmosis **(C)** Coagulation **(D)** Filtration

56. An arsenious sulphide sol carries a negative charge. The maximum precipitating power of this sol is : possessed by :

(A) K_2SO_4 **(B)** $CaCl_2$ **(C)** Na_3PO_4 **(D)** $AlCl_3$

57. For adsorption of a gas on a solid, the plot of log (x/m) Vs log P is linear with a slope equal to [n being a whole number]

(A) K **(B)** log K **(C)** n **(D)** 1/n

58. 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)** None of the above

59. On passing light from colloidal solution, the effect due to scattering of light is known as :

(A) Electrophoresis **(B)** Tyndall effect **(C)** Electro-osmosis **(D)** Coagulation

60. Tyndall effect is shown by :

(A) Sol **(B)** Solution **(C)** Plasma **(D)** Precipitation

61. According to Hardy - Schulze rule, the coagulating power of cation follows the order :

(A) $Na^+ > Ba^{2+} > Al^{3+}$ **(B)** $Al^{3+} > Ba^{2+} > Na^+$ **(C)** $Ba^{2+} > Al^{3+} > Na^+$ **(D)** $Al^{3+} > Na^+ > Ba^{2+}$

62. Milk is an example of :

(A) True solution **(B)** Gel **(C)** Suspension **(D)** Emulsion

63. The stability of lyophilic colloid is due to which of the following :

(A) Charge on their particles **(B)** Large size of their particles

(C) Small size of their particles **(D)** Solvation by dispersion medium

64. A colloidal solution is subjected to an electrical field. The particles move towards anode. The coagulation of the same solution is studied using NaCl, $BaCl_2$ and $AlCl_3$ solutions. Their coagulating power should be

(A) $NaCl > BaCl_2 > AlCl_3$ **(B)** $BaCl_2 > AlCl_3 > NaCl$

(C) $AlCl_3 > BaCl_2 > NaCl$ **(D)** $BaCl_2 > NaCl > AlCl_3$

65. Which of the following is most effective in coagulating a ferric hydroxide sol :

(A) KCl **(B)** KNO_2 **(C)** K_2SO_4 **(D)** $K_3[Fe(CN)_6]$

66. Most effective ion to coagulate a negative sol is :

(A) PO_4^{3-} **(B)** Al^{3+} **(C)** Ba^{2+} **(D)** K^+

67. Which of the following electrolytes will be most effective in the coagulation of gold sol :

(A) $NaNO_3$ **(B)** $K_4[Fe(CN)_6]$ **(C)** Na_3PO_4 **(D)** $MgCl_2$

68. The property of colloid is :

(A) Scattering of light **(B)** Shows attraction **(C)** Dialysis **(D)** Emulsion

69. Which one is colloid :

(A) NaCl **(B)** Urea **(C)** Cane Sugar **(D)** Blood

70. 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

Exercise # 2 Part # I [Multiple Correct Choice Type Questions]

1. Which of the following statements are true for physisorption?
(A) Extent of adsorption increases with increase in pressure.
(B) It needs activation energy
(C) It can be reversed easily
(D) It occurs at high temperature.

2. Which of the following are hydrophobic sols?
(A) Protein sol **(B)** Gold sol **(C)** Gum sol **(D)** $Fe(OH)_3$ sol.

3. If Cl_2 gas is enclosed in presence of powdered charcoal in a closed vessel, the pressure of the gas decreases. It is because
(A) the gas molecules are absorbed at the surface
(B) the gas molecules concentrate at the surface of the charcoal
(C) the gas molecules are adsorbed at the surface
(D) the gas molecules are desorbed by the surface

4. The diameter of colloidal particle is of the order :
(A) 10^{-3} m **(B)** 10^{-6} m **(C)** 10^{-15} m **(D)** 10^{-7} m

5. Which of the following colloidal solutions contain negatively charged colloidal particles?
(A) $Fe(OH)_3$ sol **(B)** As_2S_3 sol **(C)** Blood **(D)** Gold sol

6. Which of the following are examples of aerosols?
(A) Whipped cream **(B)** Cloud **(C)** Fog **(D)** Soap lather

7. The origin of charge on colloidal solution is
(A) Self dissociation (in soaps and detergents) **(B)** Electron capture during Bredig's arc method
(C) Selective adsorption of ion on their surface **(D)** It is due to addition of protective colloids

8. Which of the following are based on Tyndall effect.
(A) Tail of comets **(B)** Deltas
(C) Blue colour of sky **(D)** Coagulation

9. When negatively charged colloids like As_2S_3 sol is added to positively charged $Fe(OH)_3$ sol in suitable amounts
(A) Both the sols are precipitated simultaneously .
(B) This process is called mutual coagulation.
(C) They become positively charged colloids.
(D) They become negatively charged colloids.

10. Which of the following are incorrect statements ?
(A) Hardy Schulz rule is related to coagulation
(B) Brownian movement and Tyndall effect are the characteristic of colloids.
(C) In gel, the liquid is dispersed in liquid
(D) Higher the gold number, more is the protective power of lyophillic sols.

11. Which of the following are multimolecular colloids ?
(A) Sulphur **(B)** Egg albumin in water **(C)** Gold sol **(D)** Soap solution

12. The size of colloidal particles is :
(A) 1-10 Å **(B)** 20 - 50 Å **(C)** 10 - 100 Å **(D)** 1 -200 Å

13. Which of the following statements is correct?
(A) The efficiency of a heterogeneous catalyst depends upon its surface area.
(B) Catalyst operates by providing alternate path for the reaction that involves a lower activation energy.
(C) Catalyst lowers the energy of activation of the forward direction without affecting the energy of activation of the backward direction.
(D) Catalyst does not affect the overall enthalpy change of the reaction.

14. Which of the following statements is (are) true?
(A) The concentration of a homogeneous catalyst may appear in the rate expression.
(B) A catalyst is always consumed in the reaction.
(C) A catalyst must always be in the same phase as the reactants.
(D) None of these

15. Which is the correct statement in case of milk :
(A) Milk is an emulsion of fat in water
(B) Milk is an emulsion of protein in water
(C) Milk is stabilized by protein
(D) Milk is stabilized by fat

16. Tyndall effect will be observed in :
(A) Solution (B) Precipitate (C) Sol (D) Vapour

17. The Brownian motion is due to :
(A) Temperature fluctuation within the liquid phase
(B) Attraction and repulsion between charge on the colloidal particles
(C) Impact of molecules of the dispersion medium on the colloidal particles
(D) Convective current

18. In coagulating the colloidal solution of As_2S_3 which has the minimum coagulating value :
(A) NaCl (B) KCl (C) $BaCl_2$ (D) $AlCl_3$

19. The charge on As_2S_3 sol is due to the adsorbed :
(A) H^+ (B) OH^- (C) O^{-2} (D) S^-

20. The sky looks blue due to :
(A) Dispersion (B) Reflection (C) Transmission (D) Scattering

21. Gold number is minimum in case of :
(A) Gelatin (B) Egg albumin (C) Gumarabic (D) Starch

22. The size of a colloidal particle is :
(A) > 0.1 μ (B) 1m μ to 0.1 μ (C) < 0.1 μ (D) More than 3000 m μ

23. Which of the following electrolytes is least effective in causing flocculation of ferric hydroxide sol :
(A) $K_4[Fe(CN)_6]$ (B) K_2CrO_4 (C) KBr (D) K_2SO_4

24. On addition of one ml solution of 10% NaCl to 10 ml gold sol in the presence of 0.0250 gm of starch the coagulation is just prevented. Starch has the following gold number :
(A) 0.025 (B) 0.25 (C) 2.5 (D) 25

25. Which one is a lyophobic colloid :
(A) Gelatin (B) Starch (C) Sulphur (D) Gum arabic

26. Smoke is an example of :
(A) Gas dispersed in liquid **(B)** Gas dispersed in solid
(C) Solid dispersed in gas **(D)** Solid dispersed in solid

27. Tyndall effect in colloidal solutions is due to :
(A) Scattering of light **(B)** Reflection of light
(C) Absorption of light **(D)** Presence of electrically charged particles

28. Which one of the following is not a colloidal system :
(A) Smoke **(B)** Ink **(C)** Air **(D)** Blood

29. Which of the following will have highest coagulation power for As_2S_3 colloid ?
(A) PO_4^{3-} **(B)** SO_4^{2-} **(C)** Na^+ **(D)** Al^{3+}

30. Positive sol is :
(A) Gold **(B)** Gelatin **(C)** As_2S_3 **(D)** None

31. A colloidal solution of arsenious sulphide is most readily coagulated by the addition of a normal solution?
(A) NaCl **(B)** $CaCl_2$ **(C)** Na_3PO_4 **(D)** $Al_2(SO_4)_3$

32. A colloid always :
(A) Contains two phases **(B)** Is a true solution
(C) Contains three phases **(D)** Contains only water soluble particles

33. Colloidal solution of silver is prepared by :
(A) Colloidal milk **(B)** Double decomposition method
(C) Bredig's method **(D)** Peptization

34. Which of the following is wrong :
(A) Enthalpy (numerical value) of physisorption is greater than that of chemisorption
(B) Physisorption is not very specific but chemisorption is highly specific
(C) Chemisorption takes place at relatively high temperatures
(D) In physisorption generally multi–molecular layers are formed on the adsorbent

35. Which of the following gases, will be adsorbed maximum on a solid surface :
(A) CO_2 **(B)** O_2 **(C)** N_2 **(D)** H_2

36. Which of the following is a mismatch :
(A) Lyophilic colloids – reversible sols
(B) Associated collides – micelles
(C) Tyndall effect – scattering of light by colloidal particle
(D) Electrophoresis – movement of dispersion medium under the influence of electric field

37. Lyophobic colloids are :
(A) Reversible colloids **(B)** Irreversible colloids **(C)** Protective colloids **(D)** Gum proteins

38. Which of the following ions has maximum flocculation value :
(A) $[Fe(CN)_6)]^{4-}$ **(B)** Cl^- **(C)** SO_4^{2-} **(D)** PO^{-3}_4

39. The arsenious sulphide sol has - ve charge. The maximum power of precipitating is of :
(A) H_2SO_4 **(B)** Na_3PO_4 **(C)** $CaCl_2$ **(D)** $AlCl_3$

40. Which of the following ions will be most effective in coagulating the As_2S_3 sol :

(A) Fe^{3+} **(B)** Ba^{2+} **(C)** Cl^- **(D)** PO_4^{3-}

41. When freshly precipitated $Fe(OH)_3$ is shaken with aqueous solution of $FeCl_3$, a colloidal solution is formed. This process is known as :

(A) Emulsification **(B)** Coagulation **(C)** Peptization **(D)** Electro–osmosis

42. (i) At 298 K the volume of NH_3 adsorbed by 1g of charcoal is higher than that of H_2 under similar conditions.

(ii) The movement of colloidal particles towards the oppositely charged electrodes on passing electric current is known as Brownian movement.

(A) T, T **(B)** T, F **(C)** F, T **(D)** F, F

43. Which of the following kinds of catalysis can be explained by the adsorption theory?

(A) heterogeneous catalysis **(B)** enzyme catalysis

(C) homogeneous catalysis **(D)** acid base catalysis

44. Which of the following relations is (are) correct according to Freundlich ?

(i) $x/m = \text{constant}$

(ii) $x/m = \text{constant} \times p^{1/n}\ (n > 1)$

(iii) $x/m = \text{constant} \times p^{n}\ (n > 1)$

(A) All are correct **(B)** All are wrong **(C)** (ii) is correct **(D)** (iii) is correct

45. The principle(s) involved in the chromatographic operation is (are) :

(A) Adsorption **(B)** Absorption **(C)** Partition **(D)** None

46. A negative catalyst will

(A) raise the energy of activation for a given reaction

(B) take away the internal energy of reactants and deactivate them

(C) catalyse the backward reaction more than the forward one, thereby shifting equilibrium backward.

(D) none of these

47. When a graph is plotted between log x/m and log p, it is straight line with an angle 45° and intercept 0.3010 on y-axis. If initial pressure is 0.3 atm, what will be the amount of gas adsorbed per gm of adsorbent :

(A) 0.4 **(B)** 0.6 **(C)** 0.8 **(D)** 0.1

48. A liquid is found to scatter a beam of light but leaves no residue when passed through the filter paper. The liquid can be described as

(A) a suspension **(B)** Oil **(C)** a colloidal sol **(D)** a true solution

49. The physical adsorption of gases on the solid surface is due to

(A) vander Waals forces **(B)** covalent bonding

(C) hydrogen bonding **(D)** All of these

50. Correct equation of Freundlich isotherm is

(A) $\log\left(\frac{x}{m}\right) = \log K + \frac{1}{n}\log C$ **(B)** $\log\left(\frac{x}{n}\right) = \log m + \frac{1}{m}\log C$

(C) $\log\left(\frac{x}{m}\right) = \log C + \frac{1}{K}\log C$ **(D)** $\log\left(\frac{x}{m}\right) = \log C + \frac{1}{n}\log K$

51. Identify the correct statement regarding enzymes.
(A) Enzymes are specific biological catalysts that can normally function at very high tempt. (T ≈ 1000 K)
(B) Enzymes are normally heterogeneous catalysts that are very specific in action
(C) Enzymes are specific biological catalysts that can not be poisoned
(D) Enzymes are non-biological catalysts.

52. Which of the following statements about physical adsorption is correct ?
(A) It is usually monolayer
(B) It is reversible in nature
(C) It involves van der Waals interactions between adsorbent and adsorbate
(D) It involves small enthalpy of adsorption as compared to chemisorption.

53. Which of the following statements regarding adsorption is correct ?
(A) Extent of adsorption of gases on charcoal increases with increase in pressure of the gas
(B) Extent of adsorption is independent of temperature
(C) Extent of chemisorption by a given mass of adsorbent is limited
(D) Extent of adsorption is dependent on the nature of adsorbent

54. Which of the following is characteristic of chemisorption?
(A) it is irreversible **(B)** it is specific
(C) it is multilayer phenomenon **(D)** heat of adsorption of about – 400 kJ

55. An example of extrinsic colloid (lyophobic colloids) is :
(A) As_2S_3 sol **(B)** $Fe(OH)_3$ sol **(C)** Egg albumin **(D)** Au sol

56. Which of the following sols is positively charged?
(A) Arsenious sulphide **(B)** Aluminium hydroxide
(C) Ferric hydroxide **(D)** Silver iodide in silver nitrate solution

Part # II [Assertion & Reason Type Questions]

Each question has 5 choices (A), (B), (C), (D) and (E) out of which only one is correct.

(A) Statement-1 is true, Statement-2 is true and Statement-2 is correct explanation for Statement-1
(B) Statement-1 is true, Statement-2 is true and Statement-2 is not correct explanation for Statement-1
(C) Statement-1 is true, Statement-2 is false
(D) Statement-1 is false, Statement-2 is true
(E) Both Statements are false

1. **Statement-1 :** Gold number is the measure of protective powers of different colloids.
Statement-2 : The smaller the gold number of lyophilic colloid, the smaller is its protective power.

2. **Statement-1 :** The property of adsorption is shown by solids to a much larger extent than liquids.
Statement-2 : Solids, particularly when finely divided, have a large surface area.

3. **Statement-1 :** Aqueous gold colloidal solution is red in colour.
Statement-2 : The colour arises due to scattering of light of colloidal gold particles.

4. **Statement-1 :** All colloidal dispersions give very low osmotic pressure and show very small freezing point depression or boiling point elevation.
   Statement-2 : Tyndall effect is due to scattering of light from the surface of colloidal particles.

5. **Statement-1 :** The Brownian movement is due to the bombardment on colloidal particles by the molecules of dispersion medium which are in the constant motion like molecules in a gas.
   Statement-2 : Brownian movement provides a visible proof of the random kinetic motion of molecules in a liquid.

6. **Statement-1 :** In the coagulation of negatively charged arsenic sulphide sol, the coagulating power decreases in the order, $Al^{3+} > Ba^{2+} > Na^{+}$.
   Statement-2 : Generally greater the valency of coagulating ion, the greater is its power of coagulation.

7. **Statement-1 :** Isoelectric point is pH at which colloidal can move towards either of electrode
   Statement-2 : At isoelectric point, colloidal particles become electrically neutral

8. **Statement-1 :** A gas with higher critical temperature gets adsorbed to more extent than a gas with lower critical temperature.
   Statement-2 : The easily liquefiable gases get adsorbed to more extent which have higher critical temperature.

9. **Statement-1 :** When $AgNO_3$ is treated with excess of KI, colloidal particles gets attracted towards anode.
   Statement-2 : Colloidal particles adsorb common ions and thus become charged.

10. **Statement-1 :** Tetraethyl lead minimises the knocking effect when mixed with petrol.
    Statement-2 : Because tetraethyl lead acts as a –ve catalyst.

11. **Statement-1 :** In physisorption, adsorption increases with increases in temperature.
    Statement-2 : Physisorption is of exothermic nature.

12. **Statement-1 :** Colloidal solution exhibit Tyndall effect while true solution do not.
    Statement-2 : Because the size of the colloidal particles is large enough to scatter light as compared to size of the true solution particles.

13. **Statement-1 :** Physisorption of molecules occurs on surface only.
    Statement-2 : In this process; the bonds of the adsorbed molecules are broken.

14. **Statement-1 :** Medicines in the colloidal state are more effective.
    Statement-2 : In the colloidal state, the medicines are easily assimilated by the body.

Exercise # 3 Part # I [Matrix Match Type Questions]

1. Match list I with list II and select the correct answer :

List I	List II
(A) Coagulation	**(p)** Scattering of light
(B) Dialysis	**(q)** Formation of colloidal solution from precipitates.
(C) Peptization	**(r)** Purification of colloids
(D) Tyndall effect	**(s)** Accumulation of colloidal sols

2. Match list I with list II and select the correct answer :

List I	List II
(A) Mechanical property of colloid	**(p)** Dialysis
(B) Purification	**(q)** Peptization
(C) Gold number	**(r)** Brownian movement
(D) Formation of a sol	**(s)** Protection

3.

Column (I)	Column (II)
(A) Gold sol	**(p)** Bredig's Arc method
(B) Purification of colloidal solution	**(q)** Negatively charged
(C) As_2S_3 sol	**(r)** Ultra centrifugation
(D) Zeta potential	**(s)** Electro kinetic potential
(E) Casein	**(t)** Double decomposition reaction
	(u) Protective colloid

4.

Column (I)	Column (II)
(A) Tyndall effect	**(p)** Zig-zag motion
(B) Brownian movement	**(q)** Sky is blue
(C) Electrophoresis	**(r)** Coagulation of colloids
(D) Hardy schulze rule	**(s)** Charge on colloidal solution
(E) Froth floatation	**(t)** Emulsion of pine oil
	(u) Gold number

Part # II [Comprehension Type Questions]

Comprehension # 1

The clouds consist of charged particles of water dispersed in air. Some of them are +vely charged, others are –vely charged. When +vely charged clouds come closer they cause lightening and thundering whereas when +ve and –ve charged colloids come closer they cause heavy rain by aggregation of minute particles. It is possible to cause artificial rain by throwing electrified sand or silver iodide from an aeroplane and thus coagulating the mist hanging in air.

Smoke screen is a cloud of smoke used to hide military, naval police etc. it consists of fine particles of TiO_2.

1. When excess of $AgNO_3$ is treated with KI solution, AgI forms

(A) +ve charged sol **(B)** –vely charged sol **(C)** neutral sol **(D)** true solution

2. AgI helps in artificial rain because :
   (A) it helps in ionisation of water
   (B) it helps in dispersion process
   (C) it helps in coagulation
   (D) all of them

3. Smoke screens consist of
   (A) fine particles of TiO_2 dispersed in air by aeroplanes
   (B) fine particles of AgI dispersed in air by aeroplanes
   (C) fine particles of Al_2O_3 dispersed in air by aeroplanes
   (D) None of these

Comprehension # 2

Many lyophilic sols and few lyophobic sols when coagulated under some special conditions changes into semi rigid mass, enclosing whole amount of liquid within itself, it is called gel and the process is called gelation. Gelatin Agar-agar, gum-Arabic can be converted into gels by cooling them under moderate concentration conditions. Hydrophobic sols like silicic acid. $Al(OH)_3$ are prepared by double decomposition and exchange of solvent method.

Types of Gel :

(i) Elastic gel : Those gel which have elastic properties.

Ex : Gelatin, Starch, Agar-Agar etc.

(ii) Non- elastic gel : Those gel which are rigid.

Ex : Silica gel.

Properties of Gel :

1.Syneresis/weeping of gel : The spontaneous liberation of liquid from a gel is called syneresis or weeping of gels. It is reverse of swelling.

Ex : Gelatin, Agar-Agar show syneresis at low concentration while silicic acid shows it at high concentration.

2. Imbibition or swelling of gel : When gel is kept in a suitable liquid (water) it absorb large volume of liquid. The phenomenon is called imbibition or swelling of gel.

3.Thixotropic : Some gels when shaken to form a sol, on keeping changes into gel are termed as thixotropic gel and phenomenon is called thixotropy.

Ex : Gelatin and silica liquify on shaking changing into corresponding sol and the sol on keeping changes back into gel.

1. Which of the following is used to adsorb water ?
   (A) Silica gel **(B)** Calcium acetate
   (C) Hair gel **(D)** Cheese

2. The process of imbibing water when elastic gel are placed in water is called :
   (A) imbibition **(B)** syneresis
   (C) coagulation **(D)** thixotropy

3. Some types of gels like gelatin and silica liquify on shaking thereby changing into sols. The sols on standing change back into gels. This process is know as
   (A) syneresis **(B)** thixotropy
   (C) double decomposition **(D)** peptization

Comprehension # 3

Read the following passage carefully and answer the questions.

The Colloidal particles are electrically charged as is indicated by their migration toward cathode or anode under the applied electric field. In a particular colloidal system, all particles carry either positive charge or negative charge.

The electric charge on colloidal particles originate in several ways. According to preferential adsorption theory, the freshly obtained precipitate particles adsorb ions from the dispersion medium, which are common to their lattice and acquire the charge of adsorbed ions. For example, freshly obtained $Fe(OH)_3$ precipitated is dispersed, by a little $FeCI_3$, into colloidal solution owing to the adsorptions of Fe^{3+} ions in preference. Thus sol particles will be positively charged.

In some cases the colloidal particles are aggregates of cations or anions having ampiphilic character. When the ions possess hydrophobic part (hydrocarbon end) as well as hydrophilic part (polar end group), they undergo association in aqueous solution to form particles having colloidal size. The formation of such particles, called micelles plays a very important role in the solubilization of water insoluble substances, (hydrocarbon, oils, fats, grease etc.). In micelles, the polar end groups are directed towards water and the hydrocarbon ends into the centre.

The charge on sol particles of proteins depends on the pH. At low pH, the basic group of protein molecule is ionized (protonated) and at higher pH (alkaline medium), the acidic group in ionized. At Isoelectric pH, characteristic to the protein, both basic and acidic groups are equally ionized.

The stability of colloidal solution is attributed largely to the electric charge of the dispersed particles. This charge causes them to be coagulated or precipitated. On addition of small amount of electrolytes, the ions carrying opposite charge are adsorbed by sol particles resulting in the neutralization of their charge. When the sol particles either with no charge or reduced charge, come closer due to Browman movement, they coalesce to form bigger particles resulting in their separation from the dispersion medium. This is what is called coagulation or precipitation of the colloidal solution. The coagulating power of the effective ion, which depend on its charge, is expressed in terms of its coagulating value, defined as its minimum concentration (m mol/L) needed to precipitate a given sol.

1. A gelatin sol at pH less then the isoelectric value is subjected to an electric field. The sol particles migrate toward
(A) Anode **(B)** Cathode
(C) Both anode and cathode **(D)** Neither anode nor cathode

2. Which of the following ions would have the minimum coagulating value for sol obtained on peptizing $Sn(OH)_4$ by little NaOH solution.
(A) Cl^- **(B)** SO_4^{2-} **(C)** K^+ **(D)** Ba^{2+}

3. How would you obtain a sol of AgI, the particles of which migrate toward cathode under the electric field ?
(A) By adding little excess of KI to $AgNO_3$ solution
(B) By adding little excess of $AgNO_3$ to KI solution
(C) By mixing equal volumes of 0.010 M $AgNO_3$ and 0.010 M KI
(D) None of these

4. When 9.0 ml of arsenius sulphide sol and 1.0 ml of 1.0×10^{-4} M $BaCl_2$ are mixed, turbidity due to precipitation just appears after 2 hours. The effective ion and its coagulating value are respectively
(A) Cl^-, 10 m mol/L **(B)** Cl^-, 20 m mol/L **(C)** Ba^{2+}, 10 m mol/L **(D)** Ba^{2+}, 20 m mol/L

5. 100 ml each of two sols of AgI, one obtained by adding $AgNO_3$ to slight excess of KI and another obtained by adding KI to slight excess of $AgNO_3$, are mixed together. Then
(A) The two sols will stabilize each other
(B) The sol particles will acquire more electric charge
(C) The sols will coagulate each other mutually
(D) A true solution will be obtained

6. Under the influence of an electric field, the particles in a sol migrate towards cathode. The coagulation of the same sol is studied using NaCl, Na_2SO_4 and Na_3PO_4 solutions. Their coagulating values will be in the order

(A) $NaCl > Na_2SO_4 > Na_3PO_4$ **(B)** $Na_2SO_4 > Na_3PO_4 > NaCl$

(C) $Na_3PO_4 > Na_2SO_4 > NaCl$ **(D)** $Na_2SO_4 > NaCl > Na_3PO_4$

Comprehension # 4

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

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

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

2. Which of the gas can displace remaining all the gases

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

3. When temperature is increased

(A) extent of adsorption increases **(B)** extent of adsorption decreases

(C) no effect on adsorption **(D)** extent of adsorption first decreases, then increases

4. Chromatogarphic separations are based on

(A) differential solubility **(B)** differential adsorption **(C)** differential absorption **(D)** None of these

5. Activated charcoal is prepared by

(A) heated charcoal with steam so that it becomes more porous

(B) addition $Ca_3(PO_4)_2$ to charcoal

(C) addition impurity to charcoal

(D) reacted with conc. HNO_3

Comprehension # 5

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

- Critical micelle concentration (CMC) is the lowest concentration at which micelle formation appears. CMC increases with the total surfactant concentration. At concentration higher than CMC, they form extended parallel sheets known as lamellar micelles which resemble biological membranes. With two molecules thick, the individual molecule is perpendicular to the sheets such that hydrophilic groups are on the outside in aqueous solution and on the inside in a non-polar medium
- In concentrated solution, micelles take the form of long cylinders packed in hexagonal arrays and are called lytotropic mesomorphs.
- In an aqueous solution (polar medium), the polar group points towards the periphery and the hydrophobic hydrocarbon chains point towards the centre forming the core of the micelle.
- Micelles from the ionic surfactants can be formed only above a certain temperature called the **Kraft temperature.**

- They are capable of forming ions.
- Molecules of soaps and detergents consist of lyophilic as well as lyophobic parts which associate together to form micelles.
- Micelles may contains as many as 100 molecules or more.

1. Select incorrect statement(s) :
(A) Surface active agent like soaps and synthetic detergents are micelles
(B) Soaps are emulsifying agents
(C) $C_{17}H_{35}$ (hydrocarbon part) and $-COO^-$ (carboxylate part) of stearate ion ($C_{17}H_{35}COO^-$) both are hydrophobic
(D) All are incorrect statements

2. Which part of the soap ($RCOO^-$) dissolved grease and forms micelle ?
(A) R part (called tail of the anion)
(B) $-COO^-$ part (called head of the anion)
(C) both (A) and (B)
(D) none of these

3. In multimolecular colloidal sols, atoms or molecules are held together by:
(A) H-bonding
(B) vander Waals forces
(C) ionic bonding
(D) polar covalent bonding

4. Cleansing action of soap occurs because :
(A) oil and grease can be absorbed into the hydrophobic centres of soap micelles and washed away
(B) oil and grease can be absorbed into hydrophilic centres of soap micelles acid washed away
(C) oil and grease can be absorbed into both hydrophilic and hydrophobic centres but not washed away
(D) cleansing action is not related to micelles

Comprehension # 6

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

1. On addition of one mL of solution of 10% NaCl to 10 mL of red gold sol in presence of 0.025 g of starch, the coagulation is just prevented. The gold number of starch is
(A) 0.025 **(B)** 0.25 **(C)** 2.5 **(D)** 25

2. Which of the following statement(s) is/are correct
(A) Higher the gold number, more protective power of colloid
(B) Lower the gold number, more the protective power
(C) Higher the coagulation value, more the coagulation power
(D) Lower the coagulation value, higher the coagulation power

3. Gold number gives an indic liation of
(A) protective nature of colloids
(B) purity of gold in suspension
(C) the charge on a colloidal solution of gold
(D) g-mole of gold per litre

Exercise # 4 [Subjective Type Questions]

1. Why is gelatin generally added to ice creams ?
2. How can metallic adsorbent be activated ?
3. Account for the following
   (i) Curdling of milk (ii) Tail of comets
   (iii) Use of potash alum in the purification of water (iv) Cleansing action of soap.
4. What happens when gelatin is added to gold sol ?
5. Which out of 'He' and 'Ne' would adsorb on the surface of charcoal more readily and why ?
6. Name two industrial processes in which heterogeneous catalysts are employed ?
7. What is fire foam ?
8. Explain what is observed
   (a) When an electrolyte NaCl is added to ferric hydroxide sol.
   (b) When an emulsion is subjected to centrifugation.
   (c) When direct current is passed through a colloidal sol.
   (d) When a beam of light is passed through a colloidal solution.
9. What are micelles? How do they differ from a normal colloidal solution?
10. The colloidal dispersions of liquids in solid media are called.....
11. Describe the following terms while stating the properties of colloids:
    (i) Brownian movement (ii) Tyndall effect (iii) Electrophoresis
12. What is meant by the colloidal state of matter? Explain the following terms:
    (i) Multimolecular colloids (ii) Electro–dialysis
13. What are micelles? Give an example of micellar system.
14. The zig–zag motion of colloidal particles is called _____.
15. Explain the terms : Physisorption and Chemisorption.
    How does adsorption of a gas on a solid surface vary with pressure?
16. What is observed when a beam of light is passed through a colloidal solution of arsenius sulphide?
17. What are lyophilic and lyophobic sols? Compare the two in terms of stability and reversibility.
18. Explain the terms 'multimolecular colloids' and 'macromolecular colloids'.
19. Explain the difference between a homogeneous and heterogeneous catalyst. Give an example of each.
20. Explain the terms shape selective catalyste, emulsification and dimulsification with one example each.
21. Explain the terms 'Brownian movement' and 'peptization' .

Exercise # 5 Part # I [Previous Year Questions] [AIEEE/JEE-MAIN]

1. 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? **[AIEEE 2005]**

(1) Coagulation in both sols can be brought about by electrophoresis
(2) Mixing the sols has no effect
(3) Sodium sulphate solution causes coagulation in both sols
(4) Magnesium chloride solution coagulates, the gold sol more readily than the iron (III) hydroxide sol.

2. The volume of colloidal particle V_C as compared to the volume of a solute particle in a true solution V_S could be: **[AIEEE 2005]**

(1) ~ 1 **(2)** ~ 10^{23} **(3)** ~ 10^{-3} **(4)** ~ 10^{3}

3. In Langmuir's model of adsorption of a gas on a solid surface : **[AIEEE 2006]**

(1) the rate of dissociation of adsorbed molecules from the surface does not depend on the surface covered
(2) the adsorption at a single site on the surface may involve multiple molecules at the same time
(3) the mass of gas striking a given area of surface is proportional to the pressure of the gas
(4) the mass of gas striking a given area of surface is independent of the pressure of the gas

4. Gold numbers of protective colloids A, B, C and D are 0.50, 0.01, 0.10 and 0.005, respectively. The correct order of their protective powers is **[AIEEE 2008]**

(1) C < B < D < A **(2)** A < C < B < D **(3)** B < D < A < C **(4)** D < A < C < B

5. In context with the industrial preparation of hydrogen from water gas (CO +H_2), which of the following is the correct statement? **[AIEEE 2008]**

(1) CO is removed by absorption in aqueous Cu_2Cl_2 Solution
(2) H_2 is removed through occlusion with Pd
(3) CO is oxidized to CO_2 with steam in the presence of a catalyst followed by absorption of CO_2 in alkali
(4) CO and H_2 are fractionally separated using differences in their densities

6. Which of the following statements is incorrect regarding physisorptions ? **[AIEEE 2009]**

(1) More easily liquefiable gases are adsorbed readily.
(2) Under high pressure it results into multi molecular layer on adsorbent surface.
(3) Enthalpy of adsorption ($\Delta H_{adsorption}$) is low and positive.
(4) It occurs because of van der Waal's forces.

7. According to Freundlich adsorption isotherm which of the following is correct? **[AIEEE 2012]**

(1) $\frac{x}{m} \propto p^0$ **(2)** $\frac{x}{m} \propto p^1$

(3) $\frac{x}{m} \propto p^{1/n}$

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

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

(1) $Al^{3+} < Ba^{2+} < Na^+$ **(2)** $Na^+ < Ba^{2+} < Al^{3+}$
(3) $Ba^{2+} < Na^+ < Al^{3+}$ **(4)** $Al^{3+} < Na^+ < Ba^{2+}$

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

(1) 1/n appears as the intercept **(2)** Only 1/n appears as the slope.
(3) log (1/n) appears as the intercept **(4)** Both k and 1/n appear in the slope term.

10. The Tyndall effect is observed only when following conditions are satisfied : **[JEE(Mains) 2017]**

(a) The diameter of the dispersed particles is much smaller than the wavelength of the light used.

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

(c) The refractive indices of the dispersed phase and dispersion medium are almost similar in magnitude.

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

(1) (a) and (d) **(2)** (b) and (d) **(3)** (a) and (c) **(4)** (b) and (c)

11. A water sample has ppm level concentration of following anions **[JEE(Mains) 2017]**

$F^{-1} = 10$; $SO_4^{2-} = 100$; $NO_3^- = 50$

The anion/anions that make/makes the water sample unsuitable for drinking is/are :

(1) only NO_3^- **(2)** both SO_4^{2-} and NO_3^-

(3) only F^{-1} **(4)** only SO_4^{2-}

Part # II [Previous Year Questions][IIT-JEE ADVANCED]

1. Adsoption of gases on solid surface is generally exothermic because **[JEE 2004]**

(A) enthalpy is positive **(B)** entropy decreases **(C)** entropy increases **(D)** free energy increases

2. Lyophilic sols are **[JEE 2005]**

(A) Irreversible sols **(B)** They are prepared from inorganic compound

(C) Coagulated by adding electrolytes **(D)** Self-stabilizing

3. Among the following, the surfactant that will form micelles in aqueous solution at the lowest molar concentration at ambient condition is : **[JEE 2008]**

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

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

4. Among the electrolytes Na_2SO_4, $CaCl_2$, $Al_2(SO_4)_3$ and NH_4Cl, the most effective coagulating agent for Sb_2S_3 sol is: **[JEE 2009]**

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

5. Silver (atomic weight = 108 g mol^{-1}) has a density of 10.5 g cm^{-3}. The number of silver atoms on a surface of area 10^{-12} m^2 can be expressed in scientific notation as $y \times 10^x$. The value of x is : **[JEE 2010]**

6. The correct statement(s) pertaining to the adsorption of a gas on a solid surface is (are) **[JEE 2011]**

(A) Adsorption is always exothermic

(B) Physisorption may transform into chemisorption at high temperature

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

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

7. Choose the correct reason(s) for the stability of the **lyophobic** colloidal particles. **[JEE 2012]**

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

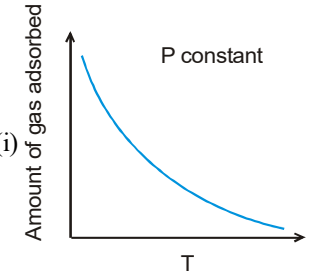
(B) Preferential adsorption of solvent on their surface from the solution.

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

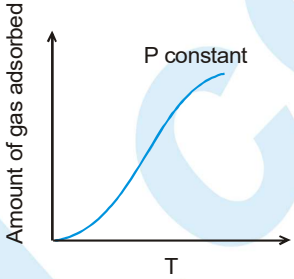
(D) Potential difference between the fixed layer and the diffused layer of opposite charges around the colloidal particles.

8. The given graph / data I, II, III and IV represent general trends observed for different physisorption and chemisorption processes under mild conditions of temperature and pressure. Which of the following choice (s) about I, II, III and IV is (are) correct **[JEE 2012]**

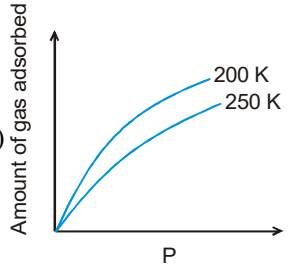
(i)



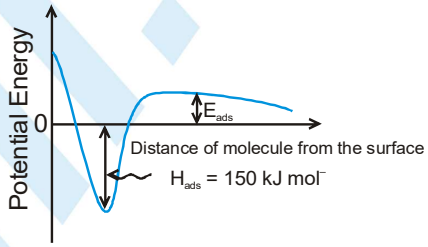
(ii)



(iii)



(iv)



(A) I is physisorption and II is chemisorption
(B) I is physisorption and III is chemisorption
(C) IV is chemisorption and II is chemisorption
(D) IV is chemisorption and III is chemisorption

9. Methylene blue, from its aqueous solution, is adsorbed on activated charcoal at 25° C. For this process, the correct statement is : **[JEE (Advanced) 2013]**

(A) The adsorption requires activation at 25°C.
(B) The adsorption is accompanied by a decreases in enthalpy.
(C) The adsorption increases with increase of temperature.
(D) The adsorption is irreversible.

10. The correct statement(s) about surface properties is(are) **[JEE (Advanced) 2017]**

(A) Cloud is an emulsion type of colloid in which liquid is dispersed phase and gas is dispersion medium

(B) The critical temperatures of ethane and nitrogen are 563 K and 126 K, respectively. The adsorption of ethane will be more than that of nitrogen on same amount of activated charcoal at a given temperature.

(C) Adsorption is accompanied by decrease in enthalpy and decrease in entropy of the system

(D) Brownian motion of colloidal particles does not depend on the size of the particles but depends on viscosity of the solution

MOCK TEST

SECTION - I : STRAIGHT OBJECTIVE TYPE

1. When a graph is plotted between log x/m and log p, it is straight line with an angle of 45° and intercept 0.3010 on y-axis. If the initial pressure is 0.3 atm, what will be the amount of gas adsorbed per gm of adsorbent :

(A) 0.4 **(B)** 0.6 **(C)** 0.8 **(D)** 0.1

2. Which one of the following statements about physical adsorption is not correct ?

(A) It is usually monolayer.

(B) It is reversible in nature.

(C) It involves vanderwaals interaction between adsorbent and adsorbate.

(D) It involves small value of adsorption.

3. Finely divided catalyst has greater surface are and has greater catalytic activity then the compact solid. If a total surface area of 6291456 cm^2 is required for adsorption of gaseous reaction in a catalysed reaction, then how many splits should be made of cube exactly 1cm in length.

(A) 60 **(B)** 80 **(C)** 20 **(D)** 22

4. Which one of the following is not characteristics of chemisorption ?

(A) it is irreversible **(B)** it is specific

(C) it is multilayer phenomenon **(D)** heat of adsorption of about -400kJ

5. A colloidal solution can be purified by the following method of

(A) dialysis **(B)** peptization **(C)** filtration **(D)** oxidation

6. Gold number of a lyophilic sol is such a property that :

(A) the larger its value, the greater is the peptising power.

(B) the lower its value, the greater is the peptising power.

(C) the lower its value, the greater is the protecting power.

(D) the larger its value, the greater is the protecting power.

7. For the coagulation of 200 mL of As_2S_3 solution, 10 mL of 1 M NaCl is required. What is the coagulating value of NaCl.

(A) 200 **(B)** 100 **(C)** 50 **(D)** 25

8. Some type of gels like gelatin loose water slowly. The process is known as :

(A) Syneresis **(B)** Thixotropy **(C)** Peptisation **(D)** Imbibition

9. Coagulation value of the electrolytes $AlCl_3$ and NaCl for As2S3 sol are 0.093 and 52 respectively. How many times $AlCl_3$ has greater coagulating power than NaCl.

(A) 930 **(B)** 520 **(C)** 560 **(D)** None of these.

10. Select the correct statement (s) :

(A) Hydrophilic colloid is a colloid in which there is a strong attraction between the dispersed phase and water.

(B) Hydrophilic colloid is a colloid in which there is a lack of attraction between the dispersed phase and water.

(C) Hydrophobic sols are often formed when a solid crystallises rapidly from a chemical reaction or a supersaturated solution.

(D) All of the above.

11. Gold number of haemoglobin is 0.03. Hence, 100 mL of gold sol will require haemoglobin so that gold is not coagulated by 10 mL of 10% NaCl solution :

(A) 0.03 mg **(B)** 30 mg **(C)** 0.30 mg **(D)** 3 mg

12. What can absorb larger volume of hydrogen gas :

(A) Colloidal solution of palladium **(B)** Finely divided nickel

(C) Finely divided platinum **(D)** Colloidal $Fe(OH)_3$

13. Which of the following statement(s) is/are true for physisoraption ?

(A) Extent of adsorption increases with increase in pressure.

(B) It needs activation energy

(C) It can be reversed easily.

(D) It occurs at high temperature.

SECTION - II : MULTIPLE CORRECT ANSWER TYPE

14. Which of the following statement (s) is/are correct :

(A) Spontaneous adsorption of gases on solid surface is an exothermic process an entropy decreases during adsorption.

(B) Formation of micelles takes place when temperature is below Kraft Temperature(T_k) and concentration is above critical micelle concentration (CMC).

(C) A colloid of $Fe(OH)_3$ is prepared by adding a little excess (required to completely precipitate Fe^{+3} ions as $Fe(OH)_3$) of NaOH in $FeCl_3$ solution the particles of this sol will more towards the cathode during electrophoresis.

(D) According to Hardy-Schulze rules the coagulation (flocculating) value of Fe^{+3} will be more than Ba^{+2} or Na^{+}.

15. Which of the following is/are incorrect statement(s) ?

(A) Hardy schulz rule is related to coagulation.

(B) Brownian movement and tyndall effect are the characteristics of colloids.

(C) In gel, the liquid is dispersed in liquid.

(D) Lower the gold number, more is the protective power of hydrophilic sols.

16. The origin of charge on colloidal solution is

(A) Frictional rubbing

(B) Electron capture during Bredig's arc method

(C) Selective adsorption of ion on their surface

(D) It is due to the addition of protective colloids.

SECTION - III : ASSERTION AND REASON TYPE

17. **Assertion :** All colloidal dispersions give very low osmotic pressure and show very small freezing point depression or boiling point elevation.

Reason : Tyndall effect is due to scattering of light from the surface of colloidal particles.

(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(B) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(C) Assertion is true but Reason is false.

(D) Assertion is false but Reason is true.

18. **Assertion :** The Brownian movement is due to the bombardment of colloidal particles by the molecules of dispersion medium which are in the constant motion like molecules of a gas.

Reason : Brownian movement provides visible proof of the random motion of a molecule in a liquid.

(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(B) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(C) Assertion is true but Reason is false.

(D) Assertion is false but Reason is true.

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

Reason : At isoelectronic point, colloidal solution become electrically neutral.

(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(B) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(C) Assertion is true but Reason is false.

(D) Assertion is false but Reason is true.

20. **Assertion :** Gelatin is added to ice cream as a protective agent so as to preserve its smoothness.

Reason : whipped cream is colloidal in nature.

(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(B) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(C) Assertion is true but Reason is false.

(D) Assertion is false but Reason is true.

21. **Assertion :** Medicines in the colloidal state are more effective.

Reason : In the colloidal state, the medicines are easily assimilated by the body.

(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(B) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(C) Assertion is true but Reason is false.

(D) Assertion is false but Reason is true.

SECTION - IV : COMPREHENSION TYPE

Read the following comprehensions carefully and answer the questions.

Comprehension # 1

The clouds consists of charged particles of water dispersed in air. Some of them are +vely charged, other are -vely charged. When ++vely charged clouds come closer they cause

lightening and thundering whereas when +ve and -ve charged colloids come closer they cause heavy rain by aggregation of minute particles. It is possible to cause artificial rain by throwing electrified sand or silver iodide from an aeroplane and thus coagulating the mist hanging in the air.

22. When excess of $AgNO_3$ is treated with KI solution, AgI forms

(A) +vely charged sol **(B)** -vely charged sol

(C) neutral sol **(D)** true solution

23. AgI helps in artificial rain because :

(A) it helps in condensation process **(B)** it helps in dispersion process

(C) it helps in coagulation **(D)** all of them

24. Smoke screens consists of

(A) fine particles of TiO_2 dispersed in air by aeroplanes

(B) fine particles of AgI dispersed in air by aeroplanes

(C) fine particles of Al_2O_3 dispersed in air by aeroplanes.

(D) None of these.

SECTION - V : MATRIX - MATCH TYPE

25. Match list I with list II and select the correct answer :

Column I	Column II
(A) Coagulation	**(p)** Scattering of light
(B) Dialysis	**(q)** Washing of precipitates
(C) Peptization	**(r)** Purification of colloids
(D) Tyndall effect	**(s)** Electrolyte

26. Match list I with list II and select the correct answer :

Column I	Column II
(A) Emulsifies	**(p)** Colloidal solution
(B) Xerogel	**(q)** Soaps
(C) Colloidal electrolyte	**(r)** Foil of cellophane
(D) Purple of Cassius	**(s)** Dextrin

ANSWER KEY

EXERCISE - 1

1. B **2.** A **3.** C **4.** D **5.** B **6.** A **7.** A **8.** B **9.** D **10.** C **11.** A **12.** B **13.** A

14. C **15.** C **16.** D **17.** C **18.** A **19.** C **20.** C **21.** B **22.** A **23.** A **24.** D **25.** C **26.** C

27. C **28.** A **29.** D **30.** B **31.** A **32.** C **33.** D **34.** A **35.** B **36.** D **37.** B **38.** D **39.** A

40. C **41.** C **42.** A **43.** B **44.** C **45.** C **46.** A **47.** B **48.** A **49.** D **50.** A **51.** B **52.** B

53. A **54.** B **55.** A **56.** D **57.** D **58.** A **59.** B **60.** A **61.** B **62.** D **63.** D **64.** C **65.** D

66. B **67.** D **68.** A **69.** D **70.** A

EXERCISE - 2 : PART # I

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

10. C, D **11.** A, C **12.** B, C **13.** A, B, D **14.** A **15.** A **16.** C **17.** C **18.** D **19.** D **20.** D

21. A **22.** B **23.** C **24.** D **25.** C **26.** C **27.** A **28.** C **29.** D **30.** B **31.** D **32.** A **33.** C

34. A **35.** A **36.** D **37.** B **38.** B **39.** D **40.** A **41.** C **42.** B **43.** A **44.** C **45.** A **46.** A

47. B **48.** C **49.** A **50.** A **51.** B **52.** B, C, D **53.** A, C, D **54.** A, B, D **55.** A, B, D **56.** B, C, D

PART # II

1. C **2** B **3.** A **4.** B **5.** B **6.** A **7.** D **8.** B **9.** A **10.** A **11.** D **12.** A **13.** C

14. A

EXERCISE - 3 : PART # I

1. A → s, B → r, C → q, D → p

2. A → r, B → p, C → s, D → q

3. A → p, q, B → r, C → q, t, D → s, E-u

4. A → q, B → p, C → s, D → r, E-t

PART # II

Comprehension # 1 : **1.** A **2.** C **3.** A

Comprehension # 2 : **1.** A **2.** A **3.** B

Comprehension # 3 : **1.** B **2.** D **3.** B **4.** C **5.** C **6.** A

Comprehension # 4 : **1.** D **2.** C **3.** B **4.** B **5.** A

Comprehension # 5 : **1.** C, D **2.** C **3.** B **4.** A

Comprehension # 6 : **1.** D **2.** B,D **3.** A

EXERCISE - 5 : PART # I

1. 2 **2.** 4 **3.** 3 **4.** 2 **5.** 3 **6.** 3 **7.** 4 **8.** 2 **9.** 2 **10.** 2 **11.** 3

PART # II

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

MOCK - TEST

1 B **2** A **3** C **4** C **5** A **6** C **7** C **8** A **9** C **10** D **11** C **12** A **13** A

14 A, C **15** C, D **16** ABC **17** B **18** B **19** B **20** B **21** A **22** A **23** C **24** A

25 A $\rightarrow$ s ; B $\rightarrow$ r ; C $\rightarrow$ q ; D $\rightarrow$ p **26** A $\rightarrow$ s ; B $\rightarrow$ r ; C $\rightarrow$ q ; D $\rightarrow$ p