22. Surface Chemistry – Multiple Choice Questions

1. Adsorption and Adsorption isotherm

1. In adsorption rate of physisorption increases when

(a) Temperature is decreased

(b) Temperature is increased

(c) Pressure is decreased

(d) None of these

2. Adsorption is multilayer in the case of

(a) Physical adsorption (b) Chemisorption

(c) Both (d) None of both

3. Which of the following statements is not applicable to chemisorption

(a) It is slow

(b) It is irreversible

(c) It is highly specific

(d) It is independent of temperature

4. In Freundlich adsorption isotherm, adsorption is proportional to pressure P as

(a) P^0 (b) P

(c) P^n (d) $P^{1/n}$

5. Which of the following is not a characteristic of chemisorption

(a) ΔH is of the order of 400 kJ

(b) Adsorption is irreversible

(c) Adsorption may be multimolecular layer

(d) Adsorption is specific

6. In neutralisation of KI by $AgNO_3$ positive charge is due to absorption of

(a) Ag^+ ions (b) Ag

(c) I ions (d) Both (b) and (c)

7. 50 mL of 1 M oxalic acid is shaken with 0.5 gm of wood charcoal. The final concentration of the solution after adsorption is 0.5 M. Amount of oxalic acid absorbed per gm of charcoal is

(a) 3.45 g (b) 3.15 g

(c) 6.30 g (d) None

8. 0.2 g of fine animal charcoal is mixed with half litre of acetic acid solution and shaken for 30 *minutes*

(a) Concentration remains same

(b) Concentration increases

(c) Concentration of the solution decrease

(d) None of these

9. The extent of adsorption of a gas on a solid depends on

(a) Nature of the gas (b) Pressure of the gas

(c) Temperature of the gas (d) All are correct

10. Which characteristic is not associated with chemical adsorption

(a) Is irreversible

(b) Forms monolayer

(c) Not very specific

(d) Heat of adsorption > 50 $kJ\ mol^{-1}$

11. Chromatographic analysis is done based on the property of

(a) Diffusion (b) Absorption

(c) Adsorption (d) Condensation

12. At the equilibrium position in the process of adsorption.....

(a) $\Delta H > 0$ (b) $\Delta H = T\Delta S$

(c) $\Delta H > T\Delta S$ (d) $\Delta H < T\Delta S$

13. Which of the following interface cannot be obtained

(a) Liquid-liquid (b) Solid-liquid

(c) Liquid-gas (d) Gas-gas

14. The term 'sorption' stands for .....

(a) Absorption

(b) Adsorption

(c) Both absorption and adsorption

(d) Desorption

15. 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) $\Delta H < 0$

16. In physisorption, adsorbent does not show specificity for any particular gas because .....

(a) Involved van der Waals' forces are universal

(b) Gases involved behave like ideal gases

(c) Enthalpy of adsorption is low

(d) It is a reversible process

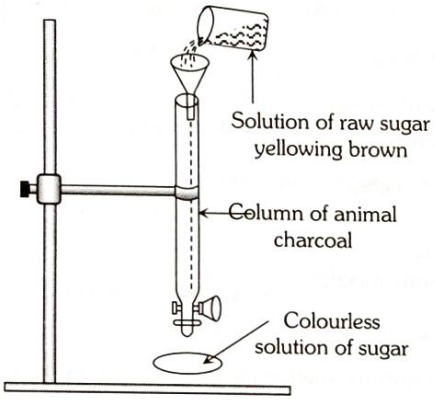
17. On the basis of data given below, predict which of the following gases shows least, adsorption on a definite amount of charcoal

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

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



(a) Absorption (b) Adsorption

(c) Coagulation (d) Emulsification

19. For Adsorption phenomenon,

(a) $\Delta H = +ve, \Delta S = -ve$ (b) $\Delta H = -ve, \Delta S = +ve$

(c) $\Delta H = -ve, \Delta S = -ve$ (d) $\Delta H = +ve, \Delta S = +ve$

20. The adsorption of a gas on a solid surface varies with pressure of the gas in which of the following manner

(a) Fast $\rightarrow$ slow $\rightarrow$ independent of the pressure

(b) Slow $\rightarrow$ fast $\rightarrow$ independent of the pressure

(c) Independent of the pressure $\rightarrow$ fast $\rightarrow$ slow

(d) Independent of the pressure $\rightarrow$ slow $\rightarrow$ fast

21. Plot of $\log x/m$ against $\log p$ is a straight line inclined at an angle of 45°. When the pressure is 0.5 atm and Freundlich parameter, k is 10, the amount of solute adsorbed per gram of adsorbent will be ($\log 5 = 0.6990$)

(a) 1g (b) 2g

(c) 3g (d) 5g

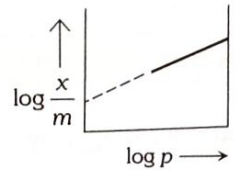
(e) 2.5g

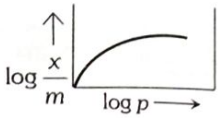
22. The most adsorbed gas on activated charcoal is

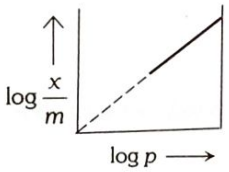
(a) N_2 (b) H_2

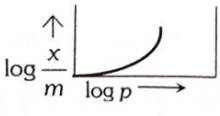
(c) CO_2 (d) CH_4

23. Which of the following curve is in accordance with Freundlich adsorption isotherm

(a) 

(b) 

(c) 

(d) 

24. In which one of the following properties, physisorption and chemisorption resemble each other

(a) Force of attraction (b) Enthalpy of adsorption

(c) Temperature effect (d) Effect of surface area

(e) Number of adsorption layers

25. According to Freundlich adsorption isotherm the amount of gas adsorbed per unit mass of the solid adsorbent varies directly with pressure when the value of n is

(a) 0 (b) 3

(c) 2 (d) 1

26. Metals like *Pt* and *Pd* can adsorb large volume of hydrogen under specific conditions. Such adsorbed hydrogen by the metal is known as

(a) Occluded hydrogen (b) Absorbed hydrogen

(c) Reactive hydrogen (d) Atomic hydrogen

27. Identify the gas which is readily adsorbed by activated charcoal

(a) N_2 (b) SO_2

(c) H_2 (d) H_2

28. Which one of the following is used for reviving the exhausted permutite

(a) *HCl* solution

(b) 10% $CaCl_2$ solution

(c) 10% $MgCl_2$ solution

(d) 10% *NaCl* solution

29. 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

30. 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

31. 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

32. 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

33. Which of the following is an example of absorption

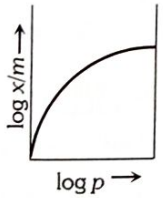
(a) Water on silica gel

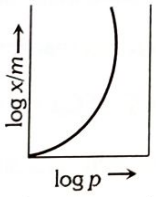
(b) Water on calcium chloride

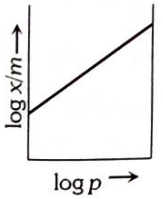
(c) Hydrogen on finely divided nickel

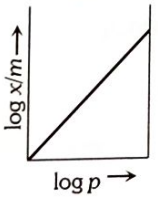
(d) Oxygen on metal surface

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

(a) 

(b) 

(c) 

(d) 

35. The charge on As_2S_3 sol is due to the adsorbed

(a) H^+ (b) OH^-

(c) O^{2-} (d) S^{2-}

36. Noble gases are adsorbed by

(a) Anhydrous calcium chloride

(b) Ferric hydroxide

(c) Conc. H_2SO_4

(d) Activated coconut charcoal

37. The equation, $\frac{P}{x} = \frac{1}{k'} + \frac{P}{k''}$ is

(a) Gibbs adsorption isotherm

(b) Freundlich adsorption isotherm

(c) Langmuir adsorption isotherm

(d) BET equation

38. The adsorption isotherm for a gas is given by the relation $x = ap/(1 + bp)$ where x is moles of gas adsorbed per gram of the adsorbent, p is the pressure of the gas, and a and b are constants. Then x

(a) Increases with p

(b) Remains unchanged with p

(c) Decreases with p

(d) Increases with p at low pressures and then remains the same at high pressure

2. Catalyst and Catalysis

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

(a) Homogenous catalysis (b) Acid base catalysis

(c) Heterogenous catalysis (d) Enzyme catalysis

2. Shape– selective catalysis is a reaction catalysed by

(a) Zeolites (b) Enzymes

(c) Platinum (d) Zeigler–Natta catalyst

(e) Acids or bases

3. Reactions in Zeolite catalyst depend on

(a) Pores (b) Apertures

(c) Size of cavities (d) All of these

4. What is the role of a catalyst in a catalysed reaction

(a) Lowers the activation energy

(b) Increases the activation energy

(c) Affects the free energy change

(d) Affects the enthalpy change

5. When a catalyst is added to a system the

(a) Value of equilibrium constant is decreased

(b) The rate of forward reaction is increased and that of backward reaction is decreased

(c) Equilibrium concentrations are unchanged

(d) Equilibrium concentrations are increased

6. $\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{dil\ H_2SO_4} \underset{\text{Fructose}}{C_6H_{12}O_6}\ (aq) + \underset{\text{Glucose}}{C_6H_{12}O_6}(aq)$

In this reaction, dilute H_2SO_4 is called

(a) Homogenous catalysis (b) Homogenous catalyst

(c) Heterogenous catalysis (d) Heterogenous catalyst

7. Which one of the following statements is correct in reversible reaction. A catalyst

(a) Increases the rate of forward reaction

(b) Decreases the rate of forward reaction

(c) Increases the rate of backward and forward reactions

(d) Alters the equilibrium constant of the reaction

8. Catalyst used in hydrogenation of oils is

(a) *Pt* (b) *Mo*

(c) *Fe* (d) *Ni*

9. Which of the following process does not occur at the interface of phases

(a) Crystallisation (b) Heterogeneous catalysis

(c) Homogeneous catalysis (d) Corrosion

10. In which of the following reactions heterogeneous catalysis is involved

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

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

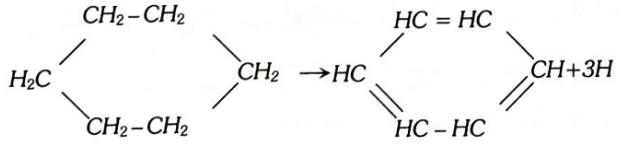
(iii) $N_2(g) + 3H_2(g) \xrightarrow{Fe(s)} 2NH_3(g)$

(iv) $CH_3COOCH_3(l) + H_2O(l) \xrightarrow{H^+} CH_3COOH(aq) + CH_3OH(aq)$

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

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

11. In the following reaction the catalyst used is



(a) Al_2O_3 (b) Cr_2O_3

(c) Cr_2O_3 and Al_2O_3 (d) *Zn* dust

12. An example for autocatalysis is

(a) Oxidation of *NO* to NO_2

(b) Oxidation of SO_2 to SO_3

(c) Decomposition of $KClO_3$ to *KCl* and O_2

(d) Oxidation of oxalic acid by acidified $KMnO_4$

13. Which of the following reaction is catalysed by enzyme maltase

(a) Starch → maltose

(b) Maltose → glucose

(c) Lactose → maltose

(d) Maltose → glucose + fructose

14. 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

15. Which of the following types of metals form the most efficient catalysts

(a) Alkali metals (b) Alkaline earth metals

(c) Transition metals (d) All of these

16. Which of the following statements is wrong

(a) Catalysts can aid a rapid reaching of the equilibrium position, but do not change the position of the equilibrium

(b) Homogenous catalysis generally involves an equilibrium reaction between atleast one of the reactants and the catalyst

(c) Heterogenous catalysis involves chemisorption on the surface of the catalyst

(d) Positive catalysts raise the energy of activation of the reaction they catalyse

17. In the redox reaction

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightleftharpoons 2Mn^{2+} + 10CO_2 + 8H_2O$$

The ion acting as autocatalyst is

(a) MnO_4^- (b) $C_2O_4^{2-}$

(c) H^+ (d) Mn^{2+}

18. Name the catalyst [X] for the reaction, $CO_{(g)} + H_{2(g)} \xrightarrow{[x]} HCHO_{(g)}$

(a) *Ni* (b) *Cu*

(c) *Cu / ZnO* (d) *Cu / Cr_2O_3*

19. Organic catalysts differ from inorganic catalysts

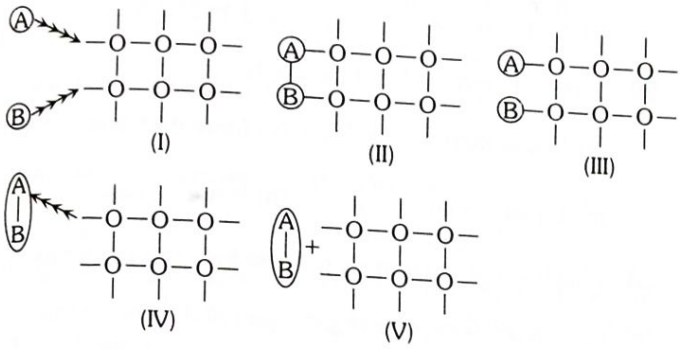
(a) By acting at very high temperature

(b) By acting at low temperature

(c) Being used up

(d) Being proteinous in nature

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



(a) $I \rightarrow II \rightarrow III \rightarrow IV \rightarrow V$ (b) $I \rightarrow III \rightarrow II \rightarrow IV \rightarrow V$

(c) $I \rightarrow III \rightarrow II \rightarrow V \rightarrow IV$ (d) $I \rightarrow II \rightarrow III \rightarrow V \rightarrow IV$

21. Which is used as autocatalyst

(a) Al_2O_3 (b) CaC_2

(c) $MnSO_4$ (d) All of these

3. Colloids, Emulsion, Gel and their Properties with Application

1. Which of the following statement is wrong for lyophobic sol

(a) Dispersed phase is generally in organic material

(b) Can be easily coagulated by small addition of electrolyte

(c) Dispersed phase particles are poorly hydrated and colloid is stabilised due to charge on the colloidal particles

(d) Reversible in nature that is after coagulation can be easily set into colloidal form

2. Suspensions are

(a) Visible to naked eye

(b) Invisible through microscope

(c) Not visible by any means

(d) Invisible under electron microscope

3. $Fe(OH)_3$ sol is

(a) Macro-molecular colloid (b) Multi-molecular colloid

(c) Micelles (d) Negative colloid

4. Which characteristic is true in respect of colloidal particle

(a) They always have two phases

(b) They are only in liquid state

(c) They can't be electrolysed

(d) They are only hydrophilic

5. Sulphur sol contains

(a) Discrete sulphur atoms

(b) Discrete sulphur molecules

(c) Large aggregates of sulphur molecules

(d) Water dispersed in solid Sulphur

6. Which one of the following is a hydrophilic colloidal sol

(a) Barium hydroxide sol (b) Arsenic sulphide sol

(c) Starch solution (d) Silver chloride sol

7. Paste is

(a) Suspension of solid in a liquid

(b) Mechanical dispersion of a solid in liquid

(c) Colloidal solution of a solid in solid

(d) None of these

8. 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

9. Which is the wrong pair

(i) Starch solution	:	sol
(ii) Aq $NaCl$	:	true solution
(iii) Milk	:	emulsion
(iv) Aq $BaSO_4$	:	true solution

(a) (i) (b) (iii)

(c) (iv) (d) (ii)

10. Which type of colloid is the dissolution of sulphur (S_8)

(a) Associated colloid

(b) Micelle

(c) Multimolecular colloid

(d) Macromolecular colloid

11. Point out the false statement

(a) Colloidal sols are homogenous

(b) Colloids carry +ve or –ve charges

(c) Colloids show Tyndall effect

(d) The size range of colloidal particles is 10-1000Å

12. Milk is an example of

(a) Pure solution (b) Gel

(c) Emulsion (d) Suspension

13. 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

14. Sodium stearate forms in water

(a) True solution (b) A suspension

(c) An emulsion (d) A colloidal solution

15. Blood contains

(a) Positively charged particles

(b) Negatively charged particles

(c) Neutral particles

(d) Negatively as well as positively charged particles

16. Which of the following reactions leads to the formation of a substance in the colloidal state

(a) $Cu + HgCl_2 \rightarrow CuCl_2 + Hg$

(b) $2HNO_3 + 3H_2S \rightarrow 3S + 4H_2O + 2NO$

(c) $2Mg + CO_2 \rightarrow 2MgO + C$

(d) $Cu + CuCl_2 \rightarrow Cu_2Cl_2$

(in presence of excess of HCl)

17. Butter is a colloidal solution of

(a) Solid – solid (b) Liquid – solid

(c) Solid – liquid (d) Gas – solid

18. The continuous phase contains the dispersed phase throughout, example is

(a) Water in milk (b) Fat in milk

(c) Water droplets in mist (d) Oil in water

19. Some substances behave as electrolytes in dilute solutions and as colloids in their concentrated solutions. Their colloidal forms are said to form

(a) Emulsions (b) Gels

(c) Micelles (d) Sols

20. Which one can act as semipermeable membrane

(a) Phenol layer (b) $Ca_3(PO_4)_2$

(c) $Cu_2[Fe(CN)_6]$ (d) All of these

21. Size of colloidal particle is

(a) 1 to 10 Å (b) 20 to 50 Å

(c) 10 to 1000 Å (d) 1 to 280 Å

22. 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 these

23. Which of the following is not true for a detergent molecule

(a) It has a non-polar organic part and a polar group

(b) It is not easily biodegraded

(c) It is a sodium salt of fatty acid

(d) It is a surface active agent

24. At high concentration of soap in water, soap behaves as .....

(a) Molecular colloid (b) Associated colloid

(c) Macromolecular colloid (d) Lyophilic colloid

25. A colloidal system having a solid substance as a dispersed phase and a liquid as a dispersion medium is classified as.....

(a) Solid sol (b) Gel

(c) Emulsion (d) Sol

26. The values of colligative properties of colloidal solution are of small order in comparison to those shown by true solutions of same concentration because of colloidal particles.....

(a) Exhibit enormous surface area

(b) Remain suspended in the dispersion medium

(c) Form lyophilic colloids

(d) Are comparatively less in number

27. The stability of lyophilic colloids is due to

(a) Charge on their particles

(b) A layer of dispersion medium on their particles

(c) The smaller size of their particles

(d) The large size of their particles

28. When a substance comes in colloidal state, the surface area of the particles

(a) Increases

(b) Decreases

(c) Remains unchanged

(d) First increases then decreases

29. In lyophilic sols the attraction of sol particles towards the medium is due to

(a) Covalent bond (b) Vander Waal's force

(c) Hydrogen bond (d) None of these

30. Which of the following is not a method of preparation of colloidal solution

(a) Electrical dispersion (b) Peptization

(c) Coagulation (d) Mechanical dispersion

31. White of an egg is partly coagulated by heating which can be again obtained back by some pepsin and little HCl. This process is called

(a) Peptization (b) Coagulation

(c) Precipitation (d) None of these

32. An emulsifier is a substance which

(a) Stabilises the emulsion

(b) Homogenises the emulsion

(c) Coagulates the emulsion

(d) Accelerates the dispersion of liquid in liquid

33. Which one of the sols acts as protective colloid

(a) As_2S_3 (b) Gelatin

(c) Au (d) $Fe(OH)_3$

34. Blood may be purified by

(a) Dialysis (b) Electro-osmosis

(c) Coagulation (d) Filtration

35. On adding few drops of dilute HCl or $FeCl_3$ to freshly precipitated ferric hydroxide, a red coloured colloidal solution is obtained. The phenomenon is known as

(a) Peptization (b) Dialysis

(c) Protective action (d) Dissolution

36. The density of gold is $19\ g/cm^3$. If $1.9\times10^{-4}\ g$ of gold is dispersed in one litre of water to give a sol having spherical gold particles of radius 10 nm, then the number of gold particles per mm^3 of the sol will be

(a) 1.9×10^{12} (b) 6.3×10^{14}

(c) 6.3×10^{10} (d) 2.4×10^{6}

37. Freshly prepared precipitate sometimes gets converted to colloidal solution by .....

(a) Coagulation (b) Electrolysis

(c) Diffusion (d) Peptisation

38. In dialysis, colloidal particles are separated from

(a) Solvent

(b) Dispersed phase

(c) Ions of electrolytes

(d) Particles of dispersion medium

39. Which of the following colloids are formed when hydrogen sulphide gas is passed through a cold solution of arsenious oxide

(a) As_2S_3 (b) As_2O_3

(c) As_2S (d) As_2H_2

40. Bredig arc method cannot be used to prepare colloidal solution of which of the following

(a) Pt (b) Fe

(c) Ag (d) Au

41. Colloidal solution of gold cannot be prepared by

(a) Bredig's arc method (b) Mechanical dispersion

(c) Reduction of gold chloride (d) Exchange of solvents

42. As_2S_3 sol has a negative charge. Capacity to precipitate it is highest in

(a) $AlCl_3$ (b) Na_3PO_4

(c) $CaCl_2$ (d) K_2SO_4

43. All colloidal dispersions have

(a) Very high osmotic pressure

(b) Low osmotic pressure

(c) No osmotic pressure

(d) High osmotic pressure

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

(a) KCl (b) KNO_3

(c) K_2SO_4 (d) $K_3[Fe(CN)_6]$

45. Which of the following substances gives a positively charged sol

(a) Gold (b) A metal sulphite

(c) Ferric hydroxide (d) An acidic dye

46. The blue colour of water in the sea is due to

(a) Refraction of blue light by the impurities in sea water

(b) Reflection of blue sky by sea water

(c) Scattering of blue light by water molecules

(d) Absorption of other colours except the blue colour by water molecules

47. The charge on $Fe(OH)_3$ sol is due to

(a) Adsorption of hydroxyl ion

(b) Adsorption of hydrogen ion

(c) Adsorption of ferric acid

(d) Adsorption of ferric ion

48. Colour of colloids depend on which of the following factors

(a) Size (b) Mass

(c) Charge (d) Nature

49. Tyndall effect is more pronounced in

(a) Hydrophilic sols (b) Hydrophobic sols

(c) Starch solution (d) Both (b) and (c)

50. Colloidal solutions of gold prepared by different methods have different colours owing to

(a) The difference in the size of the colloidal particles

(b) The fact that gold exhibits a variable valency of +1 and +3

(c) Different concentrations of gold

(d) Presence of different types of foreign particles depending upon the method of preparation of the colloid

51. Which of the following process is not responsible for the presence of electric charge on the sol particles

(a) Electron capture by sol particles

(b) Adsorption of ionic species from solution

(c) Formation of Helmholtz electrical double layer

(d) Absorption of ionic species from solution

52. The concentration of electrolyte required to coagulate a given amount of As_2S_3 sol is minimum in the case of

(a) Magnesium nitrate (b) Potassium nitrate

(c) Potassium sulphate (d) Aluminium nitrate

53. Which of the following can stabilize gold sol from coagulation by $NaCl$ solution

(a) $Fe(OH)_3$ (b) Gelatin

(c) As_2S_3 (d) None of these

54. Method by which Lyophobic sol can be protected

(a) By addition of oppositely charged sol

(b) By addition of an electrolyte

(c) By addition of lyophillic sol

(d) By boiling

55. On addition of one mL solution of $10\%NaCl$ to 10 mL gold sol in the presence of 0.25 g of starch, the coagulation is just prevented. Starch has the following gold number

(a) 0.025 (b) 0.25

(c) 0.5 (d) 250

56. Gold number is associated with

(a) Only lyophobic colloids

(b) Only lyophilic colloids

(c) Both lyophobic and lyophilic colloids

(d) None of these

57. A negatively charged suspension of clay in water will need for precipitate the minimum amount of

(a) Aluminium chloride (b) Potassium sulphate

(c) Sodium hydroxide (d) Hydrochloric acid

58. Gelatin is mostly used in making ice cream in order to

(a) Prevent making of colloid

(b) To stabilise the colloid and prevent crystallisation

(c) To stabilise mixture

(d) To enrich the aroma

59. Lyophilic sols are more stable than lyophobic sols because

(a) The colloidal particles have positive charge

(b) The colloidal particles have no charge

(c) The colloidal particles are solvated

(d) There are strong electrostatic repulsions between the negatively charged colloidal particles

60. The number of moles of lead nitrate needed to coagulate 2 mol of colloidal $[AgI]I^-$ is

(a) 2 (b) 1

(c) 1/2 (d) 2/3

(e) 5/2

61. Which of the following pairs of ions would be expected to form precipitate when their dilute solution are mixed

(a) Na^+, SO_3^{2-} (b) NH_4^+, CO_3^{2-}

(c) Na^+, S^{-2} (d) Fe^{+3}, PO_4^{-3}

62. Statement : 'To stop bleeding from an injury, ferric chloride can be applied'. Which comment about the statement is justified

(a) It is not true; ferric chloride is a poison

(b) It is true; Fe^{3+} ions coagulate blood which is a negatively charged sol

(c) It is not true; Cl^- ions form positively charged sol; profuse bleeding takes place

(d) It is true; coagulation takes place because of formation of negatively charged sol with Cl^-

(e) It is not true; ferric chloride is ionic and gets into the blood stream

63. Select wrong statement

(a) If a very small amount of $AlCl_3$ is added to gold sol, coagulation occurs, but if a large quantity of $AlCl_3$ is added, there is no coagulation

(b) Organic ions are more strongly adsorbed on charged surfaces in comparison to inorganic ions

(c) Both emulsifier and peptising agents stabilise colloids but their actions are different

(d) Colloidal solutions are thermodynamically stable

64. Which has least gold number

(a) Gelatin (b) Starch

(c) Albumin (d) Blood

65. Cloud burst due to

(a) Attraction towards the electrical charges on the earth

(b) Large amount of water present in the cloud

(c) Dense clouds are present in upper atmosphere

(d) Mutual discharge of oppositely charged clouds resulting in the coagulation

66. The coagulation of 100 *mL* of a colloidal sol of gold is completely prevented by addition of 0.25 *g* of a substance 'X' to it before adding 10 *mL* of 1% *NaCl* solution. The gold number of 'X' is

(a) 0.25 (b) 25

(c) 250 (d) 2.5

67. On addition of one *mL* of 10% *NaCl* solution to 10 *mL* gold sol in the presence of 0.25 *gm* of starch. The coagulation is just prevented, starch has gold number

(a) 0.025 (b) 0.25

(c) 2.5 (d) None

68. Which of the following electrolytes will have maximum coagulating value for Ag/Ag^+ sol

(a) Na_2S (b) Na_3PO_4

(c) Na_2SO_4 (d) $NaCl$

69. 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

70. Milk can be preserved by adding a few drops of

(a) Formic acid solution

(b) Formaldehyde solution

(c) Acetic acid solution

(d) Acetaldehyde solution

71. Which of the following ions can cause coagulation of proteins

(a) Ag^+ (b) Na^+

(c) Mg^{++} (d) Ca^{++}

72. Which of the following colloids cannot be easily coagulated

(a) Macromolecular colloids (b) Lyophobic colloids

(c) Irreversible colloids (d) Multimolecular colloids

73. Which one is an example of gel

(a) Soap (b) Cheese

(c) Milk (d) Fog

74. The emulsifying agent in milk is

(a) Lactic acid (b) Casein

(c) Lactose (d) Fat

75. Silver iodide is used for producing artificial rain because *AgI*

(a) Is easy to spray at high altitudes

(b) Is easy to synthesize

(c) Has crystal structure similar to ice

(d) Is insoluble in water

76. Pick out the statement which is not relevant in the discussion of colloids

(a) Sodium aluminium silicate is used in the softening of hard water

(b) Potash alum is used in shaving rounds and as antiseptic in medicine

(c) Artificial rain is caused by throwing electrified sand on the clouds from an aeroplane

(d) Deltas are formed at a place where the river pours its water into the sea

77. Cod liver oil is

(a) An emulsion (b) Solution

(c) Colloidal solution (d) Suspension

78. Colloidal gold is given by injection to act as

(a) Disinfectant

(b) Anticancer agent

(c) Germ killer

(d) Tonic to raise vitality of human system

4. IIT-JEE/ AIEEE

1. Which of the following statements is incorrect regarding physisorption **[2009]**

(a) It occurs because of vander Waal's forces

(b) More easily liquefiable gases are adsorbed readily

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

(d) Enthalpy of adsorption ($\Delta H_{adsorption}$) is low and positive

2. The equation for Freundlich adsorption isotherm is **[2012]**

(a) $\frac{x}{m} = kp^{1/n}$ (b) $x = mkp^{1/n}$

(c) $x/m = kp^{-n}$ (d) All of these

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

(a) The rate of dissociation of adsorbed molecules from the surface does not depend on the surface covered

(b) The adsorption at a single site on the surface may involve multiple molecules at the same time

(c) The mass of gas striking a given area of surface is proportional to the pressure of the gas

(d) The mass of gas striking a given area of surface is independent of the pressure of the gas

4. 3 *g* of activated charcoal was added to 50 *mL* of acetic acid solution (0.06N) in a flask. After an hour it was filtered and the strength of the filtrate was found to be 0.042 N. The amount of acetic acid adsorbed (per gram of charcoal) is **[2015]**

(a) 18 *mg* (b) 36 *mg*

(c) 42 *mg* (d) 54 *mg*

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

(a) $1/n$ appears as the intercept

(b) Only $1/n$ appears as the slope

(c) $\log(1/n)$ appears as the intercept

(d) Both k and $1/n$ appear in the slope term

6. Match the catalysts to the correct processes

Catalyst		Process	
(A)	$TiCl_3$	(i)	Wacker process
(B)	$PdCl_2$	(ii)	Ziegler – Natta polymerization
(C)	$CuCl_2$	(iii)	Contact process
(D)	V_2O_5	(iv)	Deacon's process

[2015]

(a) (A) – (iii), (B) – (ii), (C) – (iv), (D) – (i)

(b) (A) – (ii), (B) – (i), (C) – (iv), (D) – (iii)

(c) (A) – (ii), (B) – (iii), (C) – (iv), (D) – (i)

(d) (A) – (iii), (B) – (i), (C) – (ii), (D) – (iv)

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

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

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

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

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

8. Lyophilic sols are **[2005]**

(a) Irreversible sols

(b) They are prepared from inorganic compound

(c) Coagulated by adding electrolytes

(d) Self–stabilizing

9. 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 **[2009]**

(a) Na_2SO_4 (b) $CaCl_2$

(c) $Al_2(SO_4)_3$ (d) NH_4Cl

10. 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 **[2005]**

(a) Magnesium chloride solution coagulates, the gold sol more readily than the iron (III) hydroxide sol

(b) Sodium sulphate solution causes coagulation in both sols

(c) Mixing the sols has no effect

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

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

(a) $\frac{V_C}{V_S} \simeq 1$ (b) $\frac{V_C}{V_S} \simeq 10^{23}$

(c) $\frac{V_C}{V_S} \simeq 10^{-3}$ (d) $\frac{V_C}{V_S} \simeq 10^{3}$

12. 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 are **[2008]**

(a) $C < B < D < A$ (b) $A < C < B < D$

(c) $B < D < A < C$ (d) $D < A < C < B$

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

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

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

14. Alum helps in purifying water by **[2002]**

(a) Forming *Si* complex with clay particles

(b) Sulphate part which combines with the dirt and removes it

(c) Aluminium which coagulates the mud particles

(d) Making mud water soluble

15. The Tyndall effect is observed only when following conditions are satisfied

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

(B) The diameter of the dispersed particles 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

[2017]

(a) (B) and (D) (b) (A) and (C)

(c) (B) and (C) (d) (A) and (D)

5. NEET/ AIPMT/ CBSE-PMT

1. For the adsorption of a gas on a solid, the plot of log (x/m) versus log p is linear with slope equal to **[1994, 2006]**

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

(c) n (d) $1/n$

2. If x is amount of adsorbate and m is amount of adsorbent, which of the following relations is not related to adsorption process **[2011]**

(a) $\frac{x}{m} = p \times T$

(b) $\frac{x}{m} = f(p)$ at constant T

(c) $\frac{x}{m} = f(T)$ at constant p

(d) $p = f(T)$ at constant $\left(\frac{x}{m}\right)$

3. In Freundlich Adsorption isotherm, the value of $1/n$ is **[2012]**

(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

4. Which one of the following characteristics is associated with adsorption **[2016]**

(a) ΔG is negative but ΔH and ΔS are positive

(b) ΔG, ΔH and ΔS all are negative

(c) ΔG and ΔH are negative but ΔS is positive

(d) ΔG and ΔS are negative but ΔH is positive

5. In the reversible reaction a catalyst is the substance which **[1983; 1992]**

(a) Increases the rate of the forward reaction

(b) Decreases the value of enthalpy change in the reaction

(c) Reduces the time required for reaching the equilibrium state in the reaction

(d) Decreases the rate of the reverse reaction

6. According to the adsorption theory of catalysis, the speed of the reaction increases because **[2003]**

(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 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

7. Which one of the following forms micelles in aqueous solution above certain concentration **[2005]**

(a) Urea

(b) Dodecyl trimethyl ammonium chloride

(c) Pyridinium chloride

(d) Glucose

8. An example of an associated colloid is **[2000]**

(a) Milk (b) Soap solution

(c) Rubber latex (d) Vegetable oil

9. Fog is an example of colloidal system **[2016]**

(a) Liquid dispersed in gas (b) Gas dispersed in gas

(c) Solid dispersed in gas (d) Gas dispersed in liquid

10. The suspension of slaked lime in water is known as **[2016]**

(a) Aqueous solution of slaked lime

(b) Limewater

(c) Quicklime

(d) Milk of lime

11. At the critical micelle concentration, the surfactant molecules **[1998]**

(a) Decompose

(b) Dissociate

(c) Associate

(d) Become completely soluble

12. Which of the following forms cationic micelles above certain concentration **[2004]**

(a) Urea

(b) Cetyltrimethylammonium bromide

(c) Sodium dodecyl sulphate

(d) Sodium acetate

13. The purification of the colloidal particles from crystalloid dimensions through semipermeable membrane is known as **[1996]**

(a) Coagulation (b) Dialysis

(c) Ultrafiltration (d) Peptisation

14. Which property of colloids is not dependent on the charge on colloidal particles **[2014; 2015]**

(a) Electro-osmosis (b) Tyndall effect

(c) Coagulation (d) Electrophoresis

15. The coagulation values in millimoles per litre of the electrolytes used for the coagulation of As_2S_3 are given below

I. $(NaCl) = 52$,

II. $(BaCl_2) = 0.69$

III. $(MgSO_4) = 0.22$

The correct order of their coagulating power is **[2016]**

(a) III > I > II (b) I > II > III

(c) II > I > III (d) III > II > I

16. Gold number is **[2012]**

(a) The number of *mg* of lyophilic colloid which should be added to 10 *mL* of ferric hydroxide sol so as to prevent its coagulation by the addition of 1 *mL* of 10% sodium chloride solution

(b) The number of *mg* of lyophilic colloid which should be added to 10 *mL* of standard gold sol so as to prevent its coagulation by the addition of 1 *mL* of 10% *NaCl*

(c) The *mg* of gold salt to be added to a lyophilic colloid to coagulate it

(d) The *mg* of an electrolyte required to coagulate a colloid

17. Gold number is a measure of the **[1989]**

(a) Protective action by a lyophilic colloid on a lyophobic colloid

(b) Protective action by a lyophobic colloid on a lyophilic colloid

(c) Number of *mg* of gold in a standard red gold sol

(d) Stability of gold sol

18. When excess of electrolyte is added to a colloid it **[1989]**

(a) Coagulates (b) Precipitates

(c) Gets diluted (d) Does not change

19. The ability of an ion to bring about coagulation of a given colloid depends upon **[1997]**

(a) Its size

(b) The magnitude of its charge only

(c) The sign of its charge

(d) Both the magnitude and the sign of its charge

20. If the dispersed phase is a liquid and the dispersion medium is a solid, the colloid is known as **[1989]**

(a) A sol (b) An emulsion

(c) A gel (d) A foam

21. On which of the following properties does coagulating power of an ion depend **[2018]**

(a) The magnitude of the charge on the ion alone

(b) Size of the ion alone

(c) Both magnitude and sign of the charge the ion

(d) The sign of charge on the ion alone

6. AIIMS

1. At the high pressure, Langmuir adsorption isotherm takes the form **[2007]**

(a) $\frac{x}{m} = \frac{ap}{1+bp}$ (b) $\frac{x}{m} = \frac{a}{b}$

(c) $\frac{x}{m} = ap$ (d) $\frac{m}{x} = \frac{b}{a} + \frac{1}{ap}$

2. Which of the following statements about a catalyst is true **[1996]**

(a) It lowers the energy of activation

(b) The catalyst altered during the reaction is regenerated

(c) It does not alter the equilibrium

(d) All of these

3. Which of the following processes does not involve a catalyst **[1996]**

(a) Haber's process (b) Thermite process

(c) Ostwald process (d) Contact process

4. The process which is catalysed by one of the products is called **[2000]**

(a) Acid-base catalysis (b) Autocatalysis

(c) Negative catalysis (d) None of these

5. Enzymes with two sites are called **[2002]**

(a) Apoenzyme (b) Holoenzyme

(c) Allosteric enzyme (d) Conjugate enzyme

6. Given below, catalyst and corresponding process/reaction are matched. The mismatch is **[2006]**

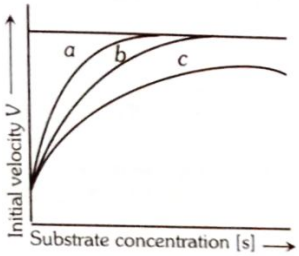
(a) $[RhCl(PPh_3)_2]$: Hydrogenation

(b) $TiCl_4 + Al(C_2H_5)_3$: Polymerization

(c) V_2O_5 : Haber-Bosch process

(d) Nickel : Hydrogenation

7. The figure given below shows three velocity-substrate concentration curves for an enzyme reaction. What do the curves *a*, *b* and *c* depict respectively **[2006]**



(a) *a*-normal enzyme reaction, *b*-competitive inhibition, *c*-non-competitive inhibition,

(b) *a*-enzyme with an allosteric modulator added, *b*-normal enzyme activity, c-competitive inhibition

(c) *a*-enzyme with an allosteric stimulator, *b*-competitive inhibitor added, *c*-normal enzyme reaction

(d) *a*-normal enzyme reaction, *b*-non-competitive inhibitor added, *c*-allosteric inhibitor added

8. Which one of the following is not a surfactant **[2003]**

(a) $CH_3-(CH_2)_{15}-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{N^+}}}}-CH_3Br^-$

(b) $CH_3-(CH_2)_{14}-CH_2-NH_2$

(c) $CH_3-(CH_2)_{16}-CH_2OSO_2^-Na^+$

(d) $OHC-(CH_2)_{14}-CH_2-COO^-Na^+$

9. Size of colloidal particles varies from **[2002]**

(a) 10^{-9} to $10^{-7}\,m$ (b) 10^{-17} to $10^{-9}\,m$

(c) 10^{-7} to $10^{-5}\,m$ (d) 10^{-10} to $10^{-4}\,m$

10. Which of the following is a lyophobic colloidal solution **[2008]**

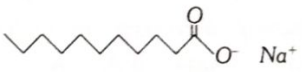
(a) Aqueous starch solution

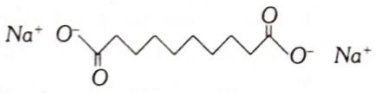
(b) Aqueous protein solution

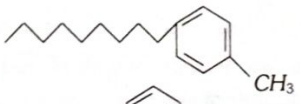
(c) Gold sol

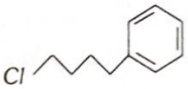
(d) Polymer solvent in some organic solvents

11. Which of the following molecules is most suitable to disperse benzene in water **[2005]**

(a) 

(b) 

(c) 

(d) 

12. Movement of colloidal particles under the influence of electrostatic field is **[2001]**

(a) Electrophoresis (b) Electrolysis

(c) Dialysis (d) Ionisation

13. Which one of the following is not a property of hydrophilic sols **[1983, 84]**

(a) High concentrations of dispersed phase can be easily attained

(b) Coagulation is reversible

(c) Viscosity and surface tension are about the same as for water

(d) The charge of the particle depends on the *pH* values of the medium; it may be positive, negative or even zero

7. Assertion and Reason

Read the assertion and reason carefully to mark the correct option out of the options given below :

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

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

(c) If assertion is true but reason is false.

(d) If the assertion and reason both are false.

(e) If assertion is false but reason is true.

1. Assertion : Deep electric shock causes death of an animal.
   Reason : Electric shock coagulate the blood. **[AIIMS 1995]**

2. Assertion : A catalyst is more effective in finely divided form.
   Reason : Finely divided form has more surface area. **[AIIMS 1998]**

3. Assertion : NH_3 adsorb more readily over activated charcoal than CO_2.
   Reason : NH_3 is non-polar. **[AIIMS 2000]**

4. Assertion : Sky appears blue in colour.
Reason : Colloidal particles of dust scatter blue light. **[AIIMS 2000]**

5. Assertion : Physical absorption of molecules takes place on surface only.
Reason : In this process, the bonds of the absorbed molecules are broken. **[AIIMS 2002]**

6. Assertion : The micelle formed by sodium stearate in water has $-COO^-$ groups at the surface.
Reason : Surface tension of water is reduced by the addition of stearate. **[AIIMS 2003]**

7. Assertion : Aqueous gold colloidal solution is red in colour.
Reason : The colour arises due to scattering of light by colloidal gold particles. **[AIIMS 2004]**

8. Assertion : The conversion of fresh precipitate to colloidal state is called peptization.
Reason : It is caused by addition of common ions. **[AIIMS 2007]**

9. Assertion : Fe^{3+} can be used for coagulation of As_2S_3 sol.
Reason : Fe^{3+} reacts with As_2S_3 to give Fe_2S_3. **[AIIMS 2006]**

10. Assertion : Colloidal solutions are stable but colloidal particles do not settle down.
Reason : Brownian movement counters the force of gravity active on colloidal particles. **[AIIMS 2008]**

22. Surface Chemistry – Answers Keys

1. Adsorption and Adsorption Isotherm

1	a	2	a	3	d	4	d	5	c
6	a	7	c	8	c	9	d	10	c
11	c	12	b	13	d	14	c	15	a
16	a	17	d	18	b	19	c	20	a
21	d	22	c	23	a	24	d	25	d
26	a	27	b	28	d	29	b	30	a
31	d	32	b	33	b	34	c	35	d
36	d	37	c	38	d				

2. Catalyst and Catalysis

1	c	2	a	3	d	4	a	5	c
6	b	7	c	8	d	9	c	10	a
11	c	12	d	13	b	14	d	15	c
16	d	17	d	18	b	19	d	20	b
21	c								

3. Colloids, Emulsion, Gel and their Properties with Application

1	d	2	a	3	b	4	a	5	c
6	c	7	a	8	a	9	c	10	c
11	a	12	c	13	b	14	d	15	b
16	b	17	b	18	b	19	c	20	c
21	c	22	a	23	c	24	b	25	d
26	d	27	b	28	a	29	c	30	c
31	a	32	a	33	b	34	a	35	a
36	d	37	d	38	c	39	a	40	b
41	d	42	a	43	b	44	d	45	c
46	c	47	d	48	a	49	b	50	a
51	d	52	d	53	b	54	c	55	d
56	b	57	a	58	b	59	c	60	b
61	d	62	b	63	a	64	a	65	d
66	b	67	d	68	b	69	c	70	b
71	a	72	a	73	b	74	b	75	c
76	a	77	a	78	d				

4. IIT-JEE/ AIEEE

1	d	2	d	3	c	4	a	5	b
6	b	7	a	8	d	9	c	10	c
11	d	12	b	13	b	14	c	15	a

5. NEET/ AIPMT/ CBSE-PMT

1	d	2	a	3	a	4	b	5	c
6	a	7	b	8	b	9	a	10	d
11	c	12	b	13	b	14	b	15	d
16	b	17	a	18	a	19	d	20	c
21	a								

6. AIIMS

1	b	2	d	3	b	4	b	5	c
6	c	7	a	8	b	9	a	10	c
11	c	12	a	13	c				

7. Assertion & Reason

1	a	2	a	3	c	4	a	5	d
6	b	7	a	8	a	9	c	10	a