18. Solutions – Multiple Choice Questions

1. Solubility

1. The statement " The mass of a gas dissolved in a given mass of a solvent at any temperature is proportional to the pressure of the gas above the solvent" is

(a) Dalton's Law of Partial Pressures

(b) Law of Mass Action

(c) Henry's Law

(d) None of these

2. Out of following which one is not an example of a solution

(a) Air (b) Brass

(c) Amalgam (d) Benzene in water

3. Henry's law constants for aqueous solution of CO, O_2, CO_2 and C_2H_2 gases are respectively at $25°C$ as 58×10^3, 43×10^3, 1.61×10^3 and 1.34×10^3. The solubility of these gases decreases in the order

(a) $CO > O_2 > CO_2 > C_2H_2$ (b) $O_2 > CO_2 > CO > C_2H_2$

(c) $C_2H_2 > CO_2 > O_2 > CO$ (d) $O_2 > CO_2 > C_2H_2 > CO$

4. When a crystal of the solute is introduced into a super saturated solution of the solute

(a) The solute dissolves

(b) The excess solutes crystallizes out

(c) The solution becomes unsaturated

(d) The solution remains super saturated

5. Which of the following units is useful in relating concentration of solution with its vapour pressure

(a) Mole fraction (b) Parts per million

(c) Mass percentage (d) Molality

6. On dissolving sugar in water at room temperature, solution feels cool to touch. Under which of the following cases dissolution of sugar will be most rapid

(a) Sugar crystals in cold water

(b) Sugar crystals in hot water

(c) Powdered sugar in cold water

(d) Powdered sugar in hot water

7. Value of Henry's constant K_H.....

(a) Increases with increase in temperature

(b) Decreases with increase in temperature

(c) Remains constant

(d) First increases then decreases

8. The value of Henry's constant, K_H is .....

(a) Greater for gases with higher solubility

(b) Greater for gases with lower solubility

(c) Constant for all gases

(d) Not related to the solubility of gases

9. K_H value for $Ar(g)$, CO_2 (g), $HCHO$ (g) and $CH_4(g)$ are 40.39, 1.67, 1.83×10^{-5} and 0.413 respectively.

Arrange these gases in the order of their increasing solubility

(a) $HCHO < CH_4 < CO_2 < Ar$

(b) $HCHO < CO_2 < CH_4 < Ar$

(c) $Ar < CO_2 < CH_4 < HCHO$

(d) $Ar < CH_4 < CO_2 < HCHO$

10. When a gas is bubbled through water at $298\,K$, a very dilute solution of the gas is obtained. Henry's law constant for the gas at $298\,K$ is $100\,kbar$. If the gas exerts a partial pressure of 1 bar, the number of millimoles of the gas dissolved in one litre of water is

(a) 0.555 (b) 5.55

(c) 0.0555 (d) 55.5

(e) 5.55×10^{-4}

11. Normal human blood sugar range is $65-105\,mg/dL$. Considering density of human blood is $1.06\,kg/L$, if a patient's sugar level reads $720\,ppm$, his/her blood sugar at that time is

(a) Normal (b) High

(c) Low (d) Cannot say

12. At equilibrium the rate of dissolution of a solid solute in a volatile liquid solvent is.....

(a) Less than the rate of crystallisation

(b) Greater than the rate of crystallisation

(c) Equal to the rate of crystallisation

(d) Zero

13. A beaker contains a solution of substance 'A'. Precipitation of substance 'A' takes place when small amount of 'A' is added to the solution. The solution is.....

(a) Saturated (b) Supersaturated

(c) Unsaturated (d) Concentrated

14. Maximum amount of a solid solute that can be dissolved in a specified amount of a given liquid solvent does not depend upon.....

(a) Temperature (b) Nature of solute

(c) Pressure (d) Nature of solvent

15. Which of the following is not correct for D_2O

(a) Boiling point is higher than H_2O

(b) D_2O reacts slowly than H_2O

(c) Viscosity is higher than H_2O at 25°

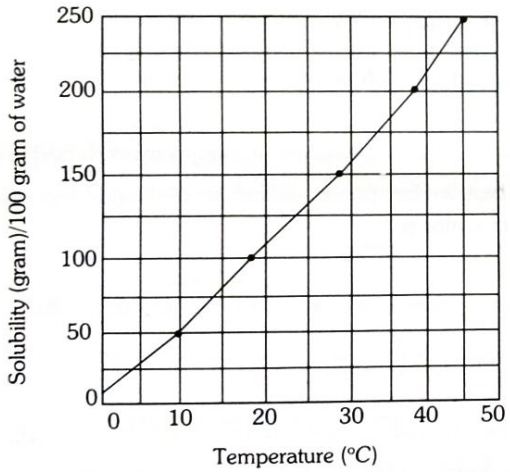
(d) Solubility of $NaCl$ in it is more than H_2O

16. Least soluble gas in water will be

(a) He (b) O_2

(c) NH_3 (d) CO_2

17. The solubility curve of KNO_3 in water is shown below

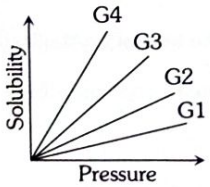


The amount of KNO_3 that dissolves in $50g$ of water at $40^\circ C$ is closest to

(a) $100g$ (b) $150g$

(c) $200g$ (d) $50g$

18. The variation of solubility of four different gases (G1, G2, etc.) in a given solvent with pressure at a constant temperature is shown in the plot



The gas with the highest value of Henry's law constant is

(a) $G4$ (b) $G2$

(c) $G3$ (d) $G1$

2. Methods of Expressing Concentration of Solution

1. The amount of anhydrous Na_2CO_3 present in 250 mL of 0.25 M solution is

(a) 6.225 g (b) 66.25 g

(c) 6.0 g (d) 6.625 g

2. The molarity of a solution made by mixing $50mL$ of conc. H_2SO_4 $(36N)$ with 50 mL of water is

(a) 36 M (b) 18 M

(c) 9 M (d) 6 M

3. 10.6 grams of a substance of molecular weight 106 was dissolved in $100mL$. $10mL$ of this solution was pipetted out into a $1000mL$ flask and made up to the mark with distilled water. The molarity of the resulting solution is

(a) $1.0\,M$ (b) $10^{-2}\,M$

(c) $10^{-3}\,M$ (d) $10^{-4}\,M$

4. To prepare a solution of concentration of 0.03 g/mL of $AgNO_3$, what amount of $AgNO_3$ should be added in 60 mL of solution

(a) 1.8 (b) 0.8

(c) 0.18 (d) None of these

5. Which of the following concentration factor is affected by change in temperature

(a) Molarity (b) Molality

(c) Mole fraction (d) Weight fraction

6. The molarity of a solution of Na_2CO_3 having $10.6g/500mL$ of solution is

(a) $0.2M$ (b) $2M$

(c) $20M$ (d) $0.02M$

7. The concentration of an aqueous solution of $0.01M\ CH_3OH$ solution is very nearly equal to which of the following

(a) $0.01\%\,CH_3OH$ (b) $0.01m\,CH_3OH$

(c) $x_{CH_3OH} = 0.01$ (d) $0.99M\,H_2O$

(e) $0.01N\,CH_3OH$

8. 40% by weight solution will contain how much mass of the solute in 1 L solution, density of the solution is 1.2 g/mL

(a) 480 g (b) 48 g

(c) 38 g (d) 380 g

9. For converting a solution if 100 *mL* KCl of 0.4 *M* concentration into a solution of KCl 0.05 *M* concentration. The quantity of water added is

(a) 900 *mL* (b) 700 *mL*

(c) 500 *mL* (d) 300 *mL*

10. In which ratio of volumes 0.4 *M* HCl and 0.9 *M* HCl are to be mixed such that the concentration of the resultant solution becomes 0.7 *M*

(a) 4 : 9 (b) 2 : 3

(c) 3 : 2 (d) 1 : 1

11. 20 *mL* of HCl solution requires 19.85 *mL* of 0.01 *M* $NaOH$ solution for complete neutralization. The molarity of HCl solution is

(a) 0.0099 (b) 0.099

(c) 0.99 (d) 9.9

12. If 5.85 *g* of $NaCl$ (molecular weight 58.5) is dissolved in water and the solution is made up to 0.5 *litre*, the molarity of the solution will be

(a) 0.2 (b) 0.4

(c) 1.0 (d) 0.1

13. Which statement is true for solution of 0.020 *M* H_2SO_4

(a) 2 *litre* of the solution contains 0.020 *mole* of SO_4^{2-}

(b) 2 *litre* of the solution contains 0.080 *mole* of H_3O^+

(c) 1 *litre* of the solution contains 0.020 *mole* H_3O^+

(d) None of these

14. 25*mL* of a solution of barium hydroxide on titration with a 0.1molar solution of hydrochloric acid gave a *titre* value of 35 *mL*. The molarity of barium hydroxide solution was

(a) 0.07 (b) 0.14

(c) 0.28 (d) 0.35

15. 3.0 molal $NaOH$ solution has a density of 1.110 *g/mL*. The molarity of the solution is

(a) 3.0504 (b) 3.64

(c) 3.05 (d) 2.9732

16. Which of the following should be done in order to prepare 0.40*M* $NaCl$ starting with 100 *mL* of 0.30*M* $NaCl$ (mol. wt. of $NaCl = 58.5$)

(a) Add 0.585 *g* $NaCl$ (b) Add 20 *mL* water

(c) Add 0.010*mL* $NaCl$ (d) Evaporate 10*mC* water

17. The density of a 3*M* sodium thiosulphate ($Na_2S_2O_3$) solution is 1.25 *g / mL*. Calculate the percent by weight of sodium thiosulphate

(a) 12.64% (b) 37.92%

(c) 0.87% (d) 63.21%

18. The molarity of pure water is

(a) 55.6 (b) 5.56

(c) 100 (d) 18

19. If 500 *mL* of a 5 *M* solution is diluted to 1500 *mL*, what will be the molarity of the solution obtained

(a) 1.5 *M* (b) 1.66 *M*

(c) 0.017 *M* (d) 1.59 *M*

20. If the concentration of glucose ($C_6H_{12}O_6$) in blood is 0.9 $g\,L^{-1}$, what will be the molarity of glucose in blood

(a) 5 *M* (b) 50 *M*

(c) 0.005 *M* (d) 0.5 *M*

21. In an experiment it showed that 10 *mL* of 0.05 *M* solution of chloride required 10*mL* of 0.1 *M* solution of $AgNO_3$, which of the following will be the formula of the chloride (X stands for the symbol of the element other than chlorine)

(a) X_2Cl_2 (b) XCl_2

(c) XCl_4 (d) X_2Cl

22. If 10 *mL* of 0.1 *M* aqueous solution of $NaCl$ is divided into 1000 drops of equal volume. What will be the concentration of one drop

(a) 0.01 *M* (b) 0.10 *M*

(c) 0.001 *M* (d) 0.0001 *M*

23. Equal volumes of molar hydrochloric acid and sulphuric acid are neutralised by dilute $NaOH$ solution and *x kcal* and *y kcal* of heat are liberated respectively. Which of the following is true

(a) $x = y$ (b) $x = y/2$

(c) $x = 2y$ (d) None of the above

24. A certain aqueous solution of $FeCl_3$ (formula mass =162) has a density of 1.1 *g / mL* and contains 20.0% $FeCl_3$. Molar concentration of this solution is

(a) 0.028 (b) 0.135

(c) 1.27 (d) 1.47

25. The amount of $K_2Cr_2O_7$ (*eq.* wt. 49.04) required to prepare 100 *mL* of its 0.05 *N* solution is

(a) 2.9424 *g* (b) 0.4904 *g*

(c) 1.4712 *g* (d) 0.2452 *g*

26. With 63 *g* of hydrated oxalic acid how many *L* of $\frac{N}{10}$ solution can be prepared

(a) 100 *L* (b) 10 *L*

(c) 1 *L* (d) 1000 *L*

27. The volume of water to be added to $100cm^3$ of 0.5 *N* H_2SO_4 to get decinormal concentration is

(a) 400 cm^3 (b) 500 cm^3

(c) 450 cm^3 (d) 100 cm^3

28. Two solutions of *HCl*, *A* and *B*, have concentrations of 0.5*N* and 0.1*M* respectively. The volume of solutions *A* and *B* required to make 2 litres of 0.2*N HCl* are

(a) 0.5*L* of *A*+1.5*L* of *B*

(b) 1.5*L* of *A*+0.5*L* of *B*

(c) 1.0*L* of *A*+1.0*L* of *B*

(d) 0.75*L* of *A*+1.25*L* of *B*

29. A solution contains 1.2046×10^{24} hydrochloric acid molecules in one dm^3 of the solution. The strength of the solution is

(a) 6 *N* (b) 2 *N*

(c) 4 *N* (d) 8 *N*

30. 20 *mL* of 10 *N HCl* are mixed with 10 *mL* of 36 *N* H_2SO_4 and the mixture is made one litre. Normality of the mixture will be

(a) 0.56 *N* (b) 0.50 *N*

(c) 0.40 *N* (d) 0.35 *N*

31. 35.4 *mL* of *HCl* is required for the neutralization of a solution containing 0.275 *g* of sodium hydroxide. The normality of hydrochloric acid is

(a) 0.97 *N* (b) 0.142 *N*

(c) 0.194 *N* (d) 0.244 *N*

32. Assuming that sea water is an aqueous solution of *NaCl* its density is 1.025 *g/mL* at 20°C and *NaCl* concentration is 3.5% (by mass), the normality of the sea water is

(a) 0.65 *N* (b) 0.68 *N*

(c) 0.66 *N* (d) 0.61 *N*

33. 5 *mL* of *N HCl*, 20 *mL* of *N*/2 H_2SO_4 and 30 *mL* of *N*/3 HNO_3 are mixed together and volume made to one litre. The normality of the resulting solution is

(a) $\frac{N}{5}$ (b) $\frac{N}{10}$

(c) $\frac{N}{20}$ (d) $\frac{N}{40}$

(e) $\frac{N}{25}$

34. *NaClO* solution reacts with H_2SO_3 as, $NaClO + H_2SO_3 \rightarrow NaCl + H_2SO_4$. A solution of *NaClO* used in the above reaction contained 15*g* of *NaClO* per litre. The normality of the solution would be

(a) 0.8 (b) 0.6

(c) 0.2 (d) 0.4

35. When a solute is present in trace quantities, the following expression is used

(a) Gram per million (b) Milligram percent

(c) Microgram percent (d) Nano gram percent

(e) Parts per million

36. The mole fraction of water in 20% aqueous solution (By weight) of H_2O_2 is

(a) $\frac{77}{68}$ (b) $\frac{68}{77}$

(c) $\frac{20}{80}$ (d) $\frac{80}{20}$

37. 1000 *gms* aqueous solution of $CaCO_3$ contains 10 *gms* of carbonate. Concentration of the solution is

(a) 10 *ppm* (b) 100 *ppm*

(c) 1000 *ppm* (d) 10000 *ppm*

38. When 6*g* urea dissolve in 180 *g* H_2O. The mole fraction of urea is

(a) $\frac{10}{10.1}$ (b) $\frac{10.1}{10}$

(c) $\frac{10.1}{0.1}$ (d) $\frac{0.1}{10.1}$

39. Molarity of H_2SO_4 is 18 *M*. Its density is 1.8 *g/mL*. Hence molality is

(a) 36 (b) 200

(c) 500 (d) 18

40. Calculate the molality of 1 *litre* solution of 93% H_2SO_4 (weight/volume). The density of the solution is 1.84 g /mL.

(a) 10.43 (b) 20.36

(c) 12.05 (d) 14.05

41. Density of a 2.05 M solution of acetic acid in water is 1.02 g/mL. The molality of the solution is

(a) $1.14 mol\, kg^{-1}$ (b) $3.28 mol\, kg^{-1}$

(c) $2.28 mol\, kg^{-1}$ (d) $0.44 mol\, kg^{-1}$

42. 4 L of 0.02 M aqueous solution of $NaCl$ was diluted by adding 1 L of water. The molality of the resultant solution is

(a) 0.004 (b) 0.008

(c) 0.012 (d) 0.016

43. 25 g of a solute of molar mass 250 $g\ mol^{-1}$ is dissolved in 100 mL of water to obtain a solution whose density is 1.25 $g\ mL^{-1}$. The molarity and molality of the solution are respectively

(a) 0.75 and 1 (b) 0.8 and 1

(c) 1 and 0.8 (d) 1 and 0.75

44. What will be the molality of the solution containing 18.25 g of HCl gas in 500 g of water

(a) $0.1m$ (b) $1M$

(c) $0.5m$ (d) $1m$

45. The weight percent of sucrose (Formula weight = 342 $g\ mol^{-1}$) in an aqueous solution is 3.42. The density of the solution is $1 g mL^{-1}$, the concentration of sucrose in the solution in $mol\, L^{-1}$ is

(a) 0.01 (b) 0.1

(c) 1.0 (d) 10

3. Colligative Properties

1. Which of the following is a colligative property

(a) Osmotic pressure (b) Boiling point

(c) Vapour pressure (d) Freezing point

2. The colligative properties of a solution depend on

(a) Nature of solute particles present in it

(b) Nature of solvent used

(c) Number of solute particles present in it

(d) Number of moles of solvent only

3. Which of the following statements is false

(a) Two different solutions of sucrose of same molality prepared in different solvents will have the same depression in freezing point

(b) The osmotic pressure of a solution is given by the equation $\pi = CRT$ (where, C is the molarity of the solution)

(c) Decreasing order of osmotic pressure for 0.01 M aqueous solutions of barium chloride, potassium chloride, acetic acid and sucrose is $BaCl_2 > KCl > CH_3COOH >$ sucrose

(d) According to Raoult's law, the vapour pressure exerted by a non volatile component of a solution is directly proportional to its mole fraction in the solution

4. The magnitude of colligative properties in all colloidal dispersions is ..... than solution

(a) Lower (b) Higher

(c) Both (d) None

5. Which has highest freezing point

(a) 1 m $K_4[Fe(CN)_6]$ solution

(b) 1 m $C_6H_{12}O_6$ solution

(c) 1 m KCl solution

(d) 1 m rock salt solution

6. Colligative properties are used for the determination of

(a) Molar Mass

(b) Equivalent weight

(c) Arrangement of molecules

(d) Melting point and boiling point

(e) Both (a) and (b)

7. Which colligative property is more useful to determine the molecular weight of the substances like proteins and polymers

(a) Lowering of vapour pressure

(b) Elevation in boiling point

(c) Depression of freezing point

(d) Osmotic pressure

4. Lowering of Vapour Pressure

1. When a substance is dissolved in a solvent, the vapour pressure of the solvent is decreased. This results in

(a) An increase in the boiling point of the solution

(b) A decrease in the boiling point of solvent

(c) The solution having a higher freezing point than the solvent

(d) The solution having a lower osmotic pressure than the solvent

2. 60 g of Urea (*Mol. wt* 60) was dissolved in 9.9 *moles* of water. If the vapour pressure of pure water is P_o, the vapour pressure of solution is

(a) 0.10 P_o (b) 1.10 P_o

(c) 0.90 P_o (d) 0.99 P_o

3. Which of the following can be measured by the Ostwald–Walker dynamic method

(a) Vapour pressure of the solvent

(b) Relative lowering of vapour pressure

(c) Lowering of vapour pressure

(d) All of these

4. The mass of a non–volatile solute of molar mass 40 $g\,mol^{-1}$ that should be dissolved in 114 g of octane to lower its vapour pressure by 20% is

(a) 10 g (b) 11.4 g

(c) 9.8 g (d) 12.8 g

5. If P^0 and P are the vapour pressure of the pure solvent and solution and n_1 and n_2 are the moles of solute and solvent respectively in the solution then the correct relation between P and P^0 is

(a) $P^0 = P\left[\frac{n_1}{n_1+n_2}\right]$ (b) $P^0 = P\left[\frac{n_2}{n_1+n_2}\right]$

(c) $P = P^0\left[\frac{n_2}{n_1+n_2}\right]$ (d) $P = P^0\left[\frac{n_1}{n_1+n_2}\right]$

6. For a non-volatile solute

(a) Vapour pressure of solute is zero

(b) Vapour pressure of solvent is zero

(c) Vapour pressure of solution is more than vapour pressure of solvent

(d) All of the options

7. A solution is obtained by dissolving 12 g of urea (*mol.wt.*60) in a *litre* of water. Another solution is obtained by dissolving 68.4 g of cane-sugar (*mol.wt.* 342) in a *litre* of water at the same temperature. The lowering of vapour pressure in the first solution is

(a) Same as that of 2nd solution

(b) Nearly one-fifth of the 2nd solution

(c) Double that of 2nd solution

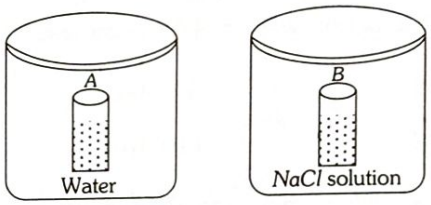
(d) Nearly five times that of 2nd solution

8. Equal weights of CH_4 and H_2 are mixed in an empty container at 25^0C. The fraction of the total pressure exerted by H_2 is

(a) 1/9 (b) 1/2

(c) 8/9 (d) 16/17

9. Two beakers of capacity 500 mL were taken. One of these beakers, labelled as "A", was filled with 400 mL water whereas the beaker labelled "B" was filled with 400 mL of $2M$ solution of $NaCl$. At the same temperature both the beakers were placed in closed containers of same material and same capacity as shown in figure



At a given temperature, which of the following statement is correct about the vapour pressure of pure water and that of $NaCl$ solution

(a) Vapour pressure in container (A) is more than that in container (B)

(b) Vapour pressure in container (A) is less than that in container (B)

(c) Vapour pressure is equal in both the containers

(d) Vapour pressure in container (B) is twice the vapour pressure in container (A)

10. An aqueous solution of methanol in water has vapour pressure

(a) Equal to that of water

(b) Equal to that of methanol

(c) More than that of water

(d) Less than that of water

11. An ideal solution was obtained by mixing methanol and ethanol. If the partial vapour pressure of methanol and ethanol are 2.619 kPa and 4.556 kPa respectively, the composition of the vapour (in terms of mole fraction) will be

(a) 0.635 methanol, 0.365 ethanol

(b) 0.365 methanol, 0.635 ethanol

(c) 0.574 methanol, 0.326 ethanol

(d) 0.173 methanol, 0.827 ethanol

12. Which has maximum vapour pressure

(a) HI (b) HBr

(c) HCl (d) HF

13. If two substances A and B have $P_A^0 : P_B^0 = 1:2$ and have mole fraction in solution 1 : 2 then mole fraction of A in vapours

(a) 0.33 (b) 0.25

(c) 0.52 (d) 0.2

14. Vapour pressure increases with increase in

(a) Concentration of solution containing non–volatile solute

(b) Temperature upto boiling point

(c) Temperature upto triple point

(d) Altitude of the concerned place of boiling

15. Pick out the wrong statement(s)

1. Vapour pressure of a liquid is the measure of the strength of intermolecular attractive forces
2. Surface tension of a liquid acts perpendicular to the surface of the liquid
3. Vapour pressure of all liquids is same at their freezing points
4. Liquids with stronger intermolecular attractive forces are more viscous than those with weaker intermolecular forces

(a) 2, 3 and 4 (b) 2 and 3

(c) 1, 2 and 3 (d) 3 only

(e) 2 only

16. Low concentration of oxygen in the blood and tissues of people living at high altitude is due to.....

(a) Low temperature

(b) Low atmospheric pressure

(c) High atmospheric pressure

(d) Both low temperature and high atmospheric pressure

17. Which values can be obtained from the information represented by the vapour pressure curve of a liquid

A. Normal boiling point

B. Normal freezing point

C. Enthalpy of vaporization

(a) A only (b) A and B only

(c) A and C only (d) A, B and C

5. Ideal and Non-ideal Solution

1. A solution with negative deviation among the following is

(a) Ethanol-Acetone

(b) Chlorobenzene-Bromobenzene

(c) Chloroform-Acetone

(d) Benzene-Toluene

2. One component of a solution follows Raoult's law over the entire range $0 \le x_1 \le 1$. The second component must follow Raoult's law in the range when x_2 is

(a) Close to zero (b) Close to 1

(c) $0 \le x_2 \le 0.5$ (d) $0 \le x_2 \le 1$

3. Considering the formation, breaking and strength of hydrogen bond, predict which of the following mixtures will show a positive deviation from Raoult's law

(a) Methanol and acetone (b) Chloroform and acetone

(c) Nitric acid and water (d) Phenol and aniline

4. On the basis of information given below mark the correct option

Information :

(i) In bromoethane and chloroethane mixture intermolecular interactions of $A-A$ and $B-B$ type are nearly same as $A-B$ type interactions

(ii) In ethanol and acetone mixture $A-A$ or $B-B$ type intermolecular interactions are stronger than $A-B$ type interactions

(iii) In chloroform and acetone mixture $A-A$ or $B-B$ type intermolecular interactions are weaker than $A-B$ type interactions

(a) Solution (ii) and (iii) will follow Raoult's law

(b) Solution (i) will follow Raoult's law

(c) Solution (ii) will show negative deviation from Raoult's law

(d) Solution (iii) will show positive deviation from Raoult's law

5. Which of the following does not show positive deviation from Raoult's law

(a) Benzene-Chloroform

(b) Benzene-Acetone

(c) Benzene-Ethanol

(d) Benzene-Carbon tetrachloride

6. All form ideal solutions except

(a) C_2H_5Br and C_2H_5I (b) C_6H_5Cl and C_6H_5Br

(c) C_6H_6 and $C_6H_5CH_3$ (d) C_2H_5I and C_2H_5OH

7. Which property is shown by an ideal solution

(a) It follows Raoult's law (b) $\Delta H_{mix} = 0$

(c) $\Delta V_{mix} = 0$ (d) All of these

8. Which of the following is not correct for ideal solution

(a) $\Delta S_{mix} = 0$ (b) $\Delta H_{mix} = 0$

(c) It obeys Raoult's law (d) $\Delta V_{mix} = 0$

9. A non ideal solution was prepared by mixing 30 *mL* chloroform and 50 *mL* acetone. The volume of mixture will be

(a) $> 80\ mL$ (b) $< 80\ mL$

(c) $= 80\ mL$ (d) $\geq 80\ mL$

10. When two liquid A and B are mixed then their boiling points becomes greater than both of them. What is the nature of this solution

(a) Ideal solution

(b) Positive deviation with non ideal solution

(c) Negative deviation with non ideal solution

(d) Normal solution

11. Which one of the following non-ideal solutions shows the negative deviation

(a) $CH_3COCH_3 + CS_2$

(b) $C_6H_6 + CH_3COCH_3$

(c) $CCl_4 + CHCl_3$

(d) $CH_3COCH_3 + CHCl_3$

12. Assuming ideal behaviour, the change enthalpy and volume of mixing of two liquids, respectively, are

(a) Zero and zero (b) +ve and zero

(c) –ve and zero (d) –ve and –ve

6. Azeotropic Mixture

1. Which will form maximum boiling point azeotrope

(a) $HNO_3 + H_2O$ solution

(b) $C_2H_5OH + H_2O$ solution

(c) $C_6H_6 + C_6H_5CH_3$ solution

(d) None of these

2. The system that forms maximum boiling azeotrope is

(a) Carbondisulphide-acetone

(b) Benzene - toluene

(c) Acetone - chloroform

(d) *n*-hexane - *n*-heptane

(e) Ethanol – acetone

3. Which one of the following mixtures can be separated into pure components by fractional distillation

(a) Benzene – toluene (b) Water – ethyl alcohol

(c) Water – nitric acid (d) Water – hydrochloric acid

4. If two liquids *A* and *B* form minimum boiling azeotrope at some specific composition then

(a) $A-B$ interactions are stronger than those between $A-A$ or $B-B$

(b) Vapour pressure of solution increase because more number of molecules of liquids *A* and *B* can escape from the solution

(c) Vapour pressure of solution decreases because less number of molecules of only one of the liquids escape from the solution

(d) $A-B$ interactions are weaker than those between $A-A$ or $B-B$

5. On the basis of information given below mark the correct option

Information : On adding acetone to methanol some of the hydrogen bonds between methanol molecules break

(a) At specific composition methanol-acetone mixture will form minimum boiling azeotrope and will show positive deviation from Raoult's law

(b) At specific composition methanol-acetone mixture will form maximum boiling azetrope and will show positive deviation from Raoult's law

(c) At specific composition methanol-acetone mixture will form minimum boiling azeotrope and will show negative deviation from Raoult's law

(d) At specific composition methanol-acetone mixture will form maximum boiling azeotrope and will show negative deviation from Raoult's law

7. Osmosis and Osmotic Pressure of the Solution

1. The osmotic pressure of a 5% (*wt/vol*) solution of cane sugar at $150^\circ C$ is

(a) 2.45 *atm* (b) 5.078 *atm*

(c) 3.4 *atm* (d) 4 *atm*

2. Two solutions *A* and *B* are separated by semi- permeable membrane. If liquid flows form *A* to *B* then

(a) *A* is less concentrated than *B*

(b) *A* is more concentrated than *B*

(c) Both have same concentration

(d) None of these

3. What would happen if a thin slice of sugar beet is placed in a concentrated solution of *NaCl*

(a) Sugar beet will lose water from its cells

(b) Sugar beet will absorb water from solution

(c) Sugar beet will neither absorb nor lose water

(d) Sugar beet will dissolve in solution

4. Isotonic solutions have

(a) Equal temperature (b) Equal osmotic pressure

(c) Equal volume (d) Equal amount of solute

5. A 5% solution of sugarcane (Mol. wt. = 342) is isotonic with 1% solution of X under similar conditions. The mol. wt. of X is

(a) 136.2 (b) 68.4

(c) 34.2 (d) 171.2

6. Which has minimum osmotic pressure

(a) 200 mL of 2 M $NaCl$ solution

(b) 200 mL of 1 M glucose solution

(c) 200 mL of 2 M urea solution

(d) All have same osmotic pressure

7. Two solutions of KNO_3 and CH_3COOH are prepared separately. Molarity of both is $0.1M$ and osmotic pressures are P_1 and P_2 respectively. The correct relationship between the osmotic pressures is

(a) $P_2 > P_1$ (b) $P_1 = P_2$

(c) $P_1 > P_2$ (d) $\frac{P_1}{P_1 + P_2} = \frac{P_2}{P_1 + P_2}$

8. Osmotic pressure of a urea solution at $10°C$ is 500 mm. Osmotic pressure of the solution become 105.3 mm. when it is diluted and temperature raised to $25°C$. The extent of dilution is

(a) 6 Times (b) 5 Times

(c) 7 Times (d) 4 Times

9. At temperature 327°C and concentration C, osmotic pressure of a solution is P. The same solutions at concentration $C/2$ and a temperature 427°C shows osmotic pressure 2 atm, value of P will be

(a) $\frac{12}{7}$ (b) $\frac{24}{7}$

(c) $\frac{6}{5}$ (d) $\frac{5}{6}$

10. 0.1 M $NaCl$ and 0.05 M $BaCl_2$ solutions are separated by a semi-permeable membrane in a container. For this system, choose the correct answer

(a) There is no movement of any solution across the membrane

(b) Water flows from $BaCl_2$ solution towards $NaCl$ solution

(c) Water flows from $NaCl$ solution towards $BaCl_2$ solution

(d) Osmotic pressure of 0.1 M $NaCl$ is lower than the osmotic pressure of $BaCl_2$ (Assume complete dissociation)

11. For getting accurate value of molar mass of a solute by osmotic pressure measurement

(a) The solute must be volatile

(b) The solution concentration must be high

(c) The solute should undergo dissociation

(d) The solute must be non-volatile

12. Desalination of sea water can be done by

(a) Osmosis (b) Reverse osmosis

(c) Filtration (d) Diffusion

13. Osmotic pressure of the solution can be increased by

(a) Increasing the temperature of the solution

(b) Decreasing the temperature of the solution

(c) Increasing the volume of the vessel

(d) Diluting the solution

14. The empirical formula of a non-electrolyte is CH_2O. A solution containing $6g$ of the compound exerts the same osmotic pressure as that of $0.05M$ glucose solution at the same temperature. The molecular formula of the compound is

(a) $C_2H_4O_2$ (b) $C_3H_6O_3$

(c) $C_5H_{10}O_5$ (d) $C_4H_8O_4$

15. An unripe mango placed in a concentrated salt solution to prepare pickle, shrivels because.....

(a) It gains water due to osmosis

(b) It loses water due to reverse osmosis

(c) It gains water due to reverse osmosis

(d) It loses water due to osmosis

16. Which of the following statements is false

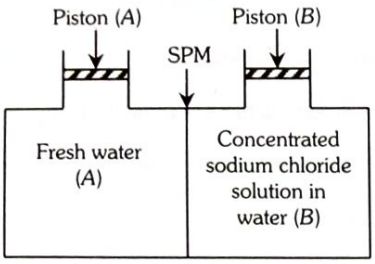
(a) Units of atmospheric pressure and osmotic pressure are the same

(b) In reverse osmosis, solvent molecules move through a semipermeable membrane from a region of lower concentration of solute to a region of higher concentration

(c) The value of molal depression constant depends on nature of solvent

(d) Relative lowering of vapour pressure, is a dimensionless quantity

17. Consider the figure and mark the correct option



(a) Water will move from side (*A*) to side (*B*) if a pressure lower osmotic pressure is applied on piston (*B*)

(b) Water will move from side (*B*) to side (*A*) if a pressure greater than osmotic pressure is applied on piston (*B*)

(c) Water will move from side (*B*) to side (*A*) if a pressure equal to osmotic pressure is applied on piston (*B*)

(d) Water will move from side (*A*) to side (*B*) if pressure equal to osmotic pressure is applied on piston (*A*)

18. Blood is isotonic with

(a) 0.16 M *NaCl* (b) Conc. *NaCl*

(c) 50 % *NaCl* (d) 30 % *NaCl*

19. The chemical composition of semipermeable membrane is

(a) Calcium sulphate (b) Barium oxalate

(c) Nickel phosphate (d) Copper ferrocyanide

20. Osmotic pressure of a solution can be measured quickly and accurately by

(a) Berkeley and Hartley's method

(b) Morse's method

(c) Pfeffer's method

(d) De Vries method

21. Which of the following associated with isotonic solutions is not correct

(a) They will have the same osmotic pressure

(b) They have the same weight concentrations

(c) Osmosis does not take place when the two solutions are separated by a semipermeable membrane

(d) They will have the same vapour pressure

22. At low concentrations, the statement that equimolal solutions under a given set of experimental conditions have equal osmotic pressure is true for

(a) All solutions

(b) Solutions of non-electrolytes only

(c) Solutions of electrolytes only

(d) None of these

23. Solution *A* contains 7 *g/L* of $MgCl_2$ and solution *B* contains 7 *g/L* of *NaCl*. At room temperature, the osmotic pressure of

(a) Solution *A* is greater than *B*

(b) Both have same osmotic pressure

(c) Solution *B* is greater than *A*

(d) Can't determine

24. If molecular weight of compound is increased then sensitivity is decreased in which of the following methods

(a) Elevation in boiling point (b) Viscosity

(c) Osmosis (d) Dialysis

25. Which of the following acts as best semipermeable membrane

(a) Parchment paper (b) $Cu_2[Fe(CN)_6]$

(c) Plant cell wall (d) Cellophane

26. At a certain temperature, the value of the slope of the plot of osmotic pressure (π) against concentration (C *in mol* L^{-1}) of a certain polymer solution is 291R. The temperature at which osmotic pressure is measured is (R is gas constant)

(a) 271°C (b) 18°C

(c) 564 *K* (d) 18 *K*

27. What will happen if a cell is placed into 0.4% (mass/volume) *NaCl* solution

(a) Cell will swell

(b) Cell will shrink

(c) There will be no change in cell volume

(d) Cell will dissolve

8. Elevation of Boiling Point of the Solvent

1. If for a sucrose solution elevation in boiling point is 0.1°C then what will be the boiling point of *NaCl* solution for same molal concentration

(a) 0.1°C (b) 0.2°C

(c) 0.08°C (d) 0.01°C

2. The temperature, at which the vapour pressure of a liquid becomes equal to the atmospheric pressure is known as

(a) Freezing point (b) Boiling point

(c) Absolute temperature (d) None of these

3. The molal elevation or ebullioscopic constant for water is

(a) 1.86 *K molality*$^{-1}$ (b) 526 *K molality*$^{-1}$

(c) 55.5 *K molality* (d) 0.52 *K molality*$^{-1}$

4. 58.5 g of $NaCl$ and 180 g of glucose were separately dissolved in 1000 mL of water. Identify the correct statement regarding the elevation of boiling point (b.pt.) of the resulting solutions

(a) $NaCl$ solution will show higher elevation of b.pt.

(b) Glucose solution will show higher elevation of b.pt.

(c) Both the solutions will show equal elevation of b.pt.

(d) The b.pt. of elevation will be shown by neither of the solutions

5. A liquid can exist only

(a) Between triple point and critical point

(b) At any temperature above melting point

(c) Between melting point and critical point

(d) Between boiling and melting points

6. The unit of ebullioscopic constant is

(a) $K\,kg\,mol^{-1}$ or $K\,(molality)^{-1}$

(b) $mol\,kg\,K^{-1}$ or $K^{-1}(molality)$

(c) $kg\,mol^{-1}K^{-1}$ or $K^{-1}(molality)^{-1}$

(d) $K\,mol\,kg^{-1}$ or $K(molality)$

7. During the evaporation of liquid

(a) The temperature of the liquid will rise

(b) The temperature of the liquid will fall

(c) May rise or fall depending on the nature

(d) The temperature remains unaffected

9. Depression of Freezing Point of the Solvent

1. 1% solution of $Ca(NO_3)_2$ has freezing point

(a) $0°C$ (b) Less than $0°C$

(c) Greater than $0°C$ (d) None of the above

2. In countries nearer to polar region, the roads are sprinkled with $CaCl_2$. This is

(a) To minimise the snow fall

(b) To minimise pollution

(c) To minimise the accumulation of dust on the road

(d) To minimise the wear and tear of the roads

3. What happens to freezing point of benzene when naphthalene is added

(a) Increases

(b) Decreases

(c) Remains unchanged

(d) First decreases and then increases

4. The two isomers X and Y with the formula $Cr(H_2O)_5ClBr_2$ were taken for experiment on depression in freezing point. It was found that one mole of X gave depression corresponding to 2 moles of particles and one mole of Y gave depression due to 3 moles of particles. The structural formulae of X and Y respectively are

(a) $[Cr(H_2O)_5Cl]Br_2$; $[Cr(H_2O)_4Br_2]Cl.H_2O$

(b) $[Cr(H_2O)_5Cl]Br_2$; $[Cr(H_2O)_3ClBr_2].2H_2O$

(c) $[Cr(H_2O)_5Br]Br\,Cl$; $[Cr(H_2O)_4ClBr]Br.H_2O$

(d) $[Cr(H_2O)_5Cl]Br_2$; $[Cr(H_2O)_4ClBr]Br.H_2O$

(e) $[Cr(H_2O)_4Br_2]Cl.H_2O$; $[Cr(H_2O)_5Cl]Br_2$

5. Pure benzene freezes at $5.3°C$. A solution of 0.223 g of phenylacetic acid $(C_6H_5CH_2COOH)$ in 4.4 g of benzene $(K_f = 5.12K\,kg\,mol^{-1})$ freezes at 4.47°C. From this observation, one can conclude that

(a) Phenylacetic acid exists as such in benzene

(b) Phenylacetic acid undergoes partial ionization in benzene

(c) Phenylacetic acid undergoes complete ionization in benzene

(d) Phenylacetic acid dimerizes in benzene

6. The change of energy on freezing $1.00kg$ of liquid water at $0°C$ and $1\,atm$ is

(a) $236.7kJ\,kg^{-1}$ (b) $333.4kJ\,kg^{-1}$

(c) $-333.4kJ\,kg^{-1}$ (d) $-236.7kJ\,kg^{-1}$

7. Heavy water freezes at

(a) $0°C$ (b) $3.8°C$

(c) $38°C$ (d) $-0.38°C$

10. Colligative Properties of Electrolyte

1. The osmotic pressure of which solution is maximum (consider that deci-molar solution of each 90% dissociated)

(a) Aluminium sulphate

(b) Barium chloride

(c) Sodium sulphate

(d) A mixture of equal volumes of (b) and (c)

2. $0.01M$ solution each of urea, common salt and Na_2SO_4 are taken, the ratio of depression of freezing point is

(a) 1 : 1 : 1 (b) 1 : 2 : 1

(c) 1 : 2 : 3 (d) 2 : 2 : 3

3. Which has the minimum freezing point

(a) One molal $NaCl$ solution

(b) One molal KCl solution

(c) One molal $CaCl_2$ solution

(d) One molal urea solution

4. The correct order of increasing boiling points of the following aqueous solutions

$0.0001\,M\,NaCl$ (I), $0.0001\,M$ Urea (II),

$0.001\,M\,MgCl_2$ (III), $0.01\,M\,NaCl$ (IV) is

(a) I < II < III < IV (b) IV < III < II < I

(c) II < I < III < IV (d) III < II < IV < I

5. Observe the following abbreviations

π_{obs} = observed colligative property

π_{cal} = theoretical colligative property assuming normal behaviour of solute. Van't Haff factor (i) is given by

(a) $i = \pi_{obs} \times \pi_{cal}$ (b) $i = \pi_{obs} + \pi_{cal}$

(c) $i = \pi_{obs} - \pi_{cal}$ (d) $i = \frac{\pi_{obs}}{\pi_{cal}}$

6. A 1.2 g/L of solution of $NaCl$ is isotonic with 7.2 g/L of solution of glucose. Calculate the van't Hoff's factor of $NaCl$ solution

(a) 2.36 (b) 1.50

(c) 1.95 (d) 1.00

7. In comparison to a 0.01 M solution of glucose, the depression in freezing point of a 0.01 $M\,MgCl_2$ solution is.....

(a) The same (b) About twice

(c) About three times (d) About six times

8. The values of van't Hoff factors for KCl, $NaCl$ and K_2SO_4 respectively are.....

(a) 2, 2 and 2 (b) 2, 2 and 3

(c) 1, 1 and 2 (d) 1, 1 and 1

9. Which of the following has the lowest freezing point

(a) 0.1 m sucrose (b) 0.1 m urea

(c) 0.1 m ethanol (d) 0.1 m glucose

10. Four solutions of K_2SO_4 with the following concentration $0.1m$, $0.01m$, $0.001m$ and $0.0001m$ are available. The maximum value of van't Hoff factor, i, corresponds to

(a) $0.0001m$ solution (b) 0.001 m solution

(c) 0.01 m solution (d) 0.1 m solution

11. A 0.001 molal solution of $[Pt(NH_3)_4Cl_4]$ in water had a freezing point depression of $0.0054^\circ C$. If K_f for water is 1.80, the correct formulation for the above molecule is

(a) $[Pt(NH_3)_4Cl_3]Cl$ (b) $[Pt(NH_3)_4Cl_2]Cl_2$

(c) $[Pt(NH_3)_4Cl]Cl_3$ (d) $[Pt(NH_3)_4Cl_4]$

12. Ammonia undergoes self dissociation according to the reaction $2NH_{3(l)} \rightleftharpoons NH_{4(am)}^{+} + NH_{2(am)}^{-}$ where am, stands for ammoniated. When $1\,mol$ of NH_4Cl is dissolved in $1\,kg$ of liquid ammonia, the b.p. at 760 torr is observed as $-32.7^\circ C$ (normal boiling b.p. of $NH_{3(l)}$ is $-33.4^\circ C$) ($k_b = 0.35$). What conclusion is reached about the nature of the solution

(a) NH_4Cl is completely dissociated in NH_3

(b) NH_4Cl is partially dissociated in NH_3

(c) NH_4Cl is not dissociated in NH_3

(d) Boiling point is not raised

13. We have three aqueous solutions of $NaCl$ labelled as 'A', 'B' and 'C' with concentrations 0.1 M, 0.01 M and 0.001 M, respectively. The value of van't Hoff factor for these solutions will be in the order.....

(a) $i_A < i_B < i_C$ (b) $i_A > i_B > i_C$

(c) $i_A = i_B = i_C$ (d) $i_A < i_B > i_C$

14. What will be the correct order of vapour pressure of water, acetone and ether at $30^\circ C$? Given that among these compounds, water has maximum boiling point and either has minimum boiling point

(a) Water<ether<acetone (b) Water<acetone<ether

(c) Ether<acetone<water (d) Acetone<ether<water

15. The boiling points of 0.01 M aqueous solution of sucrose, $NaCl$ and $CaCl_2$ would be

(a) The same

(b) Highest for sucrose solution

(c) Highest for $NaCl$ solution

(d) Highest for $CaCl_2$ solution

11. Abnormal Molecular Mass

1. Acetic acid dissolved in benzene shows a molecular weight of

(a) 60 (b) 120

(c) 180 (d) 240

2. Van't Hoff factor of centimolal solution of $K_3[Fe(CN)_6]$ is 3.333. Calculate the percent dissociation of $K_3[Fe(CN)_6]$

(a) 33.33 (b) 0.78

(c) 78 (d) 23.33

3. The molecular mass of acetic acid dissolved in water is 60 and when dissolved in benzene it is 120.This difference in behaviour of CH_3COOH is because

(a) Water prevents association of acetic acid

(b) Acetic acid does not fully dissolve in water

(c) Acetic acid fully dissolves in benzene

(d) Acetic acid does not ionize in benzene

12. IIT-JEE/AIEEE

1. The Henry's law constant for the solubility of N_2 gas in water at 298 K is 1.0×10^5 atm. The mole fraction of N_2 in air is 0.8. The number of moles of N_2 from air dissolved in 10 moles of water at 298 K and 5 atm pressure is **[2009]**

(a) 4.0×10^{-4} (b) 4.0×10^{-5}

(c) 5.0×10^{-4} (d) 4.0×10^{-6}

2. Two solutions of a substance (non electrolyte) are mixed in the following manner 480 mL of 1.5M first solution + 520 mL of 1.2M second solution. What is the molarity of the final mixture **[2005]**

(a) 1.20 M (b) 1.50 M

(c) 1.344 M (d) 2.70 M

3. The molarity of a solution obtained by mixing 800 mL of 0.5 M HCl with 200 mL of 1 M HCl will be **[2013]**

(a) 0.8 M (b) 0.6 M

(c) 0.4 M (d) 0.2 M

4. Dissolving 120g of urea (mol. wt. 60) in 1000g of water gave a solution of density 1.15g/mL. The molarity of the solution is **[2011]**

(a) 1.78 M (b) 2.00 M

(c) 2.05 M (d) 2.22 M

5. To neutralise completely 20 mL of 0.1 M aqueous solution of phosphorous acid (H_3PO_3), the volume of 0.1 M aqueous KOH solution required is **[2004]**

(a) 40 mL (b) 20 mL

(c) 10 mL (d) 60 mL

6. A molal solution is one that contains one mole of a solute in **[1986]**

(a) 1000 g of the solvent (b) One litre of the solvent

(c) One litre of the solution (d) 22.4 litres of the solution

7. With increase of temperature, which of these changes **[2002]**

(a) Molality

(b) Weight fraction of solute

(c) Fraction of solute present in water

(d) Mole fraction

8. A 5.2 molal aqueous solution of methyl alcohol, CH_3OH, is supplied. What is the mole fraction of methyl alcohol in the solution **[2011]**

(a) 0.100 (b) 0.190

(c) 0.086 (d) 0.050

9. Equimolal solutions in the same solvent have **[2005]**

(a) Same boiling point but different freezing point

(b) Same freezing point but different boiling point

(c) Same boiling and same freezing points

(d) Different boiling and different freezing points

10. Two liquids X and Y form an ideal solution. At 300 K, vapour pressure of the solution containing 1 mol of X and 3 mol of Y is 550 $mmHg$. At the same temperature, if 1mol of Y is further added to this solution, vapour pressure of the solution increases by 10 $mmHg$. Vapour pressure (in $mmHg$) of X and Y in their pure states will be respectively **[2009]**

(a) 200 and 300 (b) 300 and 400

(c) 400 and 600 (d) 500 and 600

11. The vapour pressure of water at 20°C is 17.5 mm Hg. If 18 g of glucose ($C_6H_{12}O_6$) is added to 178.2 g of water at 20°C, the vapour pressure of the resulting solution will be **[2008]**

(a) 15.750 mm Hg (b) 16.500 mm Hg

(c) 17.325 mm Hg (d) 17.675 mm Hg

12. A mixture of ethyl alcohol and propyl alcohol has a vapour pressure of 290 mm at 300 K. The vapour pressure of propyl alcohol is 200 mm. If the mole fraction of ethyl alcohol is 0.6, its vapour pressure (in mm) at the same temperature will be **[2007]**

(a) 350 (b) 300

(c) 700 (d) 360

13. Benzene and toluene form nearly ideal solutions. At 20°C, the vapour pressure of benzene is 75 $torr$ and that of toluene is 22 $torr$. The partial vapour pressure of benzene at 20°C for a solution containing 78g of benzene and 46g of toluene in $torr$ is **[2005]**

(a) 50 (b) 25

(c) 37.5 (d) 53.5

14. "Relative lowering in vapour pressure of solution containing non-volatile solute is directly proportional to mole fraction of solute". Above statement is **[1985]**

(a) Henry law (b) Dulong and Petit law

(c) Raoult's law (d) Le-Chatelier's principle

15. On mixing, heptane and octane form an ideal solution. At 373 K, the vapour pressures of the two liquid components (heptane and octane) are 105 kPa and 45 kPa respectively. Vapour pressure of the solution obtained by mixing 25.0g of heptane and 35g of octane will be (molar mass of heptane = 100 $g\ mol^{-1}$ and of octane = 114 $g\,mol^{-1}$) **[2010]**

(a) 144.5 kPa (b) 72.0 kPa

(c) 36.1 kPa (d) 96.2 kPa

16. The vapour pressure of acetone at $20°C$ is 185 torr. When 1.2g of a non-volatile substance was dissolved in 100g of acetone at 20°C, its vapour pressure was 183 torr. The molar mass $(g\,mol^{-1})$ of the substance is **[2015]**

(a) 32 (b) 64

(c) 128 (d) 488

17. Vapour pressure of a solution of $5g$ of non- electrolyte in $100g$ of water at a particular temperature is $2985\,N/m^2$. The vapour pressure of pure water is $3000\,N/m^2$. The molecular weight of the solute is **[1993]**

(a) 60 (b) 120

(c) 180 (d) 380

18. $18g$ of glucose $(C_6H_{12}O_6)$ is added to $178.2g$ of water. The vapour pressure of water for this aqueous solution at $100°C$ is **[2006; 2016]**

(a) 759.00 Torr (b) 7.60 Torr

(c) 76.00 Torr (d) 752.40 Torr

19. At $80°\,C$, the vapour pressure of pure liquid 'A' is 520 *mm Hg* and that of pure liquid 'B' is 1000 *mm Hg*. If a mixture of solution 'A' and 'B' boils at 80° C and 1 *atm* pressure, the amount of 'A' in the mixture is (1 *atm*=760 *mm Hg*) **[2008]**

(a) 34 *mol* percent (b) 48 *mol* percent

(c) 50 *mol* percent (d) 52 *mol* percent

20. For a dilute solution containing $2.5g$ of a non-volatile non-electrolyte solute in $100g$ of water, the elevation in boiling point at 1 atm pressure is $2\,^{\circ}C$. Assuming concentration of solute is much lower than the concentration of solvent, the vapour pressure (mm of Hg) of the solution is (take $K_b = 0.76K\,kg\,mol^{-1}$) **[2012]**

(a) 724 (b) 740

(c) 736 (d) 718

21. A binary liquid solution is prepared by mixing n-heptane and ethanol. Which one of the following statements is correct regarding the behaviour of the solution **[2009]**

(a) The solution formed is an ideal solution

(b) The solution is non-ideal, showing +ve deviation from Raoult's Law

(c) The solution is non-ideal, showing –ve deviation from Raoult's Law

(d) n-heptane shows +ve deviation while ethanol shows –ve deviation from Raoult's Law

22. Which of the following liquid pairs shows a positive deviation from Raoult's law **[2004]**

(a) Water-nitric acid (b) Benzene-methanol

(c) Water-hydrochloric acid (d) Acetone-chloroform

23. Liquids A and B form an ideal solution **[2003]**

(a) The enthalpy of mixing is zero

(b) The entropy of mixing is zero

(c) The free energy of mixing is zero

(d) The free energy as well as the entropy of mixing are each zero

24. An azeotropic solution of two liquids has boiling point lower than either when it **[1981]**

(a) Shows a negative deviation from Raoult's law

(b) Shows no deviation from Raoult's law

(c) Shows positive deviation from Raoult's law

(d) Is saturated

25. A 5.25% solution of a substance is isotonic with a 1.5% solution of urea (molar mass = 60 $g\,mol^{-1}$) in the same solvent. If the densities of both the solutions are assumed to be equal to 1.0 $g\,cm^{-3}$, molar mass of the substance will be **[2007]**

(a) 90.0 $g\,mol^{-1}$ (b) 115.0 $g\,mol^{-1}$

(c) 105.0 $g\,mol^{-1}$ (d) 210.0 $g\,mol^{-1}$

26. Pressure cooker reduces cooking time for food because **[2003]**

(a) Heat is more evenly distributed in the cooking space

(b) Boiling point of water involved in cooking is increased

(c) The higher pressure inside the cooker crushes the food material

(d) Cooking involves chemical changes helped by a rise in temperature

27. The elevation in boiling point of a solution of 13.44g of $CuCl_2$ in $1kg$ of water using the following information will be

(Molecular weight of $CuCl_2$ = 134.4 and K_b = 0.52 $K\,molal^{-1}$) Assume $CuCl_2$ a strong electrolyte **[2005]**

(a) 0.16 (b) 0.05

(c) 0.1 (d) 0.2

28. Which one of the following statements is FALSE **[2004]**

(a) The correct order of osmotic pressure for 0.01 M aqueous solution of each compound is $BaCl_2 > KCl > CH_3COOH >$ sucrose

(b) The osmotic pressure (π) of a solution is given by the equation $\pi = MRT$ where M is the molarity of the solution

(c) Raoult's law states that the vapour pressure of a component over a solution is proportional to its mole fraction

(d) Two sucrose solutions of same molality prepared in different solvents will have the same freezing point depression

29. After adding a solute freezing point of solution decreases to – 0.186. Calculate ΔT_b if $K_f = 1.86$ and $K_b = 0.521$ **[2000]**

(a) 0.521 (b) 0.0521

(c) 1.86 (d) 0.0186

30. During depression of freezing point in a solution, the following are in equilibrium **[2003]**

(a) Liquid solvent, solid solvent

(b) Liquid solvent, solid solute

(c) Liquid solute, solid solute

(d) Liquid solute, solid solvent

31. Which will show maximum depression in freezing point when concentration is $0.1M$ **[1989]**

(a) $NaCl$ (b) Urea

(c) Glucose (d) K_2SO_4

32. Ethylene glycol is used as an antifreeze in a cold climate. Mass of ethylene glycol which should be added to 4 kg of water to prevent it form freezing at $-6°C$ will be : (K_f for water = $1.86K\,kg\,mol^{-1}$, and molar mass of ethylene glycol = $62g\,mol^{-1}$) **[2011]**

(a) 804.32 g (b) 204.30 g

(c) 400.00 g (d) 304.60 g

33. If sodium sulphate is considered to be completely dissociated into cations and anions in aqueous solution, the change in freezing point of water (ΔT_f), when 0.01 mol of sodium sulphate is dissolved in 1 kg of water, is

($K_f = 1.86K\,kg\,mol^{-1}$) **[2010]**

(a) $0.0186\,K$ (b) $0.0372\,K$

(c) $0.0558\,K$ (d) $0.0744\,K$

34. Given that ΔT_f is the depression in freezing point of the solvent in a solution of a non-volatile solute of molality m, the quantity $\lim_{m\to 0}\left(\frac{\Delta T_f}{m}\right)$ is equal to **[1994]**

(a) Zero (b) One

(c) Three (d) None of the above

35. 75.2 g of C_6H_5OH (phenol) is dissolved in one kg of a solvent of $K_f = 14$. If the depression in freezing point is $7K$ then find the % of phenol that dimerises **[2006]**

(a) 50% (b) 75%

(c) 25% (d) 99%

36. The freezing point (in °C) of a solution containing 0.1 g of $K_3[Fe(CN)_6]$ (Mol. Wt. 329) in 100 g of water ($K_f = 1.86\ K\,Kg\,mol^{-1}$) is [2011]

(a) -2.3×10^{-2} (b) -5.7×10^{-2}

(c) -5.7×10^{-3} (d) -1.2×10^{-2}

37. Consider separate solution of $0.500\,M\ C_2H_5OH(aq)$, $0.100\,M\ Mg_3(PO_4)_2(aq)$, $0.250\,M\ KBr(aq)$ and $0.125\,M$ Na_3PO_4 (aq) at 25°C. Which statement is true about these solution, assuming all salts to be strong electrolytes **[2014]**

(a) They all have the same osmotic pressure

(b) $0.100\,M\ Mg_3(PO_4)_2(aq)$ has the highest osmotic pressure

(c) $0.125\,M\ Na_3PO_4(aq)$ has the highest osmotic pressure

(d) $0.500\,M\ C_2H_5OH(aq)$ has the highest osmotic pressure

38. Which one of the following aqueous solutions will exhibit highest boiling point **[2004]**

(a) 0.015 M urea (b) $0.01\,M\ KNO_3$

(c) $0.01\,M\ Na_2SO_4$ (d) $0.015\,M$ glucose

39. When 20 g of naphthoic acid ($C_{11}H_8O_2$) is dissolved in 50 g of benzene ($K_f = 1.72K\,kg\,mol^{-1}$), a freezing point depression of $2K$ is observed. The van't Hoff factor (i) is **[2007]**

(a) 0.5 (b) 1

(c) 2 (d) 3

40. The freezing point of equimolal aqueous solution will be highest for **[1990]**

(a) $C_6H_5NH_3^+Cl^-$ (aniline hydrochloride)

(b) $Ca(NO_3)_2$

(c) $La(NO_3)_3$

(d) $C_6H_{12}O_6$ (glucose)

41. The degree of dissociation (α) of a weak electrolyte, A_xB_y is related to van't Hoff factor (i) by the expression **[2011]**

(a) $\alpha = \frac{i-1}{(x+y-1)}$ (b) $\alpha = \frac{i-1}{x+y+1}$

(c) $\alpha = \frac{x+y-1}{i-1}$ (d) $\alpha = \frac{x+y+1}{i-1}$

42. The freezing point of benzene decreases by 0.45°C when 0.2 g of acetic acid is added to 20 g of benzene. If acetic acid associates to form a dimer in benzene, percentage association of acetic acid in benzene will be : (K_f for benzene $= 5.12\,K\,kg\,mol^{-1}$) **[2017]**

(a) 80.4% (b) 74.6%

(c) 94.6% (d) 64.6%

43. For 1 molal aqueous solution of the following compounds, which one will show the highest freezing point **[2018]**

(a) $[Co(H_2O)_4Cl_2]Cl.2H_2O$ (b) $[Co(H_2O)_3Cl_3].3H_2O$

(c) $[Co(H_2O)_6]Cl_3$ (d) $[Co(H_2O)_5Cl]Cl_2.H_2O$

44. If α is the degree of dissociation of Na_2SO_4, the Vant Hoff's factor (i) used for calculating the molecular mass is **[2005]**

(a) $1+\alpha$ (b) $1-\alpha$

(c) $1+2\alpha$ (d) $1-2\alpha$

45. The molecular weight of benzoic acid in benzene as determined by depression in freezing point method corresponds to **[1996]**

(a) Ionization of benzoic acid

(b) Dimerization of benzoic acid

(c) Trimerization of benzoic acid

(d) Solvation of benzoic acid

13. NEET/AIPMT/CBSE-PMT

1. 6.02×10^{20} molecules of urea are present in 100 *mL* of its solution. The concentration of urea solution is **[2013]**

(a) 0.02 *M* (b) 0.01 *M*

(c) 0.001 *M* (d) 0.1 *M*

(Avogadro constant, $N_A = 6.02\times10^{23}mol^{-1}$)

2. Concentrated Aqueous solution sulphuric acid 98% H_2SO_4 by mass and has a density of 1.80 $g.mL^{-1}$. Volume of acid required to make 1 *litre* of 0.1 *M* H_2SO_4 solution **[2007]**

(a) 11.10 *mL* (b) 16.65 *mL*

(c) 22.20 *mL* (d) 5.55 *mL*

3. What is molarity of a solution of *HCl* which contains 49% by weight of solute and whose specific gravity is 1.41 **[2001]**

(a) 15.25 (b) 16.75

(c) 18.92 (d) 20.08

4. How many grams of concentrated nitric acid solution 70% HNO_3 should be used to prepare 250 *mL* of 2.0 *M* HNO_3 **[2013]**

(a) 54.0 *g* conc. HNO_3 (b) 45.0 *g* conc. HNO_3

(c) 90.0 *g* conc. HNO_3 (d) 70.0 *g* conc. HNO_3

5. What is the mole fraction of the solute in a 1.00 *m* aqueous solution **[2015]**

(a) 0.177 (b) 1.770

(c) 0.0354 (d) 0.0177

6. The mole fraction of the solute in one molal aqueous solution is **[2005; 2011]**

(a) 0.027 (b) 0.036

(c) 0.018 (d) 0.009

7. What will be the molality of a solution having 18*g* of glucose (mol. wt. = 180) dissolved in 500*g* of water **[2000]**

(a) 1*m* (b) 0.5*m*

(c) 0.2*m* (d) 2*m*

8. Which of the following is dependent on temperature **[2017]**

(a) Molality (b) Molarity

(c) Mole fraction (d) Weight percentage

9. Vapour pressure of CCl_4 at 25°*C* is 143*mm* of *Hg*. 0.5*g* of a non-volatile solute (mol. wt. = 65) is dissolved in 100*mL* CCl_4. Find the vapour pressure of the solution (Density of $CCl_4 = 1.58\,g/cm^3$) **[1998]**

(a) 141.93*mm* (b) 94.39*mm*

(c) 199.34*mm* (d) 143.99*mm*

10. Vapour pressure of chloroform ($CHCl_3$) and dichloromethane (CH_2Cl_2) at 25°*C* are 200*mm Hg* and 41.5*mm Hg* respectively. Vapour pressure of the solution obtained by mixing 25.5*g* of $CHCl_3$ and 40*g* of CH_2Cl_2 at the same temperature will be (Molecular mass of $CHCl_3 = 119.5u$ and molecular mass of $CH_2Cl_2 = 85u$) **[2012]**

(a) 90.92 *mm Hg* (b) 615.0 *mm Hg*

(c) 347.9 *mm Hg* (d) 285.5 *mm Hg*

11. Torr, respectively. The total vapour pressure of solution obtained by mixing 3 *mole* of *P* and 2 *mole* of *Q* would be **[2005]**

(a) 140 torr (b) 20 torr

(c) 68 torr (d) 72 torr

12. The vapour pressure of benzene at a certain temperature is $640mm$ of Hg. A non-volatile and non-electrolyte solid weighing $2.175g$ is added to $39.08g$ of benzene. The vapour pressure of the solution is $600mm$ of Hg. What is the molecular weight of solid substance **[1999]**

(a) 49.50 (b) 59.6

(c) 69.5 (d) 79.8

13. In an experiment, 1 g of a non-volatile solute was dissolved in 100 g of acetone (mol. mass = 58) at $298K$. The vapour pressure of the solution was found to be 192.5 mm Hg. The molecular weight of the solute is (vapour pressure of acetone = 195 mm Hg) **[2001]**

(a) 25.24 (b) 35.24

(c) 50 (d) 55.24

14. The vapour pressure of a solvent decreased by $10mm$ of mercury, when a non-volatile solute was added to the solvent. The mole fraction of the solute in the solution is 0.2. What should be the mole fraction of the solvent, if decrease in the vapour pressure is to be $20mm$ of mercury **[1998]**

(a) 8 (b) 0.6

(c) 0.4 (d) 0.2

15. P_A and P_B are the vapour pressure of pure liquid components, A and B, respectively of an ideal binary solution. If X_A represents the mole fraction of component A, the total pressure of the solution will be **[2012]**

(a) $P_A + X_A(P_B - P_A)$ (b) $P_A + X_A(P_A - P_B)$

(c) $P_B + X_A(P_B - P_A)$ (d) $P_B + X_A(P_A - P_B)$

16. The relative lowering of the vapour pressure is equal to the ratio between the number of **[1991]**

(a) Solute molecules and solvent molecules

(b) Solute molecules and the total molecules in the solution

(c) Solvent molecules and the total molecules in the solution

(d) Solvent molecules and the total number of ions of the solute

17. A solution has a 1 : 4 mole ratio of pentane to hexane. The vapour pressure of the pure hydrocarbons at $20°C$ are 440 $mmHg$ for pentane and 120 $mmHg$ for hexane. The mole fraction of pentane in the vapour phase would be **[2005]**

(a) 0.549 (b) 0.200

(c) 0.786 (d) 0.478

18. Which of the following statement about the composition of the vapour of over an ideal 1 : 1 molar mixture of benzene and toluene is correct ? Assume that the temperature is constant at 25°C. (Given : Vapour Pressure Data at 25°C, benzene = 12.8 kPa, Toluene = 3.85 kPa) **[2016]**

(a) The vapour will contain a higher percentage of benzene

(b) The vapour will contain a higher percentage of toluene

(c) The vapour will contain equal amounts of benzene and toluene

(d) Not enough information is given to make a predication

19. At $100°C$ the vapour pressure of a solution of 6.5g of a solute in $100g$ water is $732mm$. If $K_b = 0.52$; the boiling point of this solution will be **[2016]**

(a) 101°C (b) 100°C

(c) 102°C (d) 103°C

20. A solution of acetone in ethanol **[2006]**

(a) Behaves like a near ideal solution

(b) Obeys Raoult's law

(c) Shows a negative deviation from Raoult's law

(d) Shows a positive deviation from Raoult's law

21. Which one is not equal to zero for an ideal solution **[2013; 2015]**

(a) ΔS_{mix} (b) ΔV_{mix}

(c) $\Delta P = P_{observed} - P_{Raoult}$ (d) ΔH_{mix}

22. Which one of the following is incorrect for ideal solution **[2016]**

(a) $\Delta G_{mix} = 0$

(b) $\Delta H_{mix} = 0$

(c) $\Delta U_{mix} = 0$

(d) $\Delta P = P_{obs} - P_{\text{calculated by Raoult's law}} = 0$

23. Formation of a solution from two components can be considered as **[2003]**

(i) Pure solvent → separated solvent molecules ΔH_1

(ii) Pure solute → separated solute molecules ΔH_2

(iii) Separated solvent and solute molecules → solution ΔH_3

Solution so formed will be ideal if

(a) $\Delta H_{soln} = \Delta H_3 - \Delta H_1 - \Delta H_2$

(b) $\Delta H_{soln} = \Delta H_1 + \Delta H_2 + \Delta H_3$

(c) $\Delta H_{soln} = \Delta H_1 + \Delta H_2 - \Delta H_3$

(d) $\Delta H_{soln} = \Delta H_1 - \Delta H_2 - \Delta H_3$

24. A solution contains non-volatile solute of molecular mass M_p. Which of the following can be used to calculate molecular mass of the solute in terms of osmotic pressure (m = Mass of solute, V = Volume of solution and π = Osmotic pressure) **[2002]**

(a) $M_p = \left(\frac{m}{\pi}\right)VRT$ (b) $M_p = \left(\frac{m}{V}\right)\frac{RT}{\pi}$

(c) $M_p = \left(\frac{m}{V}\right)\frac{\pi}{RT}$ (d) $M_p = \left(\frac{m}{V}\right)\pi RT$

25. The relationship between osmotic pressure at $273K$ when $10g$ glucose (P_1), $10g$ urea (P_2) and $10g$ sucrose (P_3) are dissolved in $250mL$ of water is **[1996]**

(a) $P_1 > P_2 > P_3$ (b) $P_3 > P_1 > P_2$

(c) $P_2 > P_1 > P_3$ (d) $P_2 > P_3 > P_1$

26. Semipermeable membrane is that which permits the passage of **[2006]**

(a) Solute molecules only

(b) Solvent molecules only

(c) Solute and solvent molecules both

(d) Neither solute nor solvent molecules

27. The solution in which the blood cells retain their normal form are with regard to the blood **[1991]**

(a) Isotonic (b) Isomotic

(c) Hypertonic (d) Equinormal

28. A solution containing 10 g per dm^3 of urea (molecular mass $= 60\,g\,mol^{-1}$) is isotonic with a 5% solution of a nonvolatile solute. The molecular mass of this nonvolatile solute is **[2006]**

(a) $350\,g\ mol^{-1}$ (b) $200\,g\ mol^{-1}$

(c) $250\,g\,mol^{-1}$ (d) $300\,g\,mol^{-1}$

29. If a $0.1M$ solution of glucose (mol. wt. 180) and 0.1molar solution of urea (mol. wt. 60) are placed on the two sides of a semipermeable membrane to equal heights, then it will be correct to say **[1992]**

(a) There will be no net movement across the membrane

(b) Glucose will flow across the membrane into urea solution

(c) Urea will flow across the membrane into glucose solution

(d) Water will flow from urea solution into glucose solution

30. $200mL$ of an aqueous solution of a protein contains its 1.26 g. The Osmotic Pressure of this solution at 300 K is found to be 2.57×10^{-3} bar. The molar mass of protein will be ($R = 0.083\,L$ bar $mol^{-1}K^{-1}$) **[2011]**

(a) 31011 $g\ mol^{-1}$ (b) 61038 $g\ mol^{-1}$

(c) 51022 $g\ mol^{-1}$ (d) 122044 $g\ mol^{-1}$

31. An aqueous solution containing $1g$ of urea boils at $100.25^\circ C$. The aqueous solution containing $3\ g$ of glucose in the same volume will boil at (Molecular weight of urea and glucose are 60 and 180 respectively) **[2000]**

(a) $100.75^\circ C$ (b) $100.5^\circ C$

(c) $100.25^\circ C$ (d) $100^\circ C$

32. When common salt is dissolved in water **[1988]**

(a) Melting point of the solution increases

(b) Boiling point of the solution increases

(c) Boiling point of the solution decreases

(d) Both melting point and boiling point decreases

33. The boiling point of $0.2\,mol\,kg^{-1}$ solution of X in water is greater than equimolal solution of Y in water. Which one of the following statements is true in this case **[2015]**

(a) Molecular mass of X is greater than the molecular mass of Y

(b) Molecular mass of X is less than the molecular mass of Y

(c) Y is undergoing dissociation in water while X undergoes no change

(d) X is undergoing dissociation in water

34. A solution of urea (mol. mass $60g\ mol^{-1}$) boils at $100.18°C$ at the atmospheric pressure. If K_f and K_b for water are 1.86 and $0.512K\ kg\ mol^{-1}$ respectively the above solution will freeze at **[2005]**

(a) $-6.54°C$ (b) $6.54°C$

(c) $0.654°C$ (d) $-0.654°C$

35. What should be the freezing point of aqueous solution containing $17\,gm$ of C_2H_5OH in $1000\,gm$ of water (water $K_f = 1.86$ deg$-kg\,mol^{-1}$ **[2010]**

(a) $-0.69^\circ C$ (b) $-0.34^\circ C$

(c) $0.0^\circ C$ (d) $0.34^\circ C$

36. A $0.0020m$ aqueous solution of an ionic compound $Co(NH_3)_5(NO_2)Cl$ freezes at $-0.00732°C$. Number of moles of ions which 1 mol of ionic compound produces on being dissolved in water will be ($k_f = -1.86°C/m$) **[2009]**

(a) 2 (b) 3

(c) 4 (d) 1

37. Of the following 0.10 m aqueous solutions, which one will exhibit the largest freezing point depression **[2014]**

(a) $Al_2(SO_4)_3$ (b) K_2SO_4

(c) KCl (d) $C_6H_{12}O_6$

38. If molality of the dilute solution is doubled, the value of molal depression constant (K_f) will be **[2017]**

(a) Doubled (b) Halved

(c) Tripled (d) Unchanged

39. The highest osmotic pressure corresponds to the following solution **[1991]**

(a) $M/10$ urea (b) $M/10$ glucose

(c) $M/10\,HCl$ (d) $M/10\,BaCl_2$

40. Which one has the highest boiling point **[1990]**

(a) $0.1N\,Na_2SO_4$ (b) $0.1N\,MgSO_4$

(c) $0.1M\,Al_2(SO_4)_3$ (d) $0.1M\,BaSO_4$

41. Which of the following $0.10m$ aqueous solution will have the lowest freezing point **[1997]**

(a) $Al_2(SO_4)_3$ (b) $C_5H_{10}O_5$

(c) KI (d) $C_{12}H_{22}O_{11}$

42. Which of the following salt has the same value of Van't Hoff factor i as that of $K_4[Fe(CN)_6]$ **[1994; 2015]**

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

(c) Na_2SO_4 (d) $Al(NO_3)_3$

43. The freezing point depression constant for water is $-1.86^\circ C m^{-1}$. If $5.00g$ Na_2SO_4 is dissolved in $45.0g$ H_2O, the freezing point is changed by $-3.82^\circ C$. Calculate the van't Hoff factor for Na_2SO_4 **[2011]**

(a) 0.381 (b) 2.05

(c) 2.63 (d) 3.11

44. The van't Hoff factor (i) for a dilute aqueous solution of the strong electrolyte barium hydroxide is **[2016]**

(a) 3 (b) 0

(c) 1 (d) 2

45. An aqueous solution is 1.00 molal in KI. Which change will cause the vapour pressure of the solution to increase **[2010]**

(a) Addition of water (b) Addition of $NaCl$

(c) Addition of Na_2SO_4 (d) Addition of 1.00 molal KI

14. AIIMS

1. What will be the molarity of a solution containing $5g$ of sodium hydroxide in $250mL$ solution **[2000]**

(a) 0.5 (b) 1.0

(c) 2.0 (d) 0.1

2. An aqueous solution of glucose is 10% in strength. The volume in which $1g$ mole of it is dissolved will be **[1992]**

(a) 18 litre (b) 9 litre

(c) 0.9 litre (d) 1.8 litre

3. What is the molarity of H_2SO_4 solution, that has a density $1.84\,g/cc$ at $35^\circ C$ and contains solute 98% by weight **[2001]**

(a) $4.18\,M$ (b) $8.14\,M$

(c) $18.4\,M$ (d) $18\,M$

4. Normality of $2M$ sulphuric acid is **[1991, 92]**

(a) $2N$ (b) $4N$

(c) $N/2$ (d) $N/4$

5. The normality of $0.3M$ phosphorus acid (H_3PO_3) is **[2000]**

(a) 0.1 (b) 0.9

(c) 0.3 (d) 0.6

6. A $500g$ tooth paste sample has $0.2g$ fluoride concentration. What is the concentration of F in terms of ppm level **[1992]**

(a) 250 (b) 200

(c) 400 (d) 1000

7. Which of the following modes of expressing concentration is independent of temperature **[1997, 2001]**

(a) Molarity (b) Molality

(c) Formality (d) Normality

8. The average osmotic pressure of human blood is 7.8 bar at $37^\circ C$. What is the concentration of an aqueous $NaCl$ solution that could be used in the blood stream **[2004]**

(a) $0.16\,mol/L$ (b) $0.32\,mol/L$

(c) $0.60\,mol/L$ (d) $0.45\,mol/L$

9. A solution containing $10g$ per dm^3 of urea (molecular mass $=60\,g\,mol^{-1}$) is isotonic with a 5% solution of a non-volatile solute. The molecular mass of this non volatile solute is **[2007]**

(a) $300\,g\,mol^{-1}$ (b) $350\,g\,mol^{-1}$

(c) $200\,g\,mol^{-1}$ (d) $250\,g\,mol^{-1}$

10. The molal boiling point constant for water is $0.513^\circ C\,kg\,mol^{-1}$. When 0.1 mole of sugar is dissolved in $200mL$ of water, the solution boils under a pressure of one atmosphere at **[1991]**

(a) $100.513^\circ C$ (b) $100.0513^\circ C$

(c) $100.256^\circ C$ (d) $101.025^\circ C$

11. The boiling point of water ($100^{\circ}C$) becomes $100.52^{\circ}C$, if 3 g of a nonvolatile solute is dissolved in $200mL$ of water. The molecular weight of solute is (K_b for water is $0.6K - kg\,mol^{-1}$) **[1998, 15]**

(a) $12.2\,g\,mol^{-1}$ (b) $15.4\,g\,mol$

(c) $17.3\,g\,mol^{-1}$ (d) $20.4\,g\,mol$

12. A 5% solution (by mass) of cane sugar in water has freezing point of 271 K and freezing point of pure water is 273.15 K. The freezing point of a 5% solution (by mass) of glucose in water is **[2006]**

(a) 271 K (b) 273.15 K

(c) 269.07 K (d) 277.23 K

13. 0.01 M solution of KCl and $BaCl_2$ are prepared in water. The freezing points of KCl is found to be $-2^{\circ}C$. What is the freezing point of $BaCl_2$ to be completely ionized **[2008]**

(a) $-3^{\circ}C$ (b) $+3^{\circ}C$

(c) $-2^{\circ}C$ (d) $-4^{\circ}C$

14. At $25^{\circ}C$, the highest osmotic pressure is exhibited by $0.1M$ solution of **[2000]**

(a) $CaCl_2$ (b) KCl

(c) Glucose (d) Urea

15. 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 : If red blood cells were removed from the body and placed in pure water, pressure inside the cells increases.

Reason : The concentration of salt content in the cells increases. **[AIIMS 2006]**

2. Assertion : On adding $NaCl$ to water its vapour pressure increases.

Reason : Addition of non-volatile solute increases the vapour pressure. **[AIIMS 1996]**

3. Assertion : Molar heat of vaporisation of water is greater than benzene.

Reason : Molar heat of vaporisation is the amount of heat required to vaporise one mole of liquid at constant temperature. **[AIIMS 1996]**

4. Assertion : Ice melts faster at high altitude.

Reason : At high altitude atmospheric pressure is high. **[AIIMS 1997]**

5. Assertion : Molecular mass of benzoic acid when determined by colligative properties is found high.

Reason : Dimerisation of benzoic acid. **[AIIMS 1998]**

6. Assertion : One molal aqueous solution of glucose contains 180g of glucose in 1 kg water.

Reason : Solution containing one mole of solute in 1000g of solvent is called one molal solution. **[AIIMS 2008]**

7. Assertion : CCl_4 and H_2O are immiscible.

Reason : CCl_4 is a polar solvent. **[AIIMS 2002]**

8. Assertion : Isotonic solutions do not show the phenomenon of osmosis.

Reason : Isotonic solutions have equal osmotic pressure. **[AIIMS 2002, 15]**

9. Assertion : Increasing pressure of pure water decreases its freezing point.

Reason : Density of water is maximum at 273 K. **[AIIMS 2003]**

10. Assertion : The water pouch of instant cold pack for treating athletic injuries breaks when squeezed and NH_4NO_3 dissolves lowering the temperature.

Reason : Addition of non-volatile solute into solvent results into depression of freezing point of the solvent. **[AIIMS 2006]**

11. Assertion : Viscosity of a liquid decreases on increasing the temperature.

Reason : Evaporation of liquid increases with rise in temperature. **[AIIMS 2007]**

18. Solutions – Answers Keys

1. Solubility

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

2. Methods of Expressing Concentration of Solution

1	d	2	c	3	b	4	a	5	a
6	a	7	e	8	a	9	b	10	b
11	a	12	a	13	b	14	a	15	d
16	a	17	b	18	a	19	b	20	c
21	b	22	b	23	b	24	b	25	d
26	b	27	a	28	a	29	b	30	a
31	c	32	d	33	d	34	d	35	e
36	b	37	d	38	d	39	c	40	a
41	c	42	d	43	c	44	d	45	b

3. Colligative Properties

1	a	2	c	3	a	4	a	5	b
6	a	7	d						

4. Lowering of Vapour Pressure

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

5. Ideal and Non-ideal Solution

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

6. Azeotropic Mixture

1	a	2	c	3	a	4	d	5	a

7. Osmosis and Osmotic Pressure of the Solution

1	b	2	b	3	a	4	b	5	b
6	b	7	c	8	b	9	b	10	b
11	d	12	b	13	a	14	d	15	d
16	b	17	b	18	a	19	d	20	a
21	d	22	b	23	c	24	d	25	a
26	b	27	a						

8. Elevation of Boiling Point of the Solvent

1	b	2	b	3	d	4	a	5	d
6	a	7	b						

9. Depression of Freezing Point of the Solvent

1	b	2	a	3	b	4	e	5	d
6	c	7	b						

10. Colligative Properties of Electrolyte

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