

**2****SOLUTIONS AND COLLIGATIVE PROPERTIES***Synopsis***2.1. Solutions**

- (1) A solution is a homogeneous molecular mixture of two or more substances, whose composition can be varied within limits.
- (2) Molality, mole fraction and mass percent do not change with temperature since they involve mass.
- (3) Molarity and Normality change with temperature since they involve volumes.
- (4) For a dilute aqueous solution, one molar solution is more concentrated than one molal solution.
- (5) Normality :

Normality indicates the number of gram equivalent of solute present in one litre of the solution.

$$N = \frac{\text{gram equivalent}}{\text{Volume of solution in dm}^3}$$

$$N = \frac{\text{Weight of solute}}{\text{Gram Equivalent Weight} \times \text{Volume of solution in dm}^3}$$

- (6) Equivalent weight/mass (E) :

**i. Equivalent weight of Acid :**

$$E_{\text{Acid}} = \frac{\text{Formula weight(or)molecular weight}}{\text{Basicity}}$$

Number of replaceable hydrogen of acid is called Basicity.

**Examples :**

$$E_{\text{HCl}} = \frac{\text{MW}_{\text{HCl}}}{\text{H}^+} = \frac{36.5}{1} = 36.5$$

$$E_{\text{H}_2\text{SO}_4} = \frac{\text{MW}}{\text{Basicity}} = \frac{98}{2} = 49$$

**ii) Equivalent weight of Base :**

$$E_{\text{Base}} = \frac{\text{Formula weight of Base}}{\text{Acidity of Base}}$$

Number of replaceable hydroxyl group of base is called Acidity.

**Example :**

$$E_{\text{NaOH}} = \frac{\text{MW}_{\text{NaOH}}}{\text{OH}^-} = \frac{40}{1} = 40$$

$$E_{\text{Ba(OH)}_2} = \frac{\text{MW}}{\text{Basicity}} = \frac{171.33}{2} = 56$$

**iii) Equivalent weight of Salt :**

$$E_{\text{Salt}} = \frac{\text{Formula weight of salt}}{\text{Total charge of the cation or anion of the salt}}$$

**Example :**

$$E_{\text{NaCl}} = \frac{\text{FW}_{\text{NaCl}}}{\text{charge}} = \frac{58.5}{1} = 58.5$$

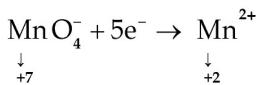
$$E_{\text{Na}_2\text{CO}_3} = \frac{\text{FW}}{\text{charge}} = \frac{106}{2} = 53$$

**iii) Equivalent weight of oxidising agent :**

$$E_{\text{oxidant}} = \frac{\text{Formula weight of oxidant}}{\text{Electrons gained by oxidant}}$$

**Examples :**1.  $\text{KMnO}_4$  = Potassium permanganate

a) In acid medium :



Change in oxidation number = 7 - 2 = 5  
(or) No. of electrons gained = 5

$$E_{\text{KMnO}_4} = \frac{\text{Formula weight of } \text{KMnO}_4}{\text{change in oxidation number}}$$

$$= \frac{158}{5} = 31.6$$

**(7) Relationship between different types of concentration :**

$$\text{i) } x_{\text{solute}} = \frac{m}{m + \frac{W_{\text{solvent}}}{\text{MW}_{\text{solvent}}}}$$

$$\text{ii) } M = \frac{M \times 1000}{\rho_{\text{solution}} \times 1000 - M (\text{MW}_{\text{solute}})}$$

$$\text{iii) } x_{\text{solute}} = \frac{M (\text{MW}_{\text{solvent}})}{M (\text{MW}_{\text{solvent}} - \text{MW}_{\text{solute}}) + \rho_{\text{solution}}}$$

$$\text{iv) } M = \frac{\% w/w \times \rho_{\text{solution}} \times 10}{\text{MW}_{\text{solute}}}$$

$$\text{v) } N = \frac{\% w/w \times \rho_{\text{solution}} \times 10}{\text{EW}_{\text{solute}}}$$

**(8) Dilution law :**

When a solution is diluted its molarity decreases and volume increases.

$$M_1 V_1 = M_2 V_2$$

$M_1$  = Molarity of the solution before dilution

$V_1$  = Volume of the solution before dilution.

$M_2$  = Molarity of the solution after dilution.

$V_2$  = Volume of the solution after dilution.

$(V_2 - V_1)$  = volume of water added

i) Mixing of solution :

When two or more acid solutions or basic solution are mixed then the resulting Molarity or Normality is given by

$$M = \frac{M_1 V_1 + M_2 V_2 + M_3 V_3 + \dots M_n V_n}{V_1 + V_2 + V_3 + \dots V_n}$$

$$N = \frac{N_1 V_1 + N_2 V_2 + N_3 V_3 + \dots N_n V_n}{V_1 + V_2 + V_3 + \dots V_n}$$

ii) When  $V_a$  ml of a strong acid of Normality  $N_a$  is mixed with  $V_b$  ml of a strong base of Normality  $N_b$ , then

- a) If  $N_a V_a = N_b V_b$ , the solution is neutral
- b) If  $N_a V_a > N_b V_b$ , the solution is acidic

$$\text{Resulting Normality} = \frac{N_a V_a - N_b V_b}{V_a + V_b}$$

iii) If  $N_a V_a < N_b V_b$ , the solution is basic

$$\text{Resulting Normality} = \frac{N_b V_b - N_a V_a}{V_a + V_b}$$

(9) Formality of a solution (F) indicates the number of gram-formula weight of the solute present in one litre of the solution.

(10) The amount of solute dissolved in 100g of a solvent to form a saturated solution at a given temperature is termed as the solubility of solute.

$$S = \frac{W_2}{W_1} \times 100, \text{ where } W_2 = \text{weight of solute},$$

$W_1$  = weight of solvent

(11) The enthalpy of dissolution of solute in water is expressed in terms of  $\Delta H_{\text{solution}}$

$$\Delta H_{\text{solution}} = \Delta H_{\text{Hydration Energy}} + \Delta H_{\text{Lattice Energy}}$$

(12) Solubility of a gas in liquid is governed by Henry's law  $p = K_H x$

Greater the value of  $K_H$  at given pressure lower is the solubility of gas in the liquid.

- (13) The colligative properties of solutions depend on the total number of solute particles present in the solution.
- Since the electrolytes ionise and give more than one particle per formula unit, in solution, the colligative property of an electrolytic solution undergoing dissociation is always greater than that of a non-electrolyte of the same molar concentration.
  - For different solutes of same molar concentration the colligative properties have greater value for the solution which gives more number of particles on ionisation.
  - For different molar concentrations of the same solute, the colligative value has greater value for the more concentrated solution.
  - For solutions of different solutes having same percentage strength, the colligative property has greater value for the solute with least molecular weight.
  - For different solutions of same molar concentration of different non-electrolyte solutes, the colligative properties have the same value for all.
- (14) For solutions of different solutes of the same percent strength, the magnitude of the colligative property is more for that solute which gives more number of particles which can be known from the knowledge of ionization behaviour and its molar mass.

For example,

- Amongst the 0.1 M solution of urea,  $\text{NaCl}$ ,  $\text{BaCl}_2$ ,  $\text{Na}_3\text{PO}_4$  and  $\text{Al}_2(\text{SO}_4)_3$ , the vapour pressure and freezing point will be the lowest while boiling point will be highest for  $\text{Al}_2(\text{SO}_4)_3$ .
- Amongst 0.1 percent solution of urea, glucose and sucrose, vapour pressure and freezing point are the lowest while boiling point is highest for urea.

- Amongst 0.1 M glucose solution and 0.15 M urea and 0.2 M sucrose solution, vapour pressure and freezing point are lowest and boiling point is highest for sucrose solution because number of particles/litre of the solution will be highest for sucrose.

#### (15) Ideal solutions :

- Raoult's law is valid only for **ideal solutions**.
- Ideal Solution is a solution in which the interactions between A and B are of the same magnitude as in the pure components, or is a solution which obeys Raoult's law at all temperatures and concentrations. An ideal solution will show no change in volume or enthalpy on mixing. i.e.

$$\Delta V_{\text{mixing}} = 0$$

$$\Delta H_{\text{mixing}} = 0$$

#### (16) Non-ideal solutions :

- Non-ideal solution is a solution in which A-B interactions are of different magnitudes than those in pure components,  
Thus  $\Delta V_{\text{mixing}} \neq 0$  and  $\Delta H_{\text{mixing}} \neq 0$ .
- These solutions do not obey Raoult's law.
- Non-ideal solutions showing **positive deviation** i.e. the total vapour pressure determined experimentally is higher than that calculated.

E.g. Ethanol and cyclohexane, the intermolecular H-bonding in ethanol is reduced on adding cyclohexane.

Positive deviation solution boils at a lower temperature than expected.

Also

$$\Delta V_{\text{mixing}} = +ve \text{ and } \Delta H_{\text{mixing}} = +ve.$$

**Example :**

- a.  $\text{CHCl}_3$  and  $\text{CH}_3\text{COCH}_3$
- b.  $\text{CHCl}_3$  and  $\text{C}_6\text{H}_6$
- c.  $\text{CHCl}_3$  and  $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$
- d.  $\text{CH}_3\text{COOH}$  and  $\text{C}_6\text{H}_5\text{N}$
- e.  $\text{H}_2\text{O}$  and  $\text{HCl}$
- f.  $\text{H}_2\text{O}$  and  $\text{HNO}_3$
- g.  $\text{CH}_3\text{COCH}_3$  and  $\text{C}_6\text{H}_5\text{NH}_2$
- iv. Non-ideal solutions showing **negative deviation** i.e. the total vapour pressure determined experimentally is lower than calculated from Raoult's law. This is due to stronger interactions than in pure components.

E.g. Chloroform and acetone, show -ve deviation due to new H-bonding between chloroform and acetone molecules. Solution showing -ve deviation boils at a relatively higher temperature than expected.

Also

$$\Delta V_{\text{mixing}} = -\text{ve} \text{ and } \Delta H_{\text{mixing}} = -\text{ve}.$$

**Example :**

- a.  $\text{C}_6\text{H}_6$  and  $\text{C}_2\text{H}_5\text{OH}$
- b.  $\text{CHCl}_3$  and  $\text{C}_2\text{H}_5\text{OH}$
- c.  $\text{C}_6\text{H}_6$  and  $\text{CH}_3\text{COCH}_3$
- d.  $\text{CCl}_4$  and  $\text{CHCl}_3$
- e.  $\text{CCl}_4$  and  $\text{C}_6\text{H}_6$
- f.  $\text{CCl}_4$  and  $\text{C}_6\text{H}_5\text{CH}_3$
- g.  $\text{H}_2\text{O}$  and  $\text{CH}_3\text{OH}$
- h.  $\text{H}_2\text{O}$  and  $\text{C}_2\text{H}_5\text{OH}$
- i.  $\text{CS}_2$  and  $\text{CH}_3\text{COCH}_3$
- j.  $\text{C}_6\text{H}_{14}$  and  $\text{C}_2\text{H}_5\text{OH}$

- (17) i. Freezing point depressions are larger than boiling point elevations for the same solution, because for any given solvent  $K_f > K_b$ . Therefore, it is more convenient to obtain the molar mass of unknown solute by

measuring the freezing point depression rather than the boiling point elevation.

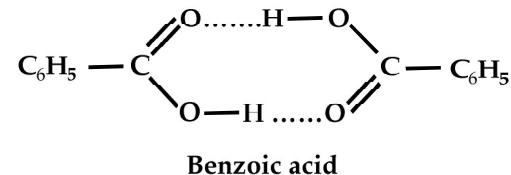
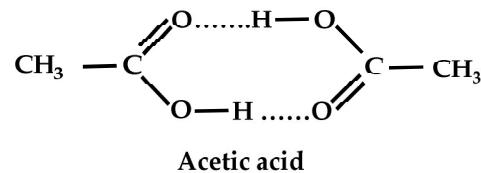
- ii. Rast method for determining the depression in freezing point is an important method. It is based on the fact that depression in freezing point of camphor, if used as a solvent, is 20 times more than the depression, produced by the same amount of solute if water is used as a solvent ( $K_f$  of camphor = 40,  $K_f$  for water = 1.86). Further, Rast method involves the determination of melting point (which is easier) of camphor and its mixture with the given solute since camphor is solid.
  - iii. Ethylene glycol is commonly added to car radiators to depress the freezing point of water. It is known as **antifreeze**.
  - iv.  $\text{NaCl}$  or  $\text{CaCl}_2$  (anhydrous) are used to clear snow on roads. It depresses the freezing point of water and reduces the temperature at which ice is expected to be formed.
  - v. Depression in freezing point occurs only when the concentration of the solute is more in the liquid phase than in the solid phase. However, if the concentration of solute is more in the solid phase than in the liquid phase, then there is a corresponding elevation in freezing point (e.g. in case of solid solution system).
- (18) i. The phenomenon of osmosis was first observed by **Abbe Nollet**.
- ii. When outflow of water occurs from a cell, it is called **Exo-osmosis** and when inward flow of water into a cell takes place, it is called **Endo-osmosis**.
  - iii. Gelatinous  $\text{Cu}_2[\text{Fe}(\text{CN})_6]$  and gelatinous  $\text{Ca}_3(\text{PO}_4)_2$  are artificial semipermeable membranes.
  - iv. Semipermeable membrane of  $\text{Cu}_2[\text{Fe}(\text{CN})_6]$  does not work in non-aqueous solutions because it gets dissolved in non-aqueous solvents.

- v. Silica gardens : When small crystals of copper sulphate, nickel sulphate etc. are added to 5% sodium silicate solution, the so called silica garden or chemical garden is produced because of diffusion of metal ions from crystals to form precipitate of metal silicate. These precipitate acts as semipermeable membrane around the crystal. Osmosis takes place and water flows from dilute sodium silicate solution to stronger salt solution. The membrane bursts at its weaker points so as to liberate more metal ions and these ions further give rise to new membrane. As a result, the growth of metal silicates looks like small plants.
- vi. Bursting of red blood cells when placed in water is due to osmosis.
- vii. A 0.91 % solution of pure NaCl is isotonic with human RBC's.
- viii. When a plant cell is placed in a **hypertonic solution**, the fluid from the plant cell comes out and the cell shrinks. This phenomenon is called **plasmolysis** and is due to **osmosis**.
- ix. The colligative property such as osmotic pressure is useful to determine relative molecular masses as compared to elevation of boiling point and depression in freezing point in which relative molecular masses are difficult to determine.
- x. Osmotic pressure method is the best method for determining the molecular masses of polymers since observed value of any other colligative property is too small to be measured with reasonable accuracy.

**(19) Association, dissociation and vant hoff factor:**

- i. Association generally occurs in the non-aqueous solvents.

Example:- Benzoic acid and acetic acid exist as dimers due to the formation of hydrogen bonds as shown below.



- ii. Dissociation generally occurs in the aqueous solution because in the aqueous solution the high dielectric constant of water helps in the dissociation of the molecules.
- iii. For solutions showing dissociation, the van't Hoff factor  $i > 1$ .
- iv. For solutions showing association, the van't Hoff factor  $i < 1$ .
- v. For solutions showing neither dissociation nor association,  $i = 1$ .

**CLASSWORK**

**Multiple Choice Questions**

**1.1 SOLUTIONS :**

- (1) Increasing temperature of an aqueous solution causes
  - (a) Decrease in molality
  - (b) Decrease in molarity
  - (c) Decrease in mole fraction
  - (d) Decrease in % w/w.
- (2) The amount of anhydrous  $\text{Na}_2\text{CO}_3$  (Molecular weight = 106) present in 250 mL of 0.25 M solution is
  - (a) 6.225 g
  - (b) 6.0 g
  - (c) 66.25 g
  - (d) 6.625 g
- (3) 19.6 g of  $\text{H}_2\text{SO}_4$  is present in 4 litres of a solution. The normality is
  - (a) 0.2
  - (b) 0.1
  - (c) 0.05
  - (d) 0.01
- (4) How many grams of a dibasic acid (Molecular weight = 200) should be present in 100 ml of aqueous solution to give a decinormal solution ?
  - (a) 1 g
  - (b) 10 g
  - (c) 2 g
  - (d) 20 g
- (5) A sugar syrup of weight 214.2 g contains 34.2 g canesugar. The molal concentration is
  - (a) 0.55
  - (b) 55
  - (c) 5.5
  - (d) 0.1
- (6) The molality of a 90%  $\text{H}_2\text{SO}_4$  solution is
  - (a) 1.8
  - (b) 91.8
  - (c) 48.4
  - (d) 94.6
- (7) Tick the correct statement.
  - (a) For dilute aqueous solutions, molality  $\cong$  molarity
  - (b) For dilute aqueous solution molarity  $<$  molality
  - (c) Molarity of pure water is 5.55
  - (d) None of these
- (8) 18 grams of glucose is dissolved in 180 g water. The mole fraction of glucose is
  - (a) 0.6428
  - (b) 0.999
  - (c) 0.0099
  - (d) 0.099

- (9) An aqueous solution of urea is 5% in strength. The volume in which 1 g mole of it is dissolved will be
  - (a) 4.8 lit
  - (b) 20 lit
  - (c) 1.2 lit
  - (d) 2.4 lit
- (10) The molarity of a 0.5 N  $\text{Na}_2\text{CO}_3$  will be
  - (a) 0.5
  - (b) 0.25
  - (c) 0.025
  - (d) 2.5
- (11) Conc.  $\text{H}_2\text{SO}_4$  has a density of 1.9 g/mL and is 99%  $\text{H}_2\text{SO}_4$  by weight. The normality of this acid is
  - (a) 19.19
  - (b) 38.38
  - (c) 9.595
  - (d) None of these
- (12) How much of KOH is needed to just neutralise 2000 cm<sup>3</sup> of 0.05 N  $\text{HNO}_3$  ?
  - (a) 560 g
  - (b) 100 g
  - (c) 56 g
  - (d) 5.6 g
- (13) 5 mL of seminormal  $\text{H}_2\text{SO}_4$ , 20 mL of 1 N  $\text{HCl}$  and 40 mL of N/4  $\text{HNO}_3$  are mixed together and the volume made upto 1 dm<sup>3</sup>. The normality of the solution thus made is
  - (a) 3025
  - (b) 0.0325
  - (c) 0.325
  - (d) 32.5
- (14) The mole fraction of  $\text{C}_2\text{H}_5\text{OH}$  (Molecular weight = 46) in 5 molal aqueous ethyl alcohol solution is
  - (a) 0.082
  - (b) 0.82
  - (c) 5
  - (d)  $\frac{5}{55.55}$
- (15) The number of iodine atoms present in 1 cm<sup>3</sup> of its 0.1 M solution is
  - (a)  $6.02 \times 10^{23}$
  - (b)  $6.02 \times 10^{22}$
  - (c)  $6.02 \times 10^{19}$
  - (d)  $1.204 \times 10^{20}$
- (16) The number of moles of hydroxide ( $\text{OH}^-$ ) ion in 0.3 litre of 0.005 M solution of  $\text{Ba}(\text{OH})_2$  is
  - (a) 0.0075
  - (b) 0.0015
  - (c) 0.0030
  - (d) 0.0050
- (17) 5 ml of 1 N  $\text{HCl}$ , 20 ml of  $\frac{N}{2}$   $\text{H}_2\text{SO}_4$  and 30 ml of  $\frac{N}{3}$   $\text{HNO}_3$  are mixed together and the final volume is made upto 1 dm<sup>3</sup>. The normality of the resulting solution is
  - (a)  $\frac{N}{5}$
  - (b)  $\frac{N}{20}$
  - (c)  $\frac{N}{40}$
  - (d)  $\frac{N}{50}$

- (18) Hydrochloric acid solution A and solution B have concentration 0.5 N and 0.1 N respectively. The volume of solutions A and B required to make 2 L of 0.2 N hydrochloric acid are
- 0.5 L of A + 1.5 L of B
  - 1.5 L of A + 0.5 L of B
  - 1.0 L of A + 1.0 L of B
  - 0.75 L of A + 1.25 L of B
- (19) A tooth paste has 0.2 g/litre fluoride. Its concentration in ppm will be
- 250
  - 200
  - 400
  - 1000
- (20) The molarity of pure water is
- 55.6
  - 50
  - 100
  - 18
- (21) Out of Molarity (M), molality (m), formality (F) and mole fraction ( $x$ ), those dependent on temperature are
- M, m
  - F,  $x$
  - m,  $x$
  - M, F
- (22) Solubility curve of  $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  in water with temperature is given as
- 
- (a) Solution process is exothermic
- (b) Solution process is exothermic till  $34^\circ\text{C}$  and endothermic after  $34^\circ\text{C}$
- (c) Solution process is endothermic till  $34^\circ\text{C}$  and exothermic thereafter
- (d) Solution process is endothermic.
- (23) Duralumin is an alloy of
- aluminium, copper and chromium
  - aluminium, copper, magnesium and manganese.
  - aluminium, magnesium, nickel and copper.
  - aluminium, antimony.

- (24) Babbitt metal is an alloy of
- antimony with tin and copper.
  - aluminium with tin and copper.
  - aluminum bronze.
  - lead with antimony.
- ### 1.2 HENRY'S LAW
- (25) The millimoles of  $\text{N}_2$  gas that will dissolve in 1 L of water at 298 K, when it is bubbled through water and has a partial pressure of 0.96 bar will be (Given that at 298 K,  $K_H = 76.8 \text{ k bar}$ )
- 0.59
  - 0.69
  - 0.79
  - 0.89
- (26) Which of the following correctly represents Henry's law?
- $m = K_H P$
  - $x = K_H P$
  - $P = K_H x$
  - All of these
- (27) The mole fraction of saturated solution is  $1.2 \times 10^{-6}$ . The pressure of the above the solution is ( $K_H = 1.44 \text{ k bar}$ )
- 0.174 bar
  - 17.4 bar
  - 27.4 bar
  - 0.274 bar
- (28) Air contain  $\text{O}_2$  and  $\text{N}_2$  in the ratio of 1 : 4. The Henry constant for  $\text{O}_2$  and  $\text{N}_2$  are  $3.30 \times 10^7 \text{ torr}$  and  $6.60 \times 10^7 \text{ torr}$  respectively. Ratio of solubility of  $\text{O}_2$  and  $\text{N}_2$  dissolved in water at atmospheric pressure and room temperature is
- 1 : 4
  - 4 : 1
  - 1 : 2
  - 2 : 1
- (29) Select the correct gas which has less solubility in water
- $\text{CO}_2$
  - $\text{NH}_3$
  - Oxygen
  - $\text{HCl}$
- (30) The Henry's law constant for oxygen is  $1.3 \times 10^{-3} \text{ mol dm}^{-3} \text{ atm}^{-1}$ . If the partial pressure of oxygen is 0.46 atm, then the concentration of dissolved oxygen at  $25^\circ\text{C}$  at 1 atmosphere pressure is
- $5.98 \times 10^{-3} \text{ mol dm}^{-3}$
  - $0.598 \times 10^{-4} \text{ mol dm}^{-3}$
  - $5.98 \times 10^{-4} \text{ mol dm}^{-3}$
  - $598 \text{ mol dm}^{-3}$

### 1.3 VAPOUR PRESSURE AND RAOUULTS LAW

- (31) The vapour pressure of pure liquid A is 70 torr at 27°C. It forms an ideal solution with another liquid B. The mole fraction of B is 0.2 and total vapour pressure of the solution is 84 torr at 27°C. The vapour pressure of pure liquid B at 27°C is  
(a) 14      (b) 56      (c) 140      (d) 70

(32) 10 cc of a volatile liquid is added to a litre of water. The vapour pressure of water over the solution  
(a) will be equal to that of pure water  
(b) will be less than that of water  
(c) will be greater than that of water  
(d) will be very high

(33) An aqueous solution of ethanol has vapour pressure  
(a) Same as that of water  
(b) Same as that of ethanol  
(c) More than that of water  
(d) Less than that of water

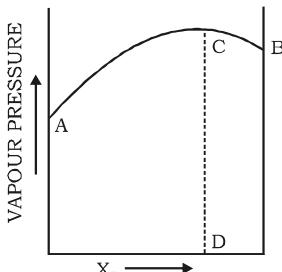
(34) The vapour pressure of pure benzene and toluene are 160 and 60 torr respectively. The mole fraction of toluene in vapour phase in contact with equimolar solution of benzene and toluene is  
(a) 0.50      (b) 0.27      (c) 0.16      (d) 0.73

#### **1.4 IDEAL AND NON - IDEAL SOLUTION :**

- (35) Which pair from the following will not form an ideal solution ?

(a)  $\text{CCl}_4 + \text{SiCl}_4$       (b)  $\text{H}_2\text{O} + \text{C}_4\text{H}_9\text{OH}$   
 (c)  $\text{C}_2\text{H}_5\text{Br} + \text{C}_2\text{H}_5\text{I}$     (d)  $\text{C}_6\text{H}_{14} + \text{C}_7\text{H}_{16}$

(36) The diagram given below is a vapour pressure-composition diagram for a binary solution of A and B. In the solution, A - B interactions are



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- (a) similar than A - A and B - B interactions  
(b) greater to A - A and B - B interactions  
(c) smaller than A - A and B - B interactions  
(d) unpredictable

(37) Water and ethanol form non-ideal solution with positive deviation from Raoult's law. This solution will have vapour pressure  
(a) equal to vapour pressure of pure water  
(b) less than vapour pressure of pure water  
(c) more than vapour pressure of pure water  
(d) less than vapour pressure of pure ethanol.

(38) A binary solution of ethanol and n-heptane is an example of  
(a) Ideal solution  
(b) Non-ideal solution with + ve deviation  
(c) Non-ideal solution with-ve deviation  
(d) unpredictable

(39) 5 ml of acetone is mixed with 100 ml of  $\text{H}_2\text{O}$ . The vapour pressure of water above the solution is  
(a) equal to the vapour pressure of pure water  
(b) equal to the vapour pressure of the solution  
(c) less than the vapour pressure of pure water  
(d) more than the vapour pressure of pure water

### 1.5 LOWERING OF VAPOUR PRESSURE :

(40) The vapour pressure of pure liquid is 10 torr and at the same temperature, when 1 g of non-volatile solute B is dissolved in 20 g of A, its vapour pressure is reduced to 9.0 torr. If the molecular weight of A is 200, that of B is  
(a) 75      (b) 100      (c) 90      (d) 120

(41) Two moles of sugar is dissolved in 5 moles of water. The vapour pressure of solution as

- compared to that of pure water is

  - (a) 5 times
  - (b)  $\frac{5}{7}$  times
  - (c)  $\frac{2}{7}$  times
  - (d) 2 times

