

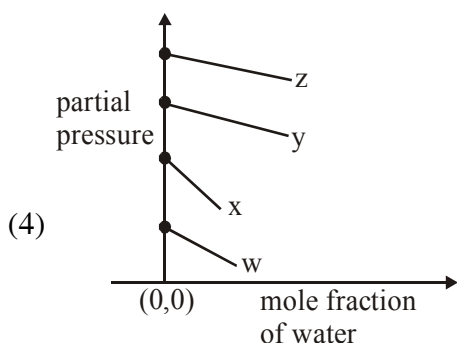
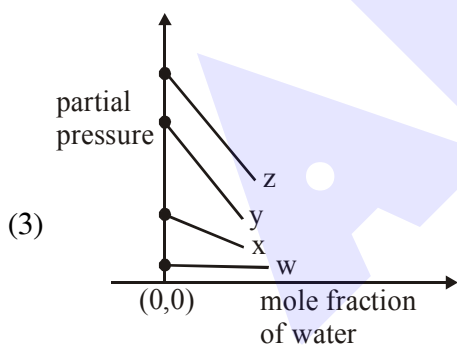
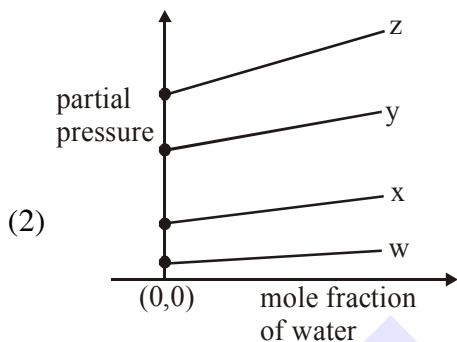
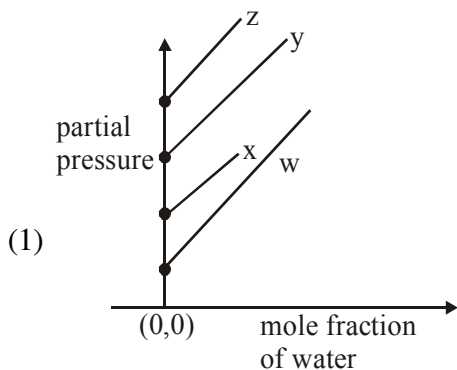
**LIQUID SOLUTION**

- Freezing point of a 4% aqueous solution of X is equal to freezing point of 12% aqueous solution of Y. If molecular weight of X is A, then molecular weight of Y is :-
  - A
  - 3A
  - 4A
  - 2A
- Molecules of benzoic acid ( $C_6H_5COOH$ ) dimerise in benzene. 'w' g of the acid dissolved in 30 g of benzene shows a depression in freezing point equal to 2K. If the percentage association of the acid to form dimer in the solution is 80, then w is :
 

(Given that  $K_f = 5 \text{ K kg mol}^{-1}$ , Molar mass of benzoic acid =  $122 \text{ g mol}^{-1}$ )

  - 1.8 g
  - 2.4 g
  - 1.0 g
  - 1.5 g
- The freezing point of a diluted milk sample is found to be  $-0.2^\circ\text{C}$ , while it should have been  $-0.5^\circ\text{C}$  for pure milk. How much water has been added to pure milk to make the diluted sample ?
  - 2 cups of water to 3 cups of pure milk
  - 1 cup of water to 3 cups of pure milk
  - 3 cups of water to 2 cups of pure milk
  - 1 cup of water to 2 cups of pure milk
- $K_2HgI_4$  is 40% ionised in aqueous solution. The value of its van't Hoff factor (i) is :-
  - 1.8
  - 2.2
  - 2.0
  - 1.6
- Liquids A and B form an ideal solution in the entire composition range. At 350 K, the vapor pressures of pure A and pure B are  $7 \times 10^3 \text{ Pa}$  and  $12 \times 10^3 \text{ Pa}$ , respectively. The composition of the vapor in equilibrium with a solution containing 40 mole percent of A at this temperature is :
  - $x_A = 0.37$ ;  $x_B = 0.63$
  - $x_A = 0.28$ ;  $x_B = 0.72$
  - $x_A = 0.76$ ;  $x_B = 0.24$
  - $x_A = 0.4$ ;  $x_B = 0.6$
- A solution containing 62 g ethylene glycol in 250 g water is cooled to  $-10^\circ\text{C}$ . If  $K_f$  for water is  $1.86 \text{ K kg mol}^{-1}$ , the amount of water (in g) separated as ice is :
  - 32
  - 48
  - 16
  - 64
- Which one of the following statements regarding Henry's law is not correct ?
  - The value of  $K_H$  increases with increase of temperature and  $K_H$  is function of the nature of the gas
  - Higher the value of  $K_H$  at a given pressure, higher is the solubility of the gas in the liquids.
  - The partial pressure of the gas in vapour phase is proportional to the mole fraction of the gas in the solution.
  - Different gases have different  $K_H$  (Henry's law constant) values at the same temperature.
- Elevation in the boiling point for 1 molal solution of glucose is 2 K. The depression in the freezing point of 2 molal solutions of glucose in the same solvent is 2 K. The relation between  $K_b$  and  $K_f$  is:
  - $K_b = 0.5 K_f$
  - $K_b = 2 K_f$
  - $K_b = 1.5 K_f$
  - $K_b = K_f$
- The vapour pressures of pure liquids A and B are 400 and 600 mmHg, respectively at 298K. On mixing the two liquids, the sum of their initial volumes is equal to the volume of the final mixture. The mole fraction of liquid B is 0.5 in the mixture. The vapour pressure of the final solution, the mole fraction of components A and B in vapour phase, respectively are-
  - 500 mmHg, 0.5, 0.5
  - 450 mmHg, 0.4, 0.6
  - 450 mmHg, 0.5, 0.5
  - 500 mmHg, 0.4, 0.6

10. For the solution of the gases w, x, y and z in water at 298K, the Henry's law constants ( $K_H$ ) are 0.5, 2, 35 and 40 kbar, respectively. The correct plot for the given data is :-



11. The osmotic pressure of a dilute solution of an ionic compound XY in water is four times that of a solution of 0.01 M  $\text{BaCl}_2$  in water. Assuming complete dissociation of the given ionic compounds in water, the concentration of XY (in  $\text{mol L}^{-1}$ ) in solution is :

(1)  $6 \times 10^{-2}$                       (2)  $4 \times 10^{-4}$   
 (3)  $16 \times 10^{-4}$                     (4)  $4 \times 10^{-2}$

12. Liquid 'M' and liquid 'N' form an ideal solution. The vapour pressures of pure liquids 'M' and 'N' are 450 and 700 mmHg, respectively, at the same temperature. Then correct statement is:

( $x_M$  = Mole fraction of 'M' in solution ;  
 $x_N$  = Mole fraction of 'N' in solution ;  
 $y_M$  = Mole fraction of 'M' in vapour phase ;  
 $y_N$  = Mole fraction of 'N' in vapour phase)

(1)  $(x_M - y_M) < (x_N - y_N)$     (2)  $\frac{x_M}{x_N} < \frac{y_M}{y_N}$

(3)  $\frac{x_M}{x_N} > \frac{y_M}{y_N}$                       (4)  $\frac{x_M}{x_N} = \frac{y_M}{y_N}$

13. Molal depression constant for a solvent is  $4.0 \text{ kg mol}^{-1}$ . The depression in the freezing point of the solvent for  $0.03 \text{ mol kg}^{-1}$  solution of  $\text{K}_2\text{SO}_4$  is :

(Assume complete dissociation of the electrolyte)

(1) 0.12 K                              (2) 0.36 K  
 (3) 0.18 K                              (4) 0.24 K

14. At room temperature, a dilute solution of urea is prepared by dissolving 0.60 g of urea in 360 g of water. If the vapour pressure of pure water at this temperature is 35 mmHg, lowering of vapour pressure will be (molar mass of urea =  $60 \text{ g mol}^{-1}$ ):-

(1) 0.027 mmHg                      (2) 0.028 mmHg  
 (3) 0.017 mmHg                      (4) 0.031 mmHg

15. A solution is prepared by dissolving 0.6 g of urea (molar mass = 60 g mol<sup>-1</sup>) and 1.8 g of glucose (molar mass = 180 g mol<sup>-1</sup>) in 100 mL of water at 27°C. The osmotic pressure of the solution is :
- (R = 0.08206 L atm K<sup>-1</sup> mol<sup>-1</sup>)
- (1) 4.92 atm                      (2) 1.64 atm  
(3) 2.46 atm                      (4) 8.2 atm
16. 1 g of non-volatile non-electrolyte solute is dissolved in 100g of two different solvents A and B whose ebullioscopic constants are in the ratio of 1 : 5. The ratio of the elevation in their boiling points,  $\frac{\Delta T_b(A)}{\Delta T_b(B)}$ , is :
- (1) 5 : 1                              (2) 10 : 1  
(3) 1 : 5                              (4) 1 : 0.2

## SOLUTION

## 1. Ans. (2)

For same freezing point, molality of both solution should be same.

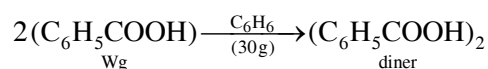
$$m_x = m_y$$

$$\frac{4 \times 1000}{96 \times M_x} = \frac{12 \times 1000}{88 \times M_y}$$

$$\text{or, } M_y = \frac{96 \times 12}{4 \times 88} M_x = 3.27 \text{ A}$$

Closest option is 3A.

## 2. Ans. (2)



$$\Delta_f T = i k_f m$$

$$2 = 0.6 \times 5 \times \frac{w \times 1000}{122 \times 30}$$

$$(i = 1 - 0.8 + 0.4 = 0.6)$$

$$w = 2.44 \text{ g}$$

## 3. Ans. (3)

## 4. Ans. (1)

For  $\text{K}_2[\text{HgI}_4]$

$$i = 1 + 0.4 (3-1)$$

$$= 1.8$$

## 5. Ans. (2)

$$y_A = \frac{P_A}{P_{\text{Total}}} = \frac{P_A^0 x_A}{P_A^0 x_A + P_B^0 x_B}$$

$$= \frac{7 \times 10^3 \times 0.4}{7 \times 10^3 \times 0.4 + 12 \times 10^3 \times 0.6} = \frac{2.8}{10} = 0.28$$

$$y_B = 0.72$$

## 6. Ans. (4)

$$\Delta T_f = K_f \cdot m$$

$$10 = 1.86 \times \frac{62/62}{W_{\text{kg}}}$$

$$W = 0.186 \text{ kg}$$

$$\Delta W = (250 - 186) = 64 \text{ gm}$$

## 7. Ans. (2)

Liquid solution

$$P_{\text{gas}} = K_H \times X_{\text{gas}}$$

More is  $K_H$  less is solubility, lesser solubility is at higher temperature. So more is temperature more is  $K_H$ .

## 8. Ans. (2)

$$\frac{\Delta T_b}{\Delta T_f} = \frac{i \cdot m \times k_b}{i \cdot m \times k_f}$$

$$\frac{2}{2} = \frac{1 \times 1 \times k_b}{1 \times 2 \times k_f}$$

$$k_b = 2k_f$$

## 9. Ans. (4)

$$P_{\text{total}} = X_A \cdot P_A^0 + X_B \cdot P_B^0 = 0.5 \times 400 + 0.5 \times 600$$

$$= 500 \text{ mmHg}$$

Now, mole fraction of A in vapour,

$$Y_A = \frac{P_A}{P_{\text{total}}} = \frac{0.5 \times 400}{500} = 0.4$$

and mole fraction of B in vapour,

$$Y_B = 1 - 0.4 = 0.6$$

Correct option : (4)

## 10. Ans. (3)

$$p = k_H \times \left( \frac{n_{\text{gas}}}{n_{\text{H}_2\text{O}} + n_{\text{gas}}} \right)$$

$$= k_H \left( 1 - \frac{n_{\text{H}_2\text{O}}}{n_{\text{H}_2\text{O}} + n_{\text{gas}}} \right)$$

$$\Rightarrow p = k_H - k_H \times \chi_{\text{H}_2\text{O}}$$

$$p = (-k_H) \times \chi_{\text{H}_2\text{O}} + k_H$$

## 11. Ans. (1)

$$\pi_{\text{XY}} = 4\pi_{\text{BaCl}_2}$$

$$2 \times [\text{XY}] = 4 \times 3 \times 0.01$$

(Assuming same temperature)

$$\Rightarrow [\text{XY}] = 0.06 \text{ M}$$

$\therefore$  Ans. is (1)

## 12. Ans. (3)

$$\therefore P_N^0 > P_M^0$$

$$\therefore y_N > X_N$$

$$\& X_M > y_M$$

Multiply we get

$$y_N X_M > X_N y_M$$

$\therefore$  Ans. is (3)

13. Ans. (2)

Sol.  $K_f = 4 \text{ K-kg/mol}$

$$m = 0.03 \text{ mol/kg}$$

$$i = 3$$

$$\Delta T_f = iK_f \times m$$

$$\Delta T_f = 3 \times 4 \times 0.03 = 0.36\text{K}$$

14. Ans. (3)

Sol. Lowering of vapour pressure =  $p^0 - p = p^0 \cdot x_{\text{solute}}$

$$\begin{aligned} \therefore \Delta p &= 35 \times \frac{0.6/60}{\frac{0.6}{60} + \frac{360}{18}} \\ &= 35 \times \frac{.01}{.01+20} = 35 \times \frac{.01}{20.01} \\ &= .017 \text{ mm Hg} \end{aligned}$$

15. Ans. (1)

$$\text{Sol. } \Pi = \frac{\left(\frac{0.6}{60} + \frac{1.8}{180}\right)}{0.1} \times 0.08206 \times 300$$

$$\Pi = 4.9236 \text{ atm}$$

16. Ans. (3)

Sol.  $\Delta T_b = K_b \times m$

$$\therefore \frac{\Delta T_{b(A)}}{\Delta T_{b(B)}} = \frac{K_{b(A)}}{K_{b(B)}} \text{ as } m_A = m_B$$

$$\therefore \frac{\Delta T_{b(A)}}{\Delta T_{b(B)}} = \frac{1}{5}$$