Solution

SOLUTIONS AND COLLIGATIVE PROPERTIES

Class 12 - Chemistry

1.
   (b) More than that of water
   Explanation:
   They show positive deviation.

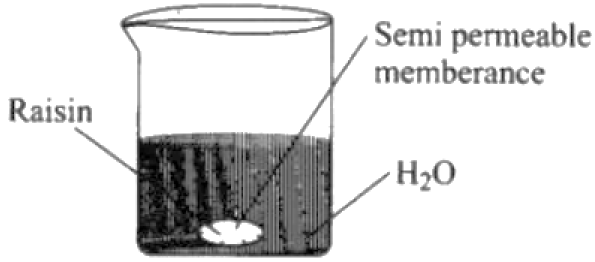
2.
   (c) 0.25
   Explanation:
   0.25

3.
   (c) hypertonic solution
   Explanation:
   The plant cell will shrink when placed in a hypertonic solution.
   Hypertonic solutions are more concentrated than the plant cell. The water from inside the cytoplasm of the cell diffuses out and the plant cell is said to have become flaccid. The cytoplasm has also shrunk and pulled away from the cell wall. This phenomenon is called plasmolysis.

4. **(a)** molar mass of solute (M)
   Explanation:
   Boiling Point Elevation is inversely proportional to the molar mass of the solute.

5.
   (d) Temperature
   Explanation: Temperature

6. On mixing equal volumes of ethanol and water, the total volume of the components increases. This is due to decrease in intermolecular forces of attraction the molecules of ethanol and water are loosely held., Thus it shows positive deviation from Raoult's law.
7. A membrane having the property that permits the flow of solvent molecules and not the solute molecules is called the semipermeable membrane SMP. During osmosis and reverse osmosis, only solvent molecules move across the semipermeable membrane.
8. a. Due to more solubility of oxygen in cold water than in warm water.
   b. Sprinkling of salt causes depression in freezing point and snow easily melts.
9. Negative deviation, Temperature increases
10. Osmotic pressure is the hydrostatic pressure applied on solution which just prevents the flow of solvent molecules through semipermeable membrane. It may be also defined as the excess pressure which must be applied to a solution to prevent the passage of solvent into it through a semipermeable membrane.
11. A solution (liquid mixtures) at certain concentration when continues to boil at constant temperature without change in its composition in solution & in vapour phase is called an azeotrope.
    Example: ethanol and water.
12. Raisins swell in size on keeping in water. This happens due to the phenomenon of osmosis. The outer skin of raisin acts as a semipermeable membrane. Water moves from a place of lower concentration to a place of higher concentration through the semipermeable membrane. Thus water enters inside the raisins and makes them swell.



Applications of the phenomenon

- Movement of the water from the soil into plant roots and subsequently into the upper portion of the plant is partly due to the process of osmosis.
- Preservation of meat against bacterial action by adding salt.
- Preservation of fruits against bacterial action by adding sugar. The bacterium in canned fruit loses water through the process of osmosis, shrivels, and dies.
- Reverse osmosis (the pure solvent flows out of the solution through a semi-permeable membrane) is used for the desalination of water.

13. Molar mass of CH_3CH_2CHCl COOH

$M_2 = (4 \times 12) + (7 \times 1) + (2 \times 16) + (1 \times 35.5) = 122.5 g/mol$

Number of moles of

CH_3CH_2CHCl COOH $= \frac{10}{122.5}$

= 8.16 × 10^{-2} mole

∴ Molality of the solution (m)

$(m) = \frac{8.16 \times 10^{-2} mol}{250} \times 1000\, g\, Kg^{-1}$

= 0.3264m

If x is the degree of dissociation of CH_3CH_2CHCl COOH then

$$\underset{\substack{n\,mol\,L^{-1}\\ n(x-1)}}{CH_3CH_2\,CHClCOOH} \rightleftharpoons \underset{\substack{0\\ nx}}{CH_3CH_2\,CHClCOO^-} + \underset{\substack{H^+\\ nx}}{}$$

To calculate Van't Hoff factor

Total moles of particles

= n[1 - x + x + x]

= n [1 + x]

$i = \frac{n(1+x)}{n} = 1 + x$

We know that

$x = \sqrt{\frac{K_a}{x}}$

$= \sqrt{\frac{1.4 \times 10^{-3}}{0.3264}}$ = 0.065

i = 1 + 0.065 = 1.065

$\Delta T_f = iK_f m$

= 1.065 × 1.86 × 0.3264 = 0.65°

14. 0.15 M solution means that 0.15 moles of C_6H_5COOH is present in 1 L

= 1000 mL of the solution

Molar mass of C_6H_5COOH = $M_2 = (7 \times 12) + (6 \times 1) + (2 \times 16) = 122 g/mol$

∴ 0.15 mole of benzoic acid

$= 0.15 \times 122 g = 18.3 g$

Thus

1000 mL of solution contains benzoic acid = 18.3 g

250 mL of solution will contain benzoic acid

$= \frac{18.3}{1000} \times 250$ = 4.575 g

15. Mass of solution = Mass of benzene (C_6H_6) + Mass of CCl_4

= 22 g + 122 g = 144 g

Mass percentage of $C_6H_6 = \frac{\text{Mass of benzene}}{\text{Mass of solution}} \times 100$

$= \frac{22g}{144g} \times 100$ = 15.28%

Mass percentage of $CCl_4 = \frac{122g}{144g} \times 100$ = 84.72% or 100-15.28 = 84.72%

16. a. Given,

$w_B\ (glucose)$ = 0.520 g

$w_A\ (H_2O)$ = 80.2 g

$K_f\ (H_2O) = 1.86 Km^{-1}$

$M_2(glucose) = 180\ g\ mol^{-1}$

$\Delta T_f = \frac{K_f \times w_B \times 1000}{M_B \times w_A}$

$\Delta T_f = \frac{1.86 Km^{-1} \times 0.520 g \times 1000}{180 g\ mol^{-1} \times 80.2 g}$

$\Delta T_f = 0.0669\ K\ or\ 0.0669^0 C$

$T_f^0 - T_f = 0.0669^0 C$

$0 - T_f = 0.0669^0 C$

$T_f = 0.0669^0 C$

b. Given, w_A = 500 g

Boiling point of solution $(\mathrm{T}_b) = 100.42^0\mathrm{C}$

$\mathrm{K}_b(H_2O) = 0.512\ K\ kg\ mol^{-1} M_2(C_3H_8O_3)$

$= (3 \times 2) + (8 \times 1) + (3 \times 16)$

$= 92\ g\ mol^{-1}$

$\Delta T_b = T_b - T_b^0$

$= 373.42 - 373\ K\ = 0.420\ K$

As we know

$\Delta T_b = \frac{k_b \times w_B \times 1000}{M_B \times\ w_A}$

$\Rightarrow\ w_B = \frac{\Delta T_b \times M_B \times w_A}{K_b \times 1000}$

$w_B = \frac{0.42\ K\ \times 92\ g\ mol^{-1} \times 500 g}{0.512\ K\ kg\ mol^{-} \times 100 kg^{-1}} = 377.3 g$

17. Molar mass of $Co(NO_3)_2 \cdot 6H_2O$

= 58.7 + 2(14 + 48) + 6 × 18

= 58.7 + 124 + 128

= 310.7 g mol^{-1}

No. of moles of $Co(NO_3)_2 \cdot 6H_2O$

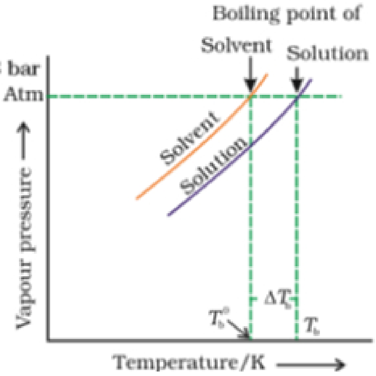
$= \frac{Mass}{Molar\ Mass}$

$= \frac{30g}{310.7\ g\ mol^{-1}}$ = 0.0966

Volume of solution = 4.3 L

Molarity of solution $= \frac{\text{No. of moles of solute}}{\text{Volume of solution in L}}$

$= \frac{0.0966\ mole}{4.3L} = 0.022 M$

18. a. 

Boiling point elevation refers to the Increase in the boiling point of a solvent upon the addition of a solute. When a non-volatile solute is added to a solvent, the resulting solution has a higher boiling point than that of the pure solvent

b. i = 3

π = i CRT

π = 3 $\times$ 0.025 $\times$ 0.0821 $\times$ 298/174 $\times$ 2

π = 5.27 $\times$ 10^{-3} atm.

19. a. 1 M has higher concentration than 1 m.

1 m solution = 1 mole in 1000 g solvent or 1 mole in 1000 cm^3 of solvent.

But 1 M solution = 1 mole in 1000 cm^3 of solution, i.e. solvent is less here.

b. $\Delta T_f = 0 - (-0.24^{\circ}C)$ = 0.24°C

$M_2 = \frac{1000 K_f W_2}{\Delta T_f W_1}$

$= \frac{1000 \times 1.86 \times 0.5}{0.24 \times 100} g\,mol^{-1}$ = 38.75 g mol^{-1}

Theoretical molar mass of KCl

= 39 + 35.5

= 74.5 g mol^{-1}

$i = \frac{\text{Calculate mol mass}}{\text{Theoretical mol mass}}$

$= \frac{74.5}{38.75} = 1.92$

$KCl \rightleftharpoons$	$K^+ +$	Cl^-
$1\ mole$	0	0
$1 - \alpha$	α	α

Total no. of moles after dissociation = $1 + \alpha$

$i = \frac{1+\alpha}{1} i - 1 = \alpha = 1.92 - 1$ = 0.92

Percentage dissociation = 92%