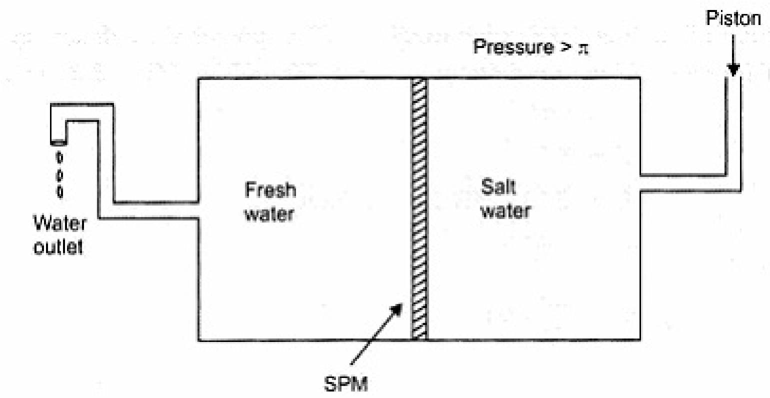
CBSE Test Paper-04

Class - 12 Chemistry (Solutions)

1. In which unit, the concentration of solution remains independent of temperature
   a. formality
   b. normaility
   c. molality
   d. molarity
2. Solubility of gas decreases with
   a. Increase in pressure
   b. Decrease in pressure
   c. Increase in temperature
   d. Decrease in temperature
3. Calculate the molarity of liquid HCl solution whose density is 1.17 g/cm^3.
   a. 36.5
   b. 32.05
   c. 18.25
   d. 42.10
4. Amalgam of mercury with sodium is an example of
   a. Solid in liquid
   b. Gas in solid
   c. Liquid in gas
   d. Liquid in solid
5. Which of the following colligative properties is associated with the concentration term maturity?
   a. Osmotic pressure
   b. Lowering of vap. pressure
   c. Elevation in b.p.
   d. Depression in f.p.
6. What are isotonic solutions?
7. Calculate the osmotic pressure of $0.25\,M$ solution of urea at 37^0C. $R = 0.083\,L\,bar/mol/k$.

8. Given below is the sketch of a plant for carrying out a process.



   i. Name the process occurring in the above plant.
   ii. To which container does the net flow of solvent take place?
   iii. Name one SPM which can be used in this plant.
   iv. Give on practical use of the plant.
9. State any two characteristics of ideal solution?
10. What are maximum boiling azeotropes? Give one example.
11. Urea forms an ideal solution with water. Determine the vapour pressure of an aqueous solution containing 10% by mass of urea at $40^0 C$. (Vapour pressure of water at $40^0 C$= 55.3 mm Hg)
12. At 300 K, 36 g of glucose present in a litre of its solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of the solution is 1.52 bars at the same temperature, what would be its concentration?
13. Define the term azeotrope?
14. Henry's law constant for the molality of methane in benzene at 298 K is $4.27 \times 105\, mm\, Hg$. Calculate the solubility of methane in benzene at 298 K under 760 mm Hg.
15. a. Define the relationship between lowering of vapour pressure and mole fraction of the volatile liquid.
    b. i. Benzoic acid completely dimerises in benzene. What will be the vapour pressure of a solution containing 61 g of benzoic acid per 500 g benzene when the vapour pressure of pure benzene at the temperature of experiment is 66.6 torr.
       ii. What would have been the vapour pressure in the absence of dimerisation?
       iii. Derive a relationship between mole fraction and vapour pressure of a component of an ideal solution in the liquid phase and vapour phase.

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Solutions

1. c. molality

   Explanation: It is independent of volume hence independent of Temperature.

2. c. Increase in temperature

   Explanation: Because of increase in kinetic energy of gas molecules with temperature their tendency to escape from the liquid will increase.

3. b. 32.05

   Explanation: $M = \frac{(1.17 * 1000)}{(36.5)}$ = 32.054

4. d. Liquid in solid

   Explanation: Solute is mercury(liquid) and solvent is sodium.

5. a. Osmotic pressure

   Explanation: Osmotic pressure depends on the number of solute particles irrespective of their nature relative to the total number of particles present in the solution.

6. Solutions of equimolar concentrations at the same temperature having same osmotic pressure, are known as isotonic solutions.
7. T = 37^0C = 310 k

   $\pi = CRT = \frac{n}{v}RT$

   $= 0.25 \times 0.083 \times 310$

   = 6.43 bar.
8. i. Reverse osmosis
   ii. In fresh water container from salt water.
   iii. Cellulose acetate is semipermeable membrane (SPM)
   iv. Purification of water and Desalination of sea water.
9. i. Ideal solutions follow Raoult's law exactly over the entire range of concentration.

   So P_A=$P^0{}_A$.x_A and P_B= $P^0{}_B$ .x_B

   ii. They can be separated by fractional distillation.
10. The solutions that show large negative deviation from Raoult's law form maximum

boiling azeotrope at a specific composition because they have a composition having maximum boiling point. For example: Nitric acid and water - 68% nitric acid and 32% water by mass with a boiling point of 393.5 K.

11. 10% by mass with mean 10 g urea is dissolved in 100 g solution.
    Mass of solvent (water) = 100-10=90 g
    No. of moles of urea = $\frac{10}{60} = 0.167\ mole$
    No. of moles of water = $\frac{90}{18} = 5\text{ mole}$
    Mole fraction of water $(x_{H_2O}) = \frac{5}{5+0.167}$
    $= 0.968$
    $\therefore$ Vapour pressure of solution = $P\ .\ x_{H_2O}$
    $= 55.3\text{ mm Hg} \times 0.968 = 53.53\text{ mm Hg}$
12. Here,
    T = 300 K
    π = 1.52 bar
    R = 0.083 bar L $K^{-1}mol^{-1}$
    Applying the relation,
    π = CRT
    $C = \frac{\pi}{RT}$
    $= \frac{1.52\,bar}{0.083\,bar\ L\ K^{-1}\ mol^{-1} \times 300\ k}$
    = 0.061 mol
    Since the volume of the solution is 1 L, the concentration of the solution would be 0.061 M.
13. 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.
14. Here,
    p = 760 mm Hg
    $k_H = 4.27 \times 10^5\,mm\,Hg$
    According to Henry's law,
    $p = k_H x$
    $x = \frac{p}{k_H}$
    $= \frac{760\,mm\,Hg}{4.27 \times 10^5\,mm\,Hg}$

$= 177.99 \times 10^{-5}$

= 178×10^{-5} (approximately)

Hence, the mole fraction of methane in benzene is 178×10^{-5}.

15. i. $\frac{\Delta P}{P^0} = ix_B$, $i = \frac{1}{2}$

$$x_B = \frac{n_B}{n_A + n_B} = \frac{\frac{W_B}{M_B}}{\frac{W_A}{M_A} + \frac{W_B}{M_B}} = \frac{\frac{61}{122}}{\frac{500}{78} + \frac{61}{122}}$$

$$x_B = \frac{0.5}{6.91}, \frac{\Delta P}{66.6} = \frac{1}{2} \times \frac{0.5}{6.91}$$

$$\Delta P = \frac{0.5 \times 66.6}{2 \times 6.91} = 2.41$$

P^0 - P = 2.41

p = 66.6 - 2.40

= 64.20 torr.

ii. In the absence of dimerisation.

i = 1

$$\frac{\Delta P}{P^0} = x_B$$

$\Delta P = \frac{0.5}{6.91} \times 66.6$ = 4.82

P = 66.6 - 4.82 = 61.78 torr.

iii. From Raoult's law

x_1 = mole fraction of liquid 1

x_2 = mole fraction of liquid 2

$$P_1 = x_1 P_1^0$$

$$P_2 = x_2 P_2^0$$

y_1 = mole fraction of component 1 in vapour phase.

y_2 = mole fraction of component 2 in vapour phase.

$$y_1 = \frac{P_1}{P_{total}} = \frac{P_1}{P_1 + P_2}$$

$$y_2 = \frac{P_2}{P_{total}} = \frac{P_2}{P_1 + P_2}$$

$$y_1 = \frac{x_1 P_1^0}{x_1 P_1^0 + x_2 P_2^0} = \frac{x_1 P_1^0}{x_1 P_1^0 + (1 - x_1) P_2^0}$$

$$y_2 = \frac{x_2 P_2^0}{x_1 P_1^0 + x_2 P_2^0}$$