

CBSE Test Paper-01
Class - 12 Chemistry (Solutions)

1. The molal depression constant depends upon
 - a. Vapour pressure of the solution
 - b. Heat of solution of the solute in the solvent
 - c. Nature of the solvent
 - d. Nature of the solute
2. Which among the following show negative deviation?
 - a. Chloroform and benzene
 - b. Acetone and benzene
 - c. Methyl alcohol and water
 - d. Carbon tetrachloride and chloroform
3. For ideal solution the volume of mixing of the pure components to form the solution is
 - a. $\Delta V_{mix} = -ve$
 - b. $\Delta V_{mix} = +ve$
 - c. $\Delta V_{mix} = 0$
 - d. None of these
4. Which will form maximum boiling azeotrope?
 - a. $C_2H_5OH + H_2O$
 - b. None of these
 - c. $HNO_3 + H_2O$
 - d. $C_6H_6 + C_6H_5CH_3$
5. When blood cells are placed in pure water, blood cells
 - a. Become white in colour
 - b. Shrinks
 - c. Diffuses in water
 - d. Swells up
6. Why melting point of a substance is used as a criterion for testing the purity of the substance?

-
7. Name two ways by which vapour pressure of a liquid can be lowered.
 8. Define the term osmotic pressure.
 9. Define cryoscopic constant?
 10. Why is osmotic pressure considered to be a colligative property?
 11. Why is ether not miscible in water?
 12. What type of mixtures of two liquids distill over at one temperature and why?
 13. Find the molality and molarity of a 15% solution of H_2SO_4 when its density is 1.10 g/cm^3 & molar mass = 98 amu.
 14. Calculate the molality of a solution containing 20.7 g of potassium carbonate dissolved in 500 ml of solution, assume density of solution = 1 g/ml.
 15. Two elements A and B form compounds having formula AB_2 and AB_4 . When dissolved in 20 g of benzene (C_6H_6), 1 g of AB_2 lowers the freezing point by 2.3 K whereas 1.0 g of AB_4 lowers it by 1.3 K. The molar depression constant for benzene is $5.1 \text{ K kg mol}^{-1}$. Calculate atomic masses of A and B.

CBSE Test Paper-01
Class - 12 Chemistry (Solutions)
Solutions

1. c. Nature of the solvent
Explanation: K_f is characteristic of solvent.
2. a. Chloroform and benzene
Explanation: The vapour pressure is lower than the solution, therefore it shows negative deviation.
3. c. $\Delta V_{mix} = 0$
Explanation: For ideal solution there is no increase or decrease in volume on mixing.
4. c. $\text{HNO}_3 + \text{H}_2\text{O}$
Explanation: Negatively deviated non ideal solution.
5. d. Swells up
Explanation: It swells up due to osmosis process and eventually burst.
6. A pure compound has a sharp melting point. Impurities present if any, lower the melting point of the compound (just because depression in freezing point takes place).
7. The two ways by which vapour pressure can be lowered are –
 - i. By decreasing the temperature.
 - ii. By adding a non- volatile solute.
8. 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.
9. When 1 mole of a solute (that neither dissociates nor associates) is dissolved in 1 kg of solvent, the depression in freezing point is called cryoscopic constant.
10. osmotic pressure is given as $\pi = CRT$ or $\pi = \frac{n}{v}RT$

Osmotic pressure depends only on the number of moles 'n' of the solute present in a definite volume of the solution V and there is no factor involving the nature of the solute. Also, osmotic pressure depends upon the molar concentration of solution. Hence, it is a colligative property.

11. Ether is not miscible in water because it cannot form H-bonds with water. However lower members of ethers are soluble in water. The solubility of ethers decreases from lower members to higher members due to increase in size of alkyl group which decreases the formation of hydrogen bonds with water.
12. Two types of liquid mixtures distil over at one temperature. Such mixtures are called azeotropic mixtures or constant boiling mixture.
 - i. Those which show positive deviation from Raoult's law and have the mole fraction corresponding to which the vapour pressure is maximum.
 - ii. Those which show negative deviation from Raoult's law and have the mole fraction corresponding to which the vapour pressure is lowest.. Hence for one of the intermediate composition, the total vapour pressure of such a solution will be highest and the boiling point will be lowest. At this point the composition of liquid and vapour phase is same and the liquid mixture boils at constant temperature and remains unchanged in composition. Therefore, this liquid mixture distills over as if it is a pure liquid. Solution acquires the property of boiling at constant temperature and remains unchanged in composition.

13. Volume = mass/density

$$= 100g/1.10g/cm^3 = 90.9cm^3$$

$$M = \% \times \text{density} \times 10/\text{molar}$$

$$\text{mass of solute} = 15 \times 1.1 \times \frac{10}{98} = 1.68M$$

$$\text{Molarity} = \frac{\text{no. of moles of H}_2\text{SO}_4}{\text{volume of solution}} \times 1000$$

$$\text{Molality} = \frac{\text{no. of moles of solute}}{\text{mass of solvent in kg}}$$

$$\frac{(15/98)}{85g} \times 1000 = 1.8 M$$

14. Molar mass of K_2CO_3

$$= \{2 \times 39\} + \{1 \times 12\} + \{3 \times 16\} = 138g/mol$$

$$\text{Amount of solute (K}_2\text{CO}_3) w_2 = 20.7g$$

Amount of water mass of solvent

$$= 500 - 20.7 = 479.3 \text{ g}$$

$$\therefore \text{Molality} = \frac{W_2 \times 1000}{M_2 \times W_1}$$

$$= \frac{20.7 \times 1000}{138 \times 479.3}$$

$$= 0.313 \text{ m}$$

15. We know that

$$M_2 = \frac{1000 \times w_2 \times k_f}{\Delta T_f \times w_1}$$

$$\text{Then, } M_{AB_2} = \frac{1000 \times 1 \times 5.1}{2.3 \times 20}$$

$$= 110.87 \text{ gmol}^{-1}$$

$$M_{AB_4} = \frac{1000 \times 1 \times 5.1}{1.3 \times 20}$$

$$= 196.15 \text{ gmol}^{-1}$$

Now, we have the molar masses of AB_2 and AB_4 as 110.87 gmol^{-1} and 196.15 gmol^{-1} respectively.

Let the atomic masses of A and B be x and y respectively.

Now, we can write:

$$x + 2y = 110.87 \dots \dots \dots (i)$$

$$x + 4y = 196.15 \dots \dots \dots (ii)$$

Subtracting equation (i) from (ii), we have

$$2y = 85.28$$

$$\Rightarrow y = 42.64$$

Putting the value of $y=42.64$ in equation (1), we have

$$x + 2 \times 42.64 = 110.87$$

$$\Rightarrow x = 25.59$$

Hence, the atomic masses of A and B are 25.59 u and 42.64 u respectively.

CBSE Test Paper-02
Class - 12 Chemistry (Solutions)

1. The rate at which a solid dissolves in liquid does not depend on
 - a. Concentration
 - b. Particle size
 - c. Temperature
 - d. Pressure
2. The tanks used by divers are filled with air diluted with
 - a. Helium
 - b. Argon
 - c. Nitrogen
 - d. Hydrogen
3. Normality of 0.3 M phosphoric acid is
 - a. 0.6
 - b. 0.1
 - c. 0.9
 - d. 0.5
4. To neutralize completely 40 mL of 0.1M aqueous solution of KOH, the volume of 0.1M aqueous solution of phosphoric acid required is
 - a. 40 mL
 - b. 20 mL
 - c. 10 mL
 - d. 60 mL
5. Which among the following show positive deviation?
 - a. Chloroform and benzene
 - b. Acetone and aniline
 - c. Hydrochloric acid and water
 - d. Acetone and carbon disulphide
6. Define the following terms:
 - i. Molality
 - ii. Molarity

-
7. What are constant boiling mixtures called?
 8. What are the factors on which vapour pressure depends?
 9. Show graphically the depression in freezing point on adding a non-volatile solute?
 10. Define the terms Mass percentage.
 11. 0.90 g of a non-electrolyte was dissolved in 87.90 g of benzene. This raised the boiling point of benzene by 0.25°C . If the molecular mass of non-electrolyte is 103.0 g/mol , Calculate the molal elevation constant for benzene?
 12. The density of 85% phosphoric acid is 1.70g/cm^3 . What is the volume of a solution that contains 17 g of phosphoric acid?
 13. A 0.1539 molal aqueous solution of cane sugar (mol mass = 342 g mol^{-1}) has a freezing point of 271 K while the freezing point of pure water is 273.15 K. What will be the freezing point of an aqueous solution containing 5 g of glucose (mol. Mass = 180 g mol^{-1}) per 100 g of solution.
 14. Calculate the mass percentage of benzene (C_6H_6) and carbon tetrachloride (CCl_4) if 22 g of benzene is dissolved in 122 g of carbon tetrachloride.
 15.
 - a. Explain giving examples the term colligative molality. Why do we sometimes get abnormal molecular masses of the substances using colligative properties of the solutions?
 - b. The freezing point depression of 0.1 molal solution of benzoic acid in benzene is 0.256 K. For benzene k_f is $5.12\text{ K kg mol}^{-1}$. Calculate the value of Van't Hoff factor for benzoic acid in benzene. What conclusion can you draw about the molecular state of benzoic acid in benzene.

CBSE Test Paper-02
Class - 12 Chemistry (Solutions)
Solutions

1. d. Pressure

Explanation: The rate at which a solid dissolves in liquid does not depend on pressure.

2. a. Helium

Explanation: Size of Helium is small so does not causes "Bents" to divers when the dive back to surface. As it is less soluble.

3. a. 0.9

Explanation: $N = M \times n_f$

$$N = 0.3 \times 3 = 0.9$$

4. b. 20 mL

Explanation: $M_1v_1 = M_2v_2$

$$N = M \times n_f$$

$$V=20\text{ml}$$

5. d. Acetone and carbon disulphide

Explanation: (Solute- solute and > solute – solvent interactions Solvent – solvent)

6. a. Molality is defined as the number of moles of the solute per kilogram of solvent.

$$\text{Molality}(m) = \frac{\text{Moles of solutes}}{\text{Mass of solvent in Kg}}$$

- b. Molarity (M) = Number of moles of solute dissolved in one litre of solution.

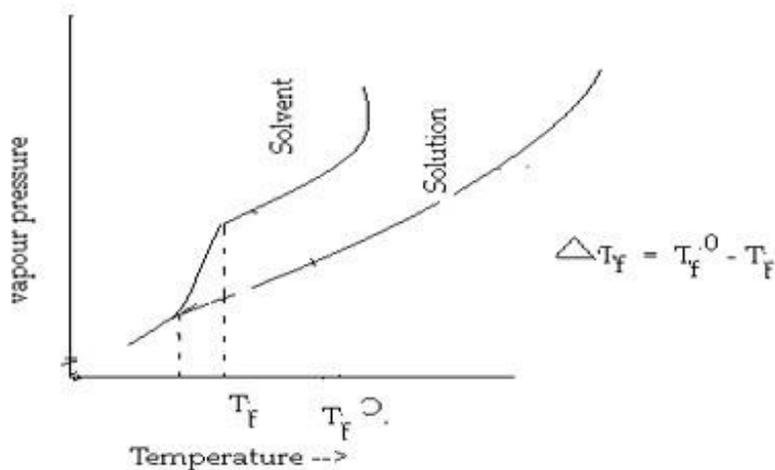
$$\text{Molarity}(M) = \frac{\text{No. of Moles of solute}}{\text{Volume of solution in litre}}$$

7. Azeotropes or azeotropic mixtures (meaning in greek boiling without change).

8. The factors on which vapour pressure depends are –

1. Temperature of the liquid.
2. Nature of the liquid.

9.



10. **Mass percentage:** The mass percentage of a component in a given solution is defined as the mass of the component per 100g of the solution.

$$\text{Mass \% of a component} = \frac{\text{Mass of the component in the solution}}{\text{Total mass of the solution}} \times 100$$

$$11. \Delta T_b = K_b \frac{W_{\text{solute}}}{W_{\text{solvent}}} \times \frac{1000}{M_{\text{solute}}}$$

$$K_b = \Delta T_b \times M_{\text{solute}} \times \frac{W_{\text{solvent}}}{W_{\text{solute}}} \times \frac{1}{1000}$$

$$= 103 \times 0.25 \times \frac{87.90}{0.90} \times \frac{1}{1000}$$

$$= 2.514 \text{ Kg/mol.}$$

12. 85 g phosphoric acid is present in 100 g of solution. 17 g of phosphoric acid is present in $\frac{100}{85} \times 17 = 20\text{g}$ of solution

$$\text{Volume of 17 g of 85\% acid} = \frac{\text{mass}}{\text{density}}$$

$$= \frac{20\text{g}}{1.70\text{gcm}^{-3}} = 11.8\text{cm}^3$$

$$13. \Delta T_f = 273.15 - 271\text{K}$$

$$= 2.15 \text{ K}$$

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

$$m = \frac{\Delta T_f}{K_f}$$

$$0.1539 = \frac{2.15}{K_f}, K_f = \frac{2.15}{0.1539}$$

$$W_2 = 5\text{g}$$

$$M_2 = 180 \text{ g mol}^{-1}$$

$$\Delta T_f = K_f \times m$$

$$= \frac{2.15}{0.1539} \times \frac{5}{180} \times \frac{1000}{95} = 4.08 \text{ K}$$

$$\Delta T_f = T_f^0 - T_f$$

$$T_f = T_f^0 - \Delta T_f$$

$$T_f = 273 - 4.08 = 268.92\text{K}$$

Freezing point of the solution $T_f = 268.92\text{K}$

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

$$= 22\text{ g} + 122\text{ g} = 144\text{ g}$$

$$\text{Mass percentage of } \text{C}_6\text{H}_6 = \frac{\text{Mass of benzene}}{\text{Mass of solution}} \times 100$$

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

$$\text{Mass percentage of } \text{CCl}_4 = \frac{122\text{g}}{144\text{g}} \times 100 = 84.72\% \text{ or } 100 - 15.28 = 84.72\%$$

15. The colligative properties like elevation in boiling point and depression in freezing point depend upon molality of solution, this is called colligative molality. We get abnormal molecular mass if the solute either undergoes association or dissociation.

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

$$0.256 = i \times 5.12 \times 0.1$$

$$i = \frac{0.256}{0.512} = \frac{1}{2}$$

As the value of van't hoff factor is less than 1, the benzoic acid undergoes association in solution.

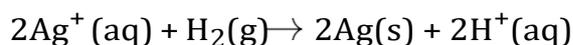
Benzoic acid exists as dimer in benzene.

CBSE Test Paper-03
Class - 12 Chemistry (Solutions)

1. Which of the following types of compounds will have Vant Hoff factor = 1?
- strong electrolytes
 - None of these
 - non electrolytes
 - weak electrolytes

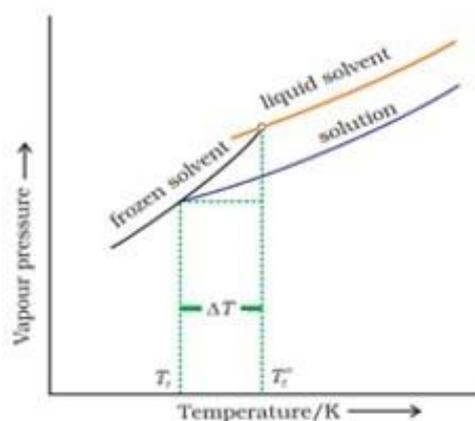
2. The sum of all mole fraction for a mixture is always equal to
- 0
 - 1
 - 3
 - 2

3. The e.m.f of the cell in which the reaction:



Occurs is 0.80 V. The standard reduction potential of Ag^+ / Ag electrode is:

- 0.80 V
 - 0.40 V
 - 0.80 V
 - 0.40 V
4. The following graph shows



- Depression in freezing point of the solvent
- Relative lowering of vapour pressure

-
- c. Elevation in boiling point of the solvent
 - d. Osmotic pressure
5. The boiling point of a solvent containing a non-volatile solute:
 - a. None of these
 - b. does not change
 - c. is elevated
 - d. is depressed
 6. What is meant by reverse osmosis?
 7. What do you expect to happen when Red Blood Corpuscles (RBC's) are placed in
 - i. 1% NaCl solution
 - ii. 0.5% NaCl solution.
 8. Define the term colligative properties?
 9. A person suffering from high blood pressure should take less common salt, why?
 10. Define Henry's law about solubility of a gas in a liquid.
 11. State Raoult's law for a binary solution containing volatile components.
 12. One litre of sea water weight 1030 g and contains about $6 \times 10^{-3}g$ of dissolved. Calculate the concentration of dissolved oxygen in ppm?
 13. Calculate the molarity of each of the following solutions:
 - a. 30 g of $Co(NO_3)_2 \cdot 6H_2O$ in 4.3 L of solution
 - b. 30 mL of 0.5 M H_2SO_4 diluted to 500 mL.
 14. Calculate the mass of a non-volatile solute (molar mass 40 g mol^{-1}) which should be dissolved in 114 g octane to reduce its vapour pressure to 80%.
 15. Amongst the following compounds, identify which are insoluble, partially soluble and highly soluble in water?
 - i. phenol
 - ii. toluene
 - iii. formic acid
 - iv. ethylene glycol
 - v. chloroform
 - vi. pentanol.
-

CBSE Test Paper-03
Class - 12 Chemistry (Solutions)
Solutions

1. c. non electrolytes

Explanation: non electrolytes- since no association or dissociation.

2. b. **Explanation:** $X_A = \frac{N_A}{(N_A+N_B)}$ and $X_B = \frac{N_B}{(N_A+N_B)}$

So $X_A + X_B = 1$

3. a. 0.80 V

Explanation: $2Ag^+_{(aq)} + H_{2(g)} \rightarrow 2Ag_{(s)} + 2H^+_{(aq)}$

Formula: $E_o = E_{cathode} - E_{anode}$

$E_o = E_{Ag^+/Ag} - E_{H^+/H_2} = +0.80 - 0 = +0.80 V$

At Cathode: $2Ag^+ + 2e^- \rightarrow 2Ag$ $E_o = +0.80 V$

At Anode: $H_2(g) \rightarrow 2H^+(aq) + 2e^-$ $E_o = 0 V$

Overall Cell reaction: $2Ag^+_{(aq)} + H_{2(g)} \rightarrow 2Ag_{(s)} + 2H^+_{(aq)}$ $E_o = 0.80 V$

4. a. Depression in freezing point of the solvent

Explanation: This graph is for depression in freezing point. Freezing point is the temperature at which vapour pressure of pure solid solvent becomes equal to vapour pressure of solution.

5. c. is elevated

Explanation: When a non volatile solute is added the elevation in BP takes place with decrease in vapour pressure.

6. Reverse osmosis is the process of movement of solvent through a semipermeable membrane from the solution to the pure solvent by applying pressure greater than osmotic pressure on the solution side.

7. i. Red blood cells will shrink due to plasmolysis as the water flows out of the cells.

Here the solution is hypertonic.

- ii. Red blood cells will swell and may even burst as the water flows into the cells.

Here the solution is hypotonic.

8. The properties which depends upon amount of solute and not upon the nature of

solute are called colligative properties.

- Common salt contains Na^+ and Cl^- which increase osmotic pressure of blood, therefore increase blood pressure. So an increase in salt intake retains the fluids which raises the blood pressure by increasing the blood volume and can increase the work load on the heart.
- Henry's law states that the solubility of a gas in a liquid is directly proportional to the pressure of the gas. Alternatively, Henry's law states that, 'the mass of a gas dissolved per unit volume of the solvent at a given temperature is proportional to the pressure of the gas in equilibrium with the solution.
- Raoult's law states that, 'At a given temperature, for a solution of volatile liquids, the partial vapour pressure of each volatile component in the solution is directly proportional to its mole fraction or equal to the product of the vapour pressure of the pure component and its mole fraction.

$$P_A = P_A^0 X_A, P_B = P_B^0 X_B$$

Where P_A and P_B are the partial vapour pressure of volatile component A and B respectively. P_A^0 and P_B^0 are vapour pressure of pure A and B respectively. X_A and X_B are mole fraction of A and B respectively.

- Mass of $\text{O}_2 = 6 \times 10^{-3} \text{g}$
ppm of O_2 in 10^3g sea water = $\frac{\text{mass of } \text{O}_2}{\text{mass of sea water}} \times 10^6$
 $= \frac{6 \times 10^{-3}}{1030} \times 10^6 = 5.8 \text{ppm}.$

- Molarity is given by: $\text{Molarity} = \frac{\text{Moles of solute}}{\text{Volume solution in litre}}$

- Molar mass of $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} = 59 + 2(14 + 3 \times 16) + (6 \times 18) = 291 \text{ g mol}^{-1}$

$$\text{Therefore, Moles of } \text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} = \frac{30}{291} \text{ mol}$$

$$= 0.103 \text{ mol}$$

$$\text{Therefore, molarity} = \frac{0.103 \text{ mol}}{4.3 \text{ L}}$$

$$= 0.023 \text{ M}$$

- Number of moles present in 1000 mL of 0.5 M $\text{H}_2\text{SO}_4 = 0.5 \text{ mol}$

$$\therefore \text{Number of moles present in 30 mL of 0.5 M } \text{H}_2\text{SO}_4 = \frac{0.5 \times 30}{1000} \text{ mol}$$

$$= 0.015 \text{ mol}$$

$$\text{Therefore, molarity} = \frac{0.015}{0.5 \text{ L}} \text{ mol}$$

$$= 0.03 \text{ M}$$

14. Given, vapour pressure is reduced to 80% when non-volatile solute is dissolved in octane. It means

$$\text{if } p_1^0 = 100 \text{ atm, then } p_1 = 80 \text{ atm.}$$

$$M_B = 40 \text{ g mol}^{-1}, w_A = 114 \text{ g}$$

$$\text{and } M_1(C_8H_{18}) = 114 \text{ g mol}^{-1}$$

$$\frac{p_1^0 - p_1}{p_1^0} = \frac{\frac{w_B}{M_B}}{\frac{w_B}{M_B} + \frac{w_A}{M_A}}$$

$$\frac{100 - 80}{100} = \frac{40}{\frac{w_B}{40} + \frac{114}{114}}$$

$$0.2 = \frac{w_B}{w_B + 40}$$

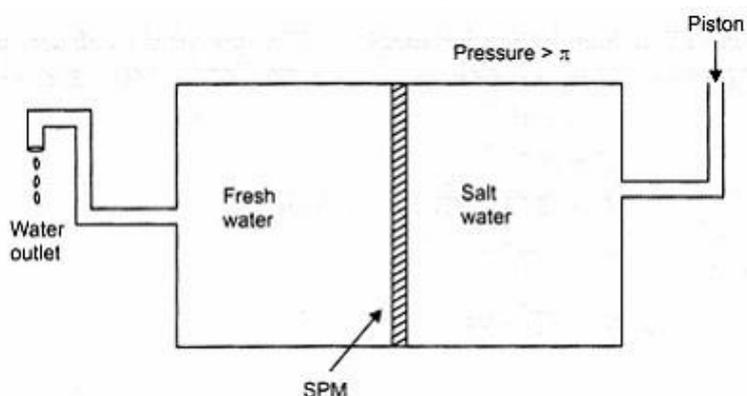
$$w_B = 10 \text{ g.}$$

15. i. Phenol (C_6H_5OH) has the polar group -OH and non-polar group $-C_6H_5$. Thus, phenol is partially soluble in water.
- ii. Toluene ($C_6H_5 - CH_3$) has no polar groups. Thus, toluene is insoluble in water.
- iii. Formic acid ($HCOOH$) has the polar group -OH and can form H-bond with water. Thus, formic acid is highly soluble in water.
- iv. Ethylene glycol () has polar -OH group and can form H-bond. Thus, it is highly soluble in water.
- v. Chloroform is insoluble in water.
- vi. Pentanol ($C_5H_{11}OH$) has polar -OH group, but it also contains a very bulky non-polar $-C_5H_{11}$ group. Thus, pentanol is partially soluble in water.

CBSE Test Paper-04
Class - 12 Chemistry (Solutions)

1. In which unit, the concentration of solution remains independent of temperature
 - a. formality
 - b. normality
 - 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 molarity?
 - 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°C .
 $R = 0.083 \text{ L bar/mol/K}$.

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 one 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 $40^{\circ}C$. (Vapour pressure of water at $40^{\circ}C = 55.3 \text{ mm Hg}$)
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 $4.27 \times 10^5 \text{ mm Hg}$. 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.

CBSE Test Paper-04
Class - 12 Chemistry (Solutions)
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. $T = 37^{\circ}C = 310 \text{ k}$

$$\pi = CRT = \frac{n}{V}RT$$
$$= 0.25 \times 0.083 \times 310$$

$$= 6.43 \text{ bar.}$$

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.

$$\text{So } P_A = P_A^0 \cdot x_A \text{ and } P_B = P_B^0 \cdot x_B$$

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 = $\frac{10}{60} = 0.167 \text{ mole}$

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 = $P \cdot x_{H_2O}$
= 55.3 mm Hg \times 0.968 = 53.53 mm Hg

12. Here,

T = 300 K

$\pi = 1.52 \text{ bar}$

R = 0.083 bar L $K^{-1} \text{ mol}^{-1}$

Applying the relation,

$\pi = CRT$

$$C = \frac{\pi}{RT}$$

$$= \frac{1.52 \text{ bar}}{0.083 \text{ bar L } K^{-1} \text{ mol}^{-1} \times 300 \text{ K}}$$

$$= 0.061 \text{ mol}$$

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

$k_H = 4.27 \times 10^5 \text{ mm Hg}$

According to Henry's law,

$p = k_H x$

$$x = \frac{p}{k_H}$$

$$= \frac{760 \text{ mm Hg}}{4.27 \times 10^5 \text{ mm Hg}}$$

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

$$= 178 \times 10^{-5} \text{ (approximately)}$$

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

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

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

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

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

$$P^0 - P = 2.41$$

$$p = 66.6 - 2.40$$

$$= 64.20 \text{ torr.}$$

ii. In the absence of dimerisation.

$$i = 1$$

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

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

$$P = 66.6 - 4.82 = 61.78 \text{ torr.}$$

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.

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

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

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

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

CBSE Test Paper-05
Class - 12 Chemistry (Solutions)

1. Aquatic animals are more comfortable in cold water rather than warm water because
 - a. Solubility of gas in liquid changes with pressure
 - b. They are cold blooded animals
 - c. Solubility of gas in liquid increases with decrease in temperature
 - d. Concentration increases with increase in temperature
2. The depression in freezing point for 1M urea, 1 M glucose and 1 M NaCl are in the ratio of
 - a. 1:1:2
 - b. 3:2:2
 - c. 1:1:1
 - d. 1:2:3
3. 0.1 M solution of urea, at a given temperature, is isotonic with:
 - a. 0.1 M glucose solution
 - b. 0.1 M BaCl₂ solution
 - c. 0.1 M NaCl solution
 - d. 0.02 M KCl solution
4. Liquid ammonia bottle is first cooled before opening because
 - a. Vapour pressure increases on cooling
 - b. None of these
 - c. Vapour pressure decreases on cooling
 - d. Vapour pressure of liquid ammonia is very low at room temperature
5. Greater the value of K_H , lower will be the
 - a. Pressure
 - b. Solubility
 - c. Concentration
 - d. Temperature
6. Give reason: When 30 ml of ethyl alcohol and 30 ml of water are mixed, the volume of resulting solution is more than 60 ml.
7. Give an example of a solution containing a liquid solute in a solid solvent.

-
8. How much urea (molar mass 60 g/mol) should be dissolved in 50 g of water so that its vapour pressure at room temperature is reduced by 25%?
 9. Name two factors on which the vapour pressure of the liquid depend?
 10. What happens when blood cells are placed in pure water?
 11. Define the terms: Van't Hoff factor
 12. 100 mg of a protein is dissolved in just enough water to make 10.0 mL of solution. If this solution has an osmotic pressure of 13.3 mm Hg at 25°C what is the molar mass of the protein?
($R = 0.0821 \text{ L at mol}^{-1} \text{ K}^{-1}$ 760 mm Hg = 1 atm)
 13. Calculate the molarity and molality of a 15% solutions (by weight) of sulphuric acid density 1.020 g cm^{-3} (Atomic mass H = 1, O = 16 ,S = 32 amu).
 14. Calculate the mass of ascorbic acid (Vitamin C, $C_6H_8O_6$) to be dissolved in 75 g of acetic acid to lower its melting point by 1.5°C . $K_f = 3.9 \text{ K kg mol}^{-1}$
 15. Henry's law constant for CO_2 in water is $1.67 \times 10^8 \text{ Pa}$ at 298 K. Calculate the quantity of CO_2 in 500 mL of soda water when packed under 2.5 atm CO_2 pressure at 298 K.

CBSE Test Paper-05
Class - 12 Chemistry (Solutions)
Solutions

1. c. Solubility of gas in liquid increases with decrease in temperature

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

2. a. 1:1:2

Explanation: NaCl has $i=2$ while urea and glucose will have $i=1$

3. a. 0.1 M glucose solution

Explanation: 0.1 M solution of urea, at a given temperature, is isotonic with 0.1 M glucose solution as both are non electrolytic.

4. a. Vapour pressure decreases on cooling

Explanation: Vapour pressure decreases on cooling so that it remain in liquid state rather than going in vapour state.

5. a. Solubility

Explanation: $P_{gas} = K_H \times X_{gas}$. X_{gas} is measure of solubility of gas.

6. Ethyl alcohol and water are non ideal solutions which show positive deviation from Raoult's law. The forces of attraction becomes less in ethyl alcohol and water mixture as compared to pure ethanol and pure water. Hence the vapour pressure of the mixture increases. Due to decrease in magnitude of intermolecular forces in solutions, the molecules of ethanol and water will be loosely held and there will be increase in volume on mixing ethanol and water. i.e., $\Delta_{mixing}V = +ve$

7. Amalgam of mercury with sodium. They are called solid solutions.

8.
$$\frac{P_A^0 - P_A}{P_A^0} = \frac{W_B \times M_A}{W_A \times M_B}$$

P_A^0 = Vapour pressure of water = 100

P_A = Vapour pressure of solution = 75

W_B = mass of urea = ?

M_A = molar mass of water = 18g

$$W_A = \text{mass of water} = 50\text{g}$$

$$M_B = \text{molar mass of urea} = 60\text{g/mol}$$

$$\frac{100-75}{100} = \frac{W_B \times 18}{50 \times 60}$$
$$W_B = \frac{25 \times 60 \times 50}{100 \times 18} = 41.66\text{g}$$

9. Vapour pressure depends upon

i. Nature of liquid: Each liquid has different magnitude of intermolecular forces.

Those with weak intermolecular forces tend to escape into vapour phase and have greater vapour pressure.

ii. Temperature: Vapour pressure of a liquid increases with increase in temperature.

As the molecules acquire kinetic energy and tend to escape from vapour phase resulting in higher vapour pressure.

10. Due to osmosis, water molecules move into blood cells through the cell walls. As a result, blood cells swell and may even burst. Osmosis is the process of movement of molecules from lower concentration to higher concentration.

11. **Van't Hoff factor:** Van't Hoff factor 'i' is a correction factor defined as the ratio between the actual concentration of particles produced when the substance is dissolved and the concentration of a substance as calculated from its mass.

$$i = \frac{\text{Observed value of colligative property}}{\text{Normal value of colligative property}}$$

12. Here $W = 100 \text{ mg} = 0.100 \text{ g}$

$$V = 10.0 \text{ mL} = 0.01 \text{ L}$$

$$\pi = 13.33 \text{ mm Hg} = \frac{13.3}{760} \text{ atm}$$

$$T = 25^\circ\text{C} = 25 + 273 = 298 \text{ K}$$

$$R = 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$$

$$M = ?$$

$$\text{Molar Mass } M = \frac{WRT}{\pi V}$$
$$= \frac{0.1 \times 0.0821 \times 298}{\frac{13.3}{760} \times 0.01}$$
$$= \frac{0.1 \times 0.0821 \times 298 \times 760}{13.3 \times 0.01}$$
$$= \frac{1859 \times 4008}{0.133} = 13980.4 \text{ g mol}^{-1}$$

$$13. M = \frac{W_B}{M_B \times V_L}$$

$$\text{Molecular weight of } \text{H}_2\text{SO}_4 = M_B = (2 \times 1) + (1 \times 32) + (4 \times 16)$$

$$= 98 \text{ gmol}^{-1}$$

$$\begin{aligned}
&= \frac{15g \times 1000}{98g/mol \times 115g \times 1.02g/cm^3} \\
&= \frac{15000}{11495.4} M = 1.3048 \text{ molar} \\
\text{m (molality)} &= \frac{W_B \times 1000}{W_B \times 100g} \\
&= \frac{15g \times 10}{98g/mol^{-1}} = \frac{150}{98} = 1.53 \text{ molal.}
\end{aligned}$$

14. Mass of acetic acid, $w_1 = 75g$

$$\begin{aligned}
&\text{Molar mass of ascorbic acid } (C_6H_8O_6), M_2 = 6 \times 12 + 8 \times 1 + 6 \times 16 \\
&= 176g/mol^{-1}
\end{aligned}$$

Lowering of melting point, $\Delta T_f = 1.5K$

We know that:

$$\begin{aligned}
\Delta T_f &= \frac{K_f \times w_2 \times 1000}{M_2 \times w_1} \\
w_2 &= \frac{\Delta T_f \times M_2 \times w_1}{K_f \times 1000} \\
&= \frac{1.5 \times 176 \times 75}{3.9 \times 1000} = 5.08 \text{ g (approx)}
\end{aligned}$$

Hence, 5.08 g of ascorbic acid is needed to be dissolved.

15. $K_H = 1.67 \times 10^8 \text{ Pa}$

$$P_{CO_2} = 2.5 \text{ atm} = 2.5 \times 101325 \text{ Pa}$$

Applying Henry's law,

$$P_{CO_2} = K_H \times x_{CO_2}$$

$$\begin{aligned}
x_{CO_2} &= \frac{P_{CO_2}}{K_H} \\
&= \frac{2.5 \times 101.325 Pa}{1.67 \times 10^8 Pa} \\
&= 1.517 \times 10^{-3}
\end{aligned}$$

$$\text{i.e. } \frac{n_{CO_2}}{n_{H_2O} + n_{CO_2}} = \frac{n_{CO_2}}{n_{H_2O}} = 1.517 \times 10^{-3}$$

For 500 mL of soda water, water present = 500 mL

$$= 500g = \frac{500g}{18g/mol^{-1}} = 27.78 \text{ moles}$$

$$\therefore \frac{n_{CO_2}}{n_{H_2O}} = 1.517 \times 10^{-3}$$

$$\frac{n_{CO_2}}{27.78} = 1.517 \times 10^{-3}$$

$$n_{CO_2} = 1.517 \times 10^{-3} \times 27.78 = 42.14 \text{ m mol}$$

$$= 42.14 \times 10^{-3} \times 44g = \text{mass of carbondioxide}$$

$$= 1.854 \text{ g}$$