CBSE Class 12 physics

Important Questions

Chapter 2

Solutions

2 Marks Questions

1. Calculate the volume of water which could be added to 20 ml of 0.65 m HCl to dilute the solution to 0.2 m?

Ans.For dilution –

$$M_1V_1 = M_2V_2$$

$$V_2 = \frac{M_1V_1}{M_2} = \frac{0.65M \times 20 \text{ ml}}{0.2M} = 65 \text{ ml}$$

Vol of water to be added to 20 ml = $V_2 - V_1$ = 65ml – 20ml = 45 ml.

2. A solution is prepared by dissolving 11g glucose in $200\ cm^3$ water at $30^0 C$. What is the mass Percentage of glucose in solution? The density of water

$30^0 C$ is $0.996\ g/cm^3$?

Ans.Density = $\frac{mass}{volume} = 0.996 \text{ g/cm}^3$

0.996 = $\frac{mass}{200cm^3}$

$Mass = 0.996 \times 200$ = 199.2 g

Mass% of glucose = $\frac{mass \text{ of volume}}{mass \text{ of water } + \text{ mass of glucose}} \times 100$

$$= \frac{11}{199.2 + 11} 100 = 5.23\ \%$$

3. Carbon tetrachloride and water are immiscible whereas alcohol and water are miscible. Explain on the basis of molecular structures of there compounds.

Ans.Carbon tetrachloride is a non-polar compound whereas water is a polar compound. They do not interact with each other and carbon tetrachloride cannot dissolve in water whereas alcohol and water are completely miscible due to high polarity.

4. Why do mountaineers carry oxygen cylinder while climbing mountains?

Ans.At high attitudes the partial pressure of oxygen is less than that of the ground level which decreases the concentration of oxygen in blood and tissues. Low blood oxygen causes climbers to become weak and unable to think clearly & they suffer from anoxia. To avoid such situations, mountaineers carry oxygen cylinder while climbing.

5. Plot a graph between vapour pressure and mole fraction of a solution obeying Raoult's Law at constant temperature?

Ans.

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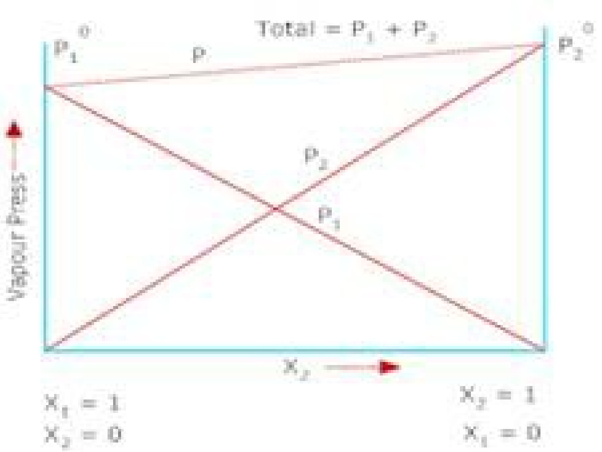


6. Name different colligative properties?

Ans. The colligative properties are –

a) Relative lowering of vapour pressure.

b) Elevation in boiling point.

c) Depression in freezing point

d) Osmotic pressure.

7. Give the characteristics of ideal solution?

Ans. An ideal solution is formed from two liquids only when –

a) They obey Raoult's Law

b) ΔHmix = 0

c) ΔVmix = 0

d) The various inter molecular forces are identical.

8. A mixture of chlorobenzene and bromobenzene is a nearly an ideal solution but a mixture of chloroform and acetone is not Explain?

Ans. Chlorobezene & bromobenzene both have similar structure and polarity. Therefore the various interactions (solute – solute, solvent – solvent & solute – solvent) are same whereas in chloroform and acetone initially there is no hydrogen bonding but after mixing solute solvent interactions (H –bond) become stronger and solution deviates from ideal behaviour.

9. 0.90g of a non – electrolyte was dissolved in 87.90g of benzene. This raised the boiling point of benzene by $0.25^0 C$. If the molecular mass of non – electrolyte is 103.0 g/mol, calculate the molal elevation constant for benzene?

Ans. $\Delta T_b = K_b \frac{Wsolute}{Wsolvent} \times \frac{1000}{Msolute}$

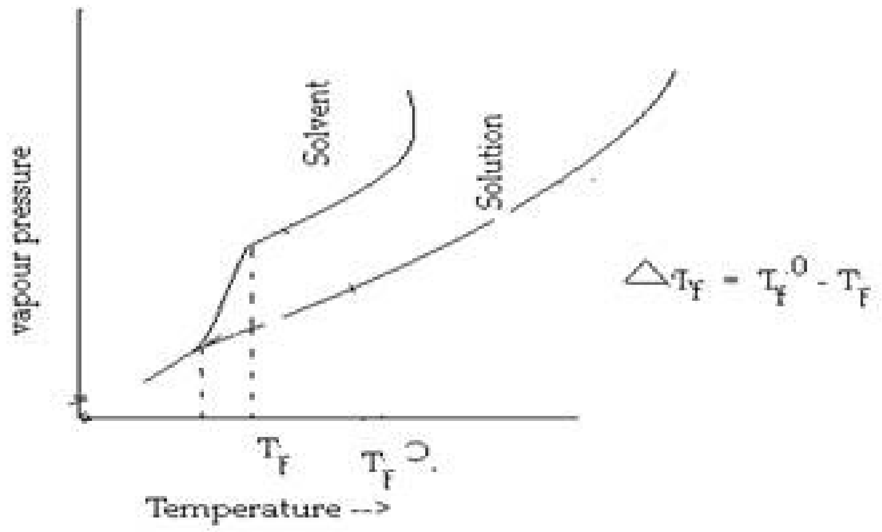
$$K_b = \Delta T_b \times Msolute \times \frac{Wsolvent}{Wsolute} \times \frac{1}{1000}$$

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

= 2.514 k kg/mol.

10. Show graphically the depression in freezing point on adding a non volatile solute?

Ans.



11. Define cryoscopic constant?

Ans. When 1 mole of a solute (that neither dissociates nor associates) is dissolved in 1kg of solvent, the depression in freezing point is called cryoscopic constant.

12. When 20g of a non – volatile solid is added to 250 ml of water, the freezing point of water becomes $-0.9^0 C$. Calculate molecular mass of the solid if kf of water is $1.86^0 Ckg/mol$.

Ans. 250 ml = 250g as density of water = 1g/ml

Freezing pt of water = 273k

Freezing point of solution = - 0.90C+273 = 272.1k

ΔT_f = 273 k – 272.1k = 0.9k

$$M_{solute} = \frac{K_f \times W_{solute} \times 1000}{\Delta T_f \times W_{solvent}}$$

$$= \frac{1.86 \times 26 \times 1000}{0.9 \times 250} = 165.3 \text{ g/mol}.$$

13. Give various expressions for van’t Hoff factor?

Ans.i= $\frac{\text{Normal Molar mass}}{\text{Abnormal molar mass}}$

= $\frac{\text{Observed colligative property}}{\text{Calculated colligative property}}$

= $\frac{\text{Total no. of moles of particles after association/dissociation}}{\text{Total no. of moles of particles before association/dissociation}}$

14. How are the various colligative properties modified after consideration of van't Hoff factor?

Ans. a) $\frac{p_1^0 - p_1}{p_1^0} = i \ X_2$

b) $\Delta T_b = i \ K_b m$

c) $\Delta T_f = \ i \ K_f \ m$

d) $\pi = i \ CRT$

15. The boiling point elevation of 0.6 g acetic acid in 100g benzene is 0.1265k. What conclusion can you draw about the state of solute in solution? Molar elevation constant for benzene is 2.53 deg per molar?

Ans. Molality of acetic acid = $\frac{0.6}{60} \times \frac{1000}{100}$

= 0.10 m.

$\Delta T_b = K_b \times m$

M = $\frac{\Delta T_b}{K_b} = \frac{0.1265}{2.53} = 0.050 \text{ m}$

i = $\frac{0.050}{0.10} = 0.50$

Since i = $\frac{1}{2}$, acetic acid exist an dimer in solution.

16. The osmotic pressure of a 0.0103 molar solution of an electrolyte is found to be 0.70 atm at $273^0 C$. Calculate van’t Hoff factor. R=0.082 L atm/1 mol/k?

Ans. i = 2.76 The solute is dissociated in solution.

17. Calculate the mass percentage of aspirin $(C_9H_8O_4)$ in acetonitrile (CH_3CN) when 6.5 g of $C_9H_8O_4$ is dissolved in 450 g of CH_3CN.

Ans. 6.5 g of $C_9H_8O_4$ is dissolved in 450 g of CH_3CN.

Then, total mass of the solution = (6.5 + 450) g

= 456.5 g

Therefore, mass percentage of $C_9H_8O_4$ = $\frac{6.5}{456.5}\times 100\%$

= 1.424%

18. If the density of some lake water is $1.25 g\ ml^{-1}$ and contains 92 g of Na^+ ions per kg of water, calculate the molality of Na^+ ions in the lake.

Ans. Number of moles present in 92 g of Na^+ ions = $-\frac{92g}{23g\ mol^{-1}}$

= 4 mol

Therefore, molality of Na+ ions in the lake $\frac{4\,mol}{1kg}$

= 4 m

19. 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?

Ans. 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.

20. Suggest the most important type of intermolecular attractive interaction in the following pairs.

(i) n-hexane and n-octane

(ii) I_2 and CCl_4

(iii) $NaClO_4$ and water

(iv) methanol and acetone

(v) acetonitrile CH_3CN and acetone (C_3H_6O).

Ans. **(i)** Van der Wall's forces of attraction.

(ii) Van der Wall's forces of attraction.

(iii) Ion-diople interaction.

(iv) Dipole-dipole interaction.

(v) Dipole-dipole interaction.

21. Based on solute-solvent interactions, arrange the following in order of increasing solubility in n-octane and explain. Cyclohexane, KCl, CH_3OH , CH_3CN .

Ans. *n*-octane is a non-polar solvent. Therefore, the solubility of a non-polar solute is more than that of a polar solute in the *n*-octane.

The order of increasing polarity is:

Cyclohexane < CH_3CN < CH_3OH < KCl

Therefore, the order of increasing solubility is:

KCl < CH_3OH < CH_3CN < Cyclohexane

22. A sample of drinking water was found to be severely contaminated with chloroform ($CHCl_3$) supposed to be a carcinogen. The level of contamination was 15 ppm (by mass):

(i) express this in percent by mass

(ii) determine the molality of chloroform in the water sample.

Ans. **(i)** 15 ppm (by mass) means 15 parts per million (106) of the solution.

Therefore, percent by mass = $\frac{15}{10^6} \times 100\%$

= $1.5 \times 10^{-3}\%$

(ii) Molar mass of chloroform $(CHCl_3) = 1 \times 12 + 1 \times 1 + 3 \times 35.5$

= 119.5 g mol^{-1}

Now, according to the question,

15 g of chloroform is present in 106 g of the solution.

i.e., 15 g of chloroform is present in $\left(106-15\right)^{\circ}$ 106 g of water.

Therefore, Molality of the solution = $\dfrac{\dfrac{15}{119.5}\,\text{mol}}{10^{6}\times 10^{-3}\,\text{Kg}}$

= $1.26\times 10^{-4}\,\text{m}$

23. What role does the molecular interaction play in a solution of alcohol and water?

Ans. In pure alcohol and water, the molecules are held tightly by a strong hydrogen bonding. The interaction between the molecules of alcohol and water is weaker than alcohol-alcohol and water-water interactions. As a result, when alcohol and water are mixed, the intermolecular interactions become weaker and the molecules can easily escape. This increases the vapour pressure of the solution, which in turn lowers the boiling point of the resulting solution.

24. Why do gases always tend to be less soluble in liquids as the temperature is raised?

Ans. Solubility of gases in liquids decreases with an increase in temperature. This is because dissolution of gases in liquids is an exothermic process.

$$\text{Gas}+\text{Liquid}\rightarrow\text{Solution}+\text{Heat}$$

Therefore, when the temperature is increased, heat is supplied and the equilibrium shifts backwards, thereby decreasing the solubility of gases.

25. Give an example of solid solution in which the solute is a gas.

Ans. In case a solid solution is formed between two substances (one having very large particles and the other having very small particles), an interstitial solid solution will be formed. For example, a solution of hydrogen in palladium is a solid solution in which the solute is a gas.