Chemistry Class 12 NCERT Solutions: Chapter 2 Solutions Part 6

Q: 5. 10% w/w solution of glucose in water means that $10g$ of glucose in present in $100g$ of the solution i.e.. , 10 g of glucose is present in $(100-10)\,g = 90g$ of water.

Molar mass of glucose $(C_6H_{12}O_6) = 6\times 12 + 12\times 1 + 6\times 16 = 180 gmol^{-1}$

Then, number of moles of glucose $= \frac{10}{180} mol$

$= 0.056\, mol$

$\therefore$ Molality of solution $= \frac{0.056\, mol}{0.09\, kg} = 0.62m$

Number of moles of water $= \frac{90g}{18 gmol^{-1}}$

$= 5\, mol$

$(x_g) = \frac{0.056}{0.056+5}$

$\Rightarrow$ Mole fraction of glucose $= 0.011$

And, mole fraction of water $x_w = l - x_g$

$= 1 - 0.011$

$= 0.989$

If the density of the solution is $1.2 gmL^{-1}$, then the volume of the $100g$ solution can be given as:

$= \frac{100g}{1.2 gmL^{-1}}$

$= 83.33\, mL$

$= 83.33\times 10^{-3} L$

$\therefore$ Molarity of the solution $= \frac{0.056\, mol}{83.33\times 10^{-3} L}$

$= 0.67M$

Q: 6. How many mL $\text{of} 0.1M\ HCl$ are required to react completely with $1g$ mixture of Na_2CO_3 and $NaHCO_3$ containing equimolar amounts of both?

Ans:

Let the amount of Na_2CO_3 in the mixture be x g.

Then, the amount of $\mathrm{NaHCO_3}$ in the mixture is $(1-x)\,g$.

Molar mass of $Na_2CO_3 = 2\times 23 + 1\times 12 + 3\times 16$

$= 106 g mol^{-1}$

$\therefore$ Number of moles $Na_2CO_3 = \frac{x}{106} mol$

Molar mass of $\mathrm{NaHCO_3} = 1\times 23 + 1\times 1\times 12 + 3\times 16$

$= 84 g mol^{-1}$

$\therefore$ Number of moles of $\mathrm{NaHCO_3} = \frac{1-x}{84} mol$

According to the question,

$$\frac{x}{106} = \frac{1-x}{84}$$

$$\Rightarrow 84x = 106 - 106x$$

$$\Rightarrow 190x = 106$$

$$\Rightarrow x = 0.5579$$

Therefore, number of moles of $Na_2CO_3 = \frac{0.5579}{106} mol$

$= 0.0053\ mol$

And, number of moles of $\mathrm{NaHCO_3} = \frac{1-0.5579}{84}$

$= 0.0053\ mol$

HCl reacts with Na_2CO_3 and $\mathrm{NaHCO_3}$ according to the following equation.

$$2HCl + Na_2CO_3 \rightarrow 2NaCl + H_2O + CO_2$$

$2\ mol$ $1\ mol$

$$HCl + NaHCO_3 \rightarrow NaCl + H_2O + CO_2$$

$1\ mol$ $1\ mol$

1 mol of Na_2CO_3 reacts with 2 mol of HCl .

Therefore, 0.0053 mol of Na_2CO_3 reacts with 2×0.0053 mol $= 0.0106\ mol$.

Similarly, 1 mol of $\mathrm{NaHCO_3}$ reacts with 1 mol of HCl .

Therefore, 0.0053 mol of $\mathrm{NaHCO_3}$ reacts with 0.0053 mol of HCl .

Total moles of HCl required $= (0.0106 + 0.0053)\ mol$

$= 0.0159\ mol$

In $0.1M$ of HCl

0.1mol of HCl is preset in 1000 mL of the solution.

Therefore, 0.0159 mol of HCl is present in $\frac{1000 \times 0.0159}{0.1} mol$

$= 159\, mL$ of the solution

Hence, $159\text{mL of} 0.1 M \text{of HCl}$ is required to react with $_{1g}$ mixture of Na_2CO_3 and NaHCO_3, containing equimolar amounts of both.

Q: 7. A solution is obtained by mixing $300 g \text{of} 25\%$ solution and $400 g \text{of} 40\%$ solution by mass. Calculate the mass percentage of the resulting solution.

Answer:

Total amount of solute present in the mixture is given by,

$$300 \times \frac{25}{100} + 400 \times \frac{40}{100}$$

$$= 75 + 160$$

$$= 235 g$$

Total amount of solution $= 300 + 400 = 700 g$

Therefore, mass percentage (w/w) of the solute in the resulting solution, $= \frac{235}{700} \times 100\%$

$$= 33.57\%$$

And, mass percentage (w/w) of the solvent in the resulting solution,

$$= (100 - 33.57)\,\%$$

$$= 66.43\%$$