EXERCISE SOLVED NUMERICAL

Q.1 A solution contains 50 g of sugar dissolved in 450 g of water. What is concentration of this solution?

Given Data:

Mass of sugar solute = 50g
Mass of water solvent = 450g

Required:

Concentration of solution (% m/m) = ?

Solution:

$$\% \text{ m/m} = \frac{\text{Mass of solute}(g)}{\text{Mass of solute}(g) + \text{Mass of solvent}(g)} \times 100$$

Solution:

$$\% \text{ m/m} = \frac{50g}{50g + 45g} \times 100$$

$$= \frac{50g}{500g} \times 100$$

Thus,

% m/m = 10% m/m

Q.2 If 60 cm^3 of alcohol is dissolved in 940 cm^3 of water, what is concentration of this solution?

Given Data:

Volume of alcohol solute = v = 60 cm^3
Volume of water solvent = v = 940 cm^3

Required Data:

Concentration of solution (% v/v) = ?

Formula:

$$\%v/v = \frac{\text{volume of solute}(cm^3)}{\text{volume of solute}(cm^3) + \text{volume of solvent}(cm^3)} \times 100$$

Solution:

$$\% \text{ v/v} = \frac{60cm^3}{60\ cm^3 + 940cm^3} \times 100$$

$$= \frac{60\ cm^3}{1000cm^3} \times 100$$

Thus % v/v = 6%v/v

Q.3 How much salt will be required to prepare following solutions (atomic mass: K=39; Na=23; S=32; O=16 and H=I)

(a) 250 cm^3 of KOH solution of 0.5 M
(b) 600 cm^3 of $NaNO_3$ solution of 0.25 M
(c) 800 cm^3 of Na_2SO_4 solution of 1.0 M

Ans:

(a) 250cm^3 of KOH solution of 0.5M

Given Data:

Molarity of solution = (M) = 0.5 M

Volume of solution $= 250\ cm^3 = \frac{250}{1000} dm^3 = 0.25 dm^3$

Molar mass of KOH $= 39+16+1 = 56 g mol^{-1}$

Required Data:

Mass of KOH $= ?$

Solution:

$$\text{Molarity} = \frac{\text{Mass of solute (g)}}{\text{Molar mass of solute } (g mol^{-1}) \times \text{volume of solution } (dm^3)}$$

$$0.5M = \frac{\text{Mass of solute (g)}}{56 g\ mol^{-1} \times 0.25 dm^3}$$

$$\text{Mass of solute} = 0.5 \times 56 \times 0.25$$

$$= 7g$$

(b) $600cm^3$ of $NaNO_3$ solution of 0.25M

Given Data:

Molarity of $NaNO_3$ solutoin $= (M) = 0.25M$

Volume of solution $= 600\ cm^3 = \frac{600}{1000} = 0.6 dm^3$

Molar mass of $NaNO_3$ $= 23 + 14 + 3(16)$

$= 85 g mol^{-1}$

Required:

Amount of $NaNO_3$ $= m = ?$

Solution:

Using the formula:

$$\text{Molarity} = \frac{\text{Mass of solute (g)}}{\text{Molarmass of solute } (g mol^{-1}) \times \text{Volume of solution } (dm^3)}$$

$$\text{Molarity} = \frac{\text{Mass of solute (g)}}{85 g mol^{-1} \times 0.6 dm^3}$$

$$\text{Mass of solute} = 0.25 \times 85 \times 0.6$$

$$\text{Mass of solute} = 12.75g$$

(c) $800cm^3$ of Na_2SO_4 solution of 1.0M

Given Data:

Molarity of Na_2SO_4 solution $= M = 1\ M$

Volume of solution $= V = 800\ cm^3 = \frac{800}{1000} = 0.8 dm^3$

Molecular mass of Na_2SO_4 $= 2(23) + 32 + 4(16)$

$= 46 + 32 + 64$

$= 142 g mol^{-1}$

Required:

Mass of Na_2SO_4 $= ?$

Solution:

Using the formula

$$\text{Molarity} = \frac{\text{Mass of solute (g)}}{\text{Molar mass of solute } (g mol^{-1}) \times \text{Volume of solution } (dm^3)}$$

$$1.0M = \frac{\text{Mass of solute}}{142 g mol^{-1} \times 0.8 dm^3}$$

$$\text{Mass of solute} = 1.0 \times 142 \times 0.8$$

$$= 113.6g$$

Q.4 When we dissolve 20 g of NaCl in 400 cm^3 of solution, what will be its molarity?

Given Data:

Mass of NaCl = 20g

Molar mass of NaCl = 23 + 35.5 = 58.5$gmol^{-1}$

Volume of Solution = 400 cm^3 = $\frac{400}{1000} 0.4 dm^3$

Required:

Molarity of solution = ?

Solution:

Using the formula:

$$\text{Molarity} = \frac{\text{Mass of solute}(g)}{\text{Molar mass of solute}(gmol^{-1}) \times \text{Volume of solution}(dm^3)}$$

$$= \frac{25g}{58.5mol \times 0.4(dm^3)}$$

$$= \frac{20}{23.4} = 0.85M$$

Q.5 We desire to prepare 100 cm^3 0.4 M solution of $MgCl_2$, how much $MgCl_2$ is needed?

Given Data:

Molarity of solution = 0.4 M

Volume of Solution = $100 cm^3 = \frac{100}{1000} dm^3 = 0.1 dm^3$

Mass of $MgCl_2$ = 24 + 2(35.5) = 95g

$= 24 + 71 = 95 gmol^{-1}$

Required:

Mass of $MgCl_2$ = ?

Solution:

Using the formula:

$$\text{Molarity} = \frac{\text{Mass of solute}}{\text{Molar mass of solute}(gmol^{-1}) \times \text{Volume of solutoin}(dm^3)}$$

$$0.4M = \frac{\text{Mass of solute}(g)}{95g\ mol^{-1} \times 0.1 dm^3}$$

Mass of solute = $0.4 \times 95 \times 0.1$

= 3.8g

Q.6 12M H_2S0_4 solutions is available in the laboratory. We need only 500cm^3 of 0.1 M solution, how it will be prepared?

Given Data:

Molarity of concentrated H_2SO_4 solution = M_1 = 12 M

Molarity of dilute H_2SO_4 solution = M_2 = 0.1 M

Volume of dilute H_2SO_4 solution = V_2 = 500cm^3

Required:

Volume of concentrated H_2SO_4 solution $= V_1 = ?$

Solution:

i. Determination of volume of concentrated solution:

Concentrated solution =Dilute solution

$$M_1 V_1 = M_2 V_2$$

$$12 \times V_1 = 0.1 \times 500$$

$$V_1 = \frac{0.1M \times 500\ cm^3}{12M}$$

Thus,

$$4.16\ cm^3$$

ii. Preparation of solution

We take $4.16cm^3$ of concentrated 12M H_2SO_4 solution with the help of graduated pipette and put in a measuring flask of $500cm^3$. Add water upto the mark, present at the neck o flask. Now it is 0.1 molar solution of H_2SO_4 .