

$6.32 \text{ g KMnO}_4 = 6.32/158 \text{ moles KMnO}_4 = 0.04 \text{ moles KMnO}_4$

Concentration of the solution = 0.04 mol l^{-1} (= 0.04 M)

Question 8

A solution contains 4 g of NaOH in 250 cm^3 of solution. Calculate the concentration of the solution in moles per litre.

Answer:

4 g of NaOH in 250 cm^3 of solution is equivalent to $4 \times 1000/250 = 16 \text{ g}$ in 1 litre

$16 \text{ g NaOH} = 16/40 \text{ moles NaOH} = 0.4 \text{ moles NaOH}$

Concentration of the solution = 0.4 mol l^{-1} (= 0.4 M)

Question 9

A solution contains 4.9 g H_2SO_4 in 100 cm^3 of solution. Calculate the concentration of the solution in moles per litre.

Answer:

4.9 g of H_2SO_4 in 100 cm^3 of solution is equivalent to $4.9 \times 1000/100 = 49 \text{ g}$ in 1 litre

$49 \text{ g H}_2\text{SO}_4 = 49/98 \text{ moles H}_2\text{SO}_4 = 0.5 \text{ moles H}_2\text{SO}_4$

Concentration of the solution = 0.5 mol l^{-1} (= 0.5 M)

Question 10

A bottle of wine contains 49 g of ethanol ($\text{C}_2\text{H}_5\text{OH}$) in 700 cm^3 of solution. Calculate the concentration of ethanol in moles per litre.

Answer:

49 g of $\text{C}_2\text{H}_5\text{OH}$ in 700 cm^3 of solution is equivalent to $49 \times 1000/700 = 70 \text{ g}$ in 1 litre

$70 \text{ g C}_2\text{H}_5\text{OH} = 70/46 \text{ moles C}_2\text{H}_5\text{OH} = 1.52 \text{ moles C}_2\text{H}_5\text{OH}$

Concentration of the solution = 1.52 mol l^{-1} (= 1.52 M)

Question 11

What mass of potassium hydroxide (KOH) is contained in 500 cm^3 of 0.05 M potassium hydroxide solution?

Answer:

$1,000 \text{ cm}^3$ of 0.05 M KOH solution contains 0.05 moles

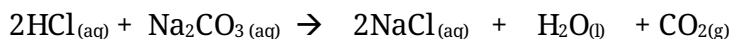
500 cm^3 of 0.05 M KOH solution contains $0.05 \times 500 / 1,000 \text{ moles}$
= 0.025 moles

Molar mass of KOH = 56 g mol^{-1}

Mass of KOH contained in 500 cm^3 solution = $56 \times 0.025 \text{ g}$

Question 52

Crystals of hydrated sodium carbonate ($\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$) of mass 3.15 g were dissolved in water and made up to 250 cm^3 in a volumetric flask. 25 cm^3 of this solution required 15 cm^3 of a 0.15 M hydrochloric acid solution for complete neutralisation. The equation for the reaction is



Find (a) the concentration of the sodium carbonate solution (b) the value of x in the formula $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$ (c) the percentage of water of crystallisation in the hydrated sodium carbonate.

Answer:

$$\begin{aligned} \text{(a)} \quad V_1 \times M_1 \times n_2 &= V_2 \times M_2 \times n_1 \\ 15 \times 0.15 \times 1 &= 25 \times M_2 \times 2 \\ M_2 &= 15 \times 0.15 \times 1 / (25 \times 2) \\ &= 0.045 \text{ mol l}^{-1} \end{aligned}$$

Concentration of the sodium carbonate solution = 0.045 mol l^{-1}

(b) Molar mass of $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O} = 46 + 12 + 48 + 18x = 106 + 18x$

$$\begin{aligned} \text{Concentration of sodium carbonate in mol l}^{-1} &= 0.045 \\ \text{Concentration of sodium carbonate in g l}^{-1} &= 3.15 / 250 = 12.6 \\ \text{Mass of 0.045 moles of Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O} &= 12.6 \text{ g} \\ \text{Molar mass of Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O} &= 12.6 / 0.045 \text{ g mol}^{-1} \\ &= 280 \text{ g mol}^{-1} \end{aligned}$$

$$106 + 18x = 280$$

$$18x = 174$$

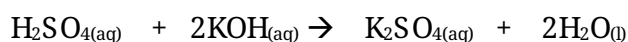
$$x = 9.7$$

(c) Molar mass of hydrated sodium carbonate = 280 g mol^{-1}

Percentage of water of crystallisation in the compound = $174 \times 100 / 280\% = 62.14\%$

Question 53

In a titration, 25 cm^3 of a potassium hydroxide solution required 27 cm^3 of a 0.12 M sulfuric acid solution for complete neutralisation. Calculate the concentration of the potassium hydroxide solution in (a) mol l^{-1} (b) g l^{-1} . The equation for the reaction is



Answer: