Titration Calculations

① $25.0cm^3$ of $0.100moldm^{-3}$ NaOH solution required $23.5cm^3$ of dilute hydrochloric acid for neutralisation. Calculate the concentration of the hydrochloric acid.

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

$C = \frac{n}{V}$ $\quad 0.100 \times \frac{25}{1000} = 2.5 \times 10^{-3}$ moles of NaOH

2.5×10^{-3} = moles of HCl $\quad \frac{2.5 \times 10^{-3}}{(23.5/1000)} = \underline{\underline{0.106 moldm^{-3}}}$

② $25.0cm^3$ of sodium hydroxide solution of unknown concentration was titrated with dilute sulphuric acid of concentration $0.050moldm^{-3}$. $20.0cm^3$ of the acid was required to neutralise the alkali. Find the concentration of the sodium hydroxide in $moldm^{-3}$.

$$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$$

$0.05 \times \left(\frac{20}{1000}\right) = 1 \times 10^{-3}$ moles of H_2SO_4

$1 \times 10^{-3} \times 2 = 2 \times 10^{-3}$ moles of NaOH $\quad \frac{2 \times 10^{-3}}{(25.0/1000)} = \underline{\underline{0.08 moldm^{-3}}}$

~~$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$~~

③ $25.0cm^3$ of $0.100 mol dm^{-3}$ sodium hydrogencarbonate solution was titrated with dilute sulphuric acid of unknown concentration. $17.6cm^3$ of the acid was required to neutralise the sodium hydrogencarbonate. Find the concentration of sulphuric acid in gdm^{-3}.

$$2NaHCO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O + 2CO_2$$

$0.100 \times \left(\frac{25}{1000}\right) = 2.5\times10^{-3}$ moles of $NaHCO_3$

$\frac{2.5\times10^{-3}}{2} = 1.25\times10^{-3}$ moles of H_2SO_4.

$\frac{1.25\times10^{-3}}{(17.6/1000)} = 0.071 mol dm^{3} \times 98$ (Mr of H_2SO_4) $= \underline{\underline{6.96 gdm^{-3}}}$

④ 2.10g of sodium hydrogencarbonate was dissolved in water and the solution made up to $250cm^3$. $25.0cm^3$ of this solution was pipetted into a conical flask and some methyl orange indicator added. This solution was neutralised by $25.9cm^3$ of dilute hydrochloric acid added from a burette. Calculate the concentration of the acid in ~~$mol dm^{-3}$~~ gdm^{-3}

$$NaHCO_3 + HCL \longrightarrow NaCL + CO_2 + H_2O$$

$NaHCO_3 = 84$ $\quad \frac{2.10}{84} = 0.025$ moles $\quad \frac{0.025}{(250/1000)} = 0.1 mol dm^{-3}$

~~1.25~~ $\left(\frac{25}{1000}\right) \times 0.1 = 2.5\times10^{-3}$ moles in $25cm^3$ of $NaHCO_3$.

$= 2.5\times10^{-3}$ moles of HC $\quad \frac{2.5\times10^{-3}}{(25.9/1000)} = 0.0965 mol dm^{-3}$

$0.0965 \times 36.5 = \underline{\underline{3.52 gdm^{-3}}}$