Quiz (Acid-Alkali Titration)

Important Remark:

- **The end point is the stage at which the indicator changes colour sharply.**
- **The equivalence point is the stage at which the acid and the alkali have just reacted completely during titration.**

1. 2.65 g of sodium carbonate were dissolved in water and made up to a 250.0 cm^3 solution. 25.0 cm^3 of the solution required 20.00 cm^3 of a hydrochloric acid for complete reaction. Find the molarity of the hydrochloric acid.
   (Relative atomic masses: C = 12.0, O = 16.0, Na = 23.0)

2. What is the volume of 0.050 M sulphuric acid required for complete reaction with each of the following solutions?
   (a) 25.0 cm^3 of 0.100 M NaOH(aq)
   (b) 100.0 cm^3 of 0.100 M Na_2CO_3(aq)

Suggested Answer

1. Number of moles of Na_2CO_3 used
   = mass of Na_2CO_3 / molar mass of Na_2CO_3
   = 2.65 / (23.0 × 2 + 12.0 + 16.0 × 3)
   = 0.025

   Molarity of the 250.0 cm^3 Na_2CO_3 solution
   = 0.025 / 0.25
   = 0.1 M

   $Na_2CO_3(aq) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$

   Number of moles of Na_2CO_3 in 25.0 cm^3 of solution
   = 0.1 × 0.025
   = 2.5×10^{-3}

   From the equation, mole ratio of Na_2CO_3 : HCl = 1 : 2.

   Number of moles of HCl in 20.00 cm^3 of solution
   = $2.5 \times 10^{-3} \times 2$
   = 5×10^{-3}

   Molarity of HCl(aq)
   = 5×10^{-3} / 0.02
   = 0.25 M

2. (a) Number of moles of NaOH used
   = 0.100 × 0.025
   = 2.5×10^{-3}

   $H_2SO_4(aq) + 2NaOH(aq) \longrightarrow Na_2SO_4(aq) + 2H_2O(l)$

   From the equation, mole ratio of NaOH to H_2SO_4 = 2 : 1.

   Number of moles of 0.050 M H_2SO_4 required
   = 2.5×10^{-3} / 2
   = 1.25×10^{-3}

   Volume of 0.050 M H_2SO_4 required
   = 1.25×10^{-3} / 0.050
   = 0.025 dm^3 (25.0 cm^3)

(b) Number of moles of Na_2CO_3 used
= 0.100 × 0.1
= 0.01

$H_2SO_4(aq) + Na_2CO_3(aq) \longrightarrow Na_2SO_4(aq) + CO_2(g) + H_2O(l)$

From the equation, mole ratio of Na_2CO_3 to H_2SO_4 = 1 : 1.

Number of moles of 0.050 M H_2SO_4 required
= 0.01

Volume of 0.050 M H_2SO_4 required
= 0.01 / 0.050
= 0.20 dm^3 (200.0 cm^3)