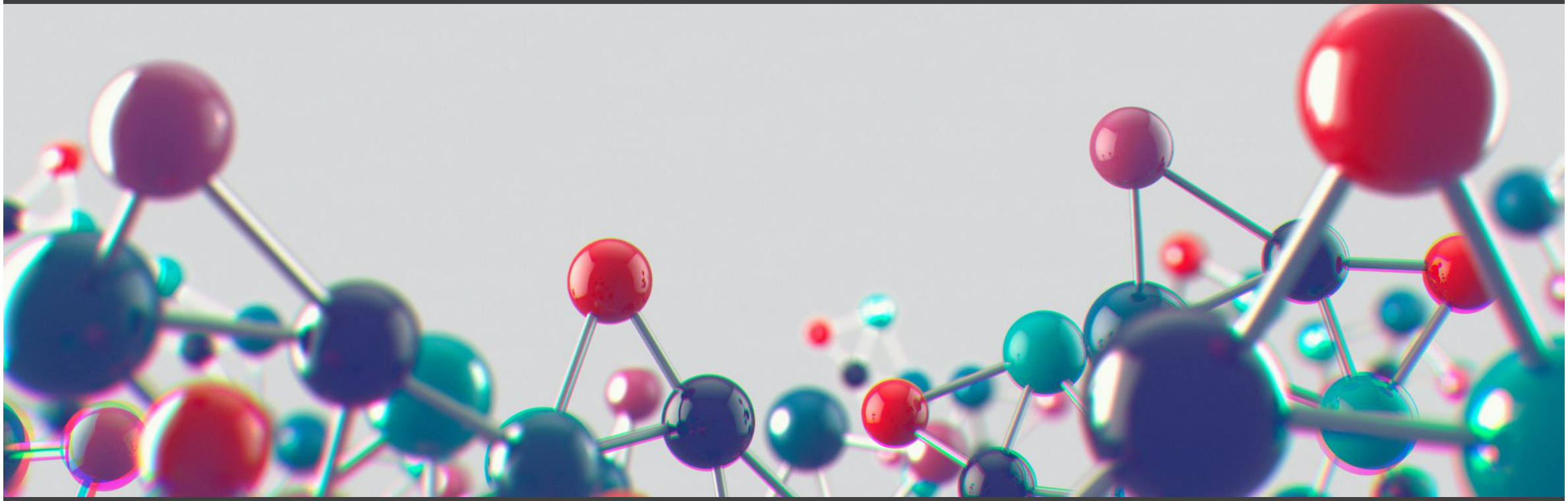

Titration Calculations – Worked Examples

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Titration Questions

1) 25.0 cm^3 of 0.020 mol/dm^3 sulphuric acid neutralises 18.6 cm^3 of barium hydroxide solution. Find the concentration of the barium hydroxide solution in mol/dm^3.

$$H_2SO_4 + Ba(OH)_2 \rightarrow BaSO_4 + 2\,H_2O$$

2) 25.0 cm^3 of a solution of sodium hydroxide required 18.8 cm^3 of 0.0500 mol/dm^3 H_2SO_4. Find the concentration of the sodium hydroxide solution in mol/dm^3.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2\,H_2O$$

Titration Questions

3) Calculate the volume of 0.05 mol/dm^3 KOH is required to neutralise 25.0 cm^3 of 0.0150 mol/dm^3 HNO_3.

$$HNO_3 + KOH \rightarrow KNO_3 + H_2O$$

4) A 250 cm^3 solution of NaOH was prepared. 25.0 cm^3 of this solution required 28.2 cm^3 of 0.100 mol/dm^3 HCl for neutralisation. Calculate what mass of NaOH was dissolved to make up the original 250 cm^3 solution.

$$HCl + NaOH \rightarrow NaCl + H_2O$$

5) What volume of 5.00 mol/dm^3 HCl is required to neutralise 200 g of $CaCO_3$?

$$2\,HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$$

Question 1 Solution

25.0 cm^3 of 0.020 mol/dm^3 sulphuric acid neutralises 18.6 cm^3 of barium hydroxide solution. Find the concentration of the barium hydroxide solution in mol/dm^3.

$$H_2SO_4 + Ba(OH)_2 \rightarrow BaSO_4 + 2\,H_2O$$

Moles of H_2SO_4 = conc x vol (dm^3) = 0.020 x 0.025 = 0.0005

$1H_2SO_4 : 1Ba(OH)_2$ Moles of $Ba(OH)_2$ = 0.0005

Concentration of $Ba(OH)_2$ = $\frac{\text{Moles}}{\text{Volume}} = \frac{0.0005}{0.0186} = 0.0269\ mol/dm^3$

Question 2 Solution

25.0 cm^3 of a solution of sodium hydroxide required 18.8 cm^3 of 0.0500 mol/dm^3 H_2SO_4. Find the concentration of the sodium hydroxide solution in mol/dm^3.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2\,H_2O$$

Moles of H_2SO_4 = conc x vol (dm^3) = 0.0500 x 0.0188 = 0.00094

$1H_2SO_4 : 2NaOH$ Moles of NaOH = 2 x 0.00094 = 0.00188

Concentration of NaOH = $\frac{\text{Moles}}{\text{Volume}} = \frac{0.00188}{0.025} = 0.0752\ mol/dm^3$

Question 3 Solution

Calculate the volume in cm^3 of 0.05 mol/dm^3 KOH required to neutralise 25.0 cm^3 of 0.0150 mol/dm^3 HNO_3.

$$HNO_3 + KOH \rightarrow KNO_3 + H_2O$$

Moles of HNO_3 = conc x vol (dm^3) = 0.0150 x 0.025 = 0.000375

$1HNO_3 : 1KOH$ Moles of KOH = 0.000375

Volume of KOH = $\frac{\text{Moles}}{\text{Conc}} = \frac{0.000375}{0.0500} = 0.0075\ dm^3 = 7.5\ cm^3$

Question 4 Solution

A 250 cm^3 solution of NaOH was prepared. 25.0 cm^3 of this solution required 28.2 cm^3 of 0.100 mol/dm^3 HCl for neutralisation. Calculate what mass of NaOH was dissolved to make up the original 250 cm^3 solution.

$HCl + NaOH \rightarrow NaCl + H_2O$

Moles of HCl = conc x vol (dm^3) = 0.100 x 0.0282 = 0.00282

1HCl : 1NaOH Moles of NaOH in 25.0 cm^3 = 0.00282

Moles of NaOH in 250 cm^3 = 0.00282 x 10 = 0.0282

Mass of NaOH = moles x molar mass = 0.0282 x 40 = 1.128 g

Question 5 Solution

What volume in cm^3 of 5.00 mol/dm^3 HCl is required to neutralise 200 g of $CaCO_3$?

$$2\ HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$$

$$\text{Moles of } CaCO_3 = \frac{\text{Mass}}{\text{Molar Mass}} = \frac{200}{100.1} = 1.998$$

$2\ HCl : CaCO_3$ Moles of HCl = 2 x 1.998 = 3.996

$$\text{Volume of HCl} = \frac{\text{Moles}}{\text{Conc}} = \frac{3.996}{5.00} = 0.799\ dm^3 = 799\ cm^3$$