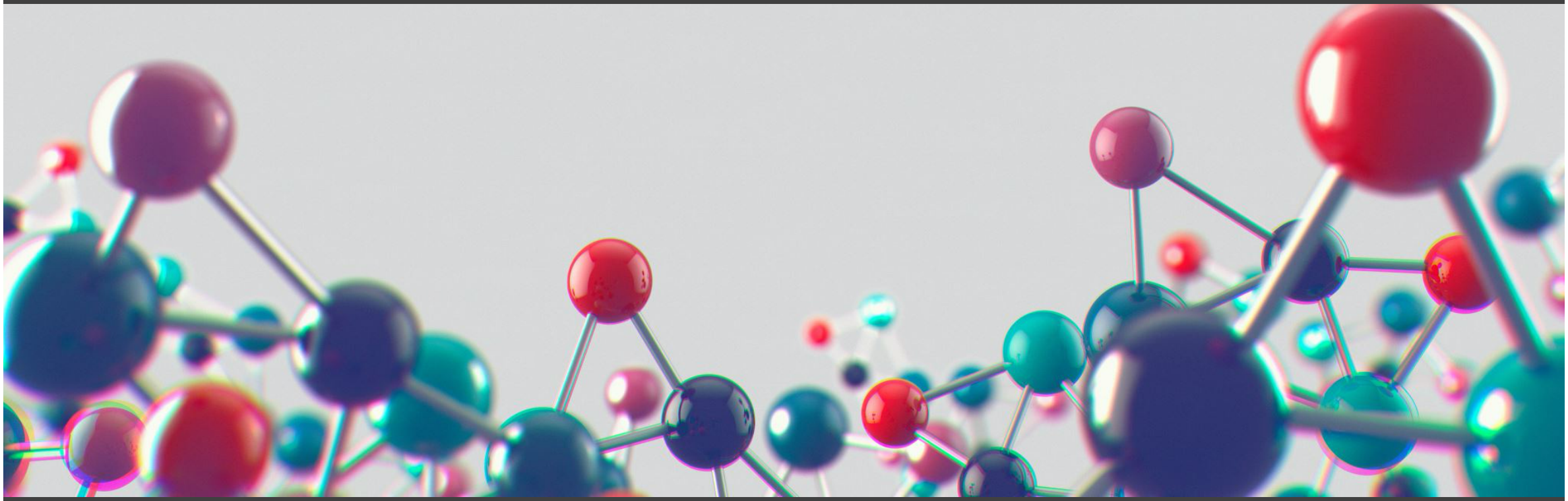

Back Titrations – Worked Examples

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Worked Example 1

1) An impure sample of calcium hydroxide of mass 0.978 g was allowed to react with 125 cm^3 of 0.150 mol/dm^3 hydrochloric acid. When the excess acid was titrated against 0.500 mol/dm^3 sodium hydroxide, 10.90 cm^3 of sodium hydroxide solution was required. Calculate the percentage purity of the sample of calcium hydroxide..

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Moles of HCl = 0.150 x 0.125 = 0.01875 moles

Moles of NaOH = 0.500 x 0.01090 = 0.00545 moles

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

Moles of unreacted HCl = 0.00545 moles

Moles of reacted HCl = 0.01875 - 0.00545 = 0.0133 moles

$$Ca(OH)_2 + 2\,HCl \rightarrow CaCl_2 + 2\,H_2O$$

Moles of $Ca(OH)_2$ = 0.0133/2 = 0.00665

Mass of $Ca(OH)_2$ = 0.00665 x 74.1 = 0.4928 g

$$\% \text{ purity} = \frac{0.4928}{0.978} \times 100 = \mathbf{50.4\%}$$

Worked Example 2

A 5.20 g sample containing ammonium chloride was added to 75.0 cm^3 of 0.75 mol/dm^3 $NaOH_{(aq)}$. This was then heated until all the ammonium chloride had reacted with the NaOH.

25.0 cm^3 of the resulting solution was added to a conical flask using a pipette and titrated against 0.500 mol/dm^3 $H_2SO_{4(aq)}$. Consistent titres of 22.50 cm^3 and 22.60 cm^3 were obtained.

Worked Example 2

A sample containing ammonium sulphate was added to 75.0 cm^3 of 0.75 mol/dm^3 $NaOH_{(aq)}$. This was then heated until all the ammonium chloride had reacted with the NaOH.

25.0 cm^3 of the resulting solution was added to a conical flask using a pipette and titrated against 0.500 mol/dm^3 $HCl_{(aq)}$. Consistent titres of 22.50 cm^3 and 22.60 cm^3 were obtained.

Original moles of NaOH added = 0.75 x 0.075 = 0.05625 moles

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Original moles of NaOH added = 0.75 x 0.075 = 0.05625 moles

Moles of HCl = 0.500 x 0.02255 = 0.011275 moles

$HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

Moles of NaOH in 25.0 cm^3 = 0.011275 moles

Moles of NaOH in 75.0 cm^3 = 0.011275 x $\frac{75.0}{25.0}$ = 0.033825 moles

A sample containing ammonium sulphate was added to 75.0 cm^3 of 0.75 mol /m^3 $NaOH_{(aq)}$. This was then heated until all the ammonia had reacted with the NaOH. 25.0 cm^3 of the resulting solution was added to a conical flask using a pipette and titrated against 0.500 mol/dm^3 $HCl_{(aq)}$. Consistent titres of 22.50 cm^3 and 22.60 cm^3 were obtained.

Original moles of NaOH added = 0.05625 moles

Moles of NaOH remaining = 0.033825 moles

Moles of NaOH that reacted = 0.05625 – 0.033825 = 0.022425

$(NH_4)_2SO_4 + 2NaOH \rightarrow 2NH_3 + Na_2SO_4 + 2H_2O$

Moles of $(NH_4)_2SO_4$ that reacted = 0.022425/2 = 0.0112125

Mass of $(NH_4)_2SO_4$ that reacted = 0.0112125 x 132.2 = **1.48 g**

Worked Example 3

1) A sample containing copper and zinc powders in a beaker was mixed with 150 cm^3 0.100 mol/dm^3 $H_2SO_{4(aq)}$. The zinc reacted with the acid to produce zinc sulphate solution and hydrogen gas.
2) The solution was filtered into a 250 cm^3 volumetric flask, the beaker and filter paper washed through with distilled water into the volumetric flask.
3) 25.0 cm^3 of this solution was titrated with 0.75 mol/dm^3 $NaOH_{(aq)}$ and the final titre found to be 15.25 cm^3. How much zinc was in the sample?

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3) 25.0 cm^3 of this solution was titrated with 0.75 mol/dm^3 $NaOH_{(aq)}$ and the final titre found to be 15.25 cm^3. How much zinc was in the sample?

Moles of H_2SO_4 added = 0.100 x 0. 150 = 0.015 moles

Worked Example 3

1) A sample containing copper and zinc powders in a beaker was mixed with 100 cm^3 0.750 mol/dm^3 $H_2SO_{4(aq)}$. The zinc reacted with the acid to produce zinc sulphate solution and hydrogen gas.
2) The solution was filtered into a 250 cm^3 volumetric flask, the beaker and filter paper washed through with distilled water into the volumetric flask.
3) 25.0 cm^3 of this solution was titrated with 0.100 mol/dm^3 $NaOH_{(aq)}$ and the final titre found to be 7.25 cm^3. How much zinc was in the sample?

Moles of H_2SO_4 added = 0.750 x 0.100 = 0.075 moles

Moles of NaOH = 0.100 x 0.00725 = 0.000725 moles

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

Moles of H_2SO_4 remaining in 25.0 cm^3 = 0.000725/2 = 0.0003625 moles

Moles of H_2SO_4 remaining in 250 cm^3 = 0.003625 moles

Moles of H_2SO_4 that reacted = 0.075 - 0.003625 = 0.071375 moles

$H_2SO_4 + Zn \rightarrow ZnSO_4 + H_2$

Moles of Zn = 0.071375 moles

Mass of Zn = 0.071375 x 65.38 = 4.67 g