Back titration

OCR A H432 · Full A-level

Answer on your own paper. Show your working where needed.

1. Limestone purity

Only $CaCO_3$ in a 0.500 g sample reacts with 50.0 cm^3 of excess 0.200 mol dm^{-3} HCl. Leftover HCl needs 20.00 cm^3 of 0.100 mol dm^{-3} NaOH. Find the mass percentage of $CaCO_3$ (M_r = 100.09). One mole $CaCO_3$ uses two moles HCl.

2. Magnesium oxide content

Only MgO in a 1.00 g sample reacts with 50.0 cm^3 of excess 1.00 mol dm^{-3} HCl. Make up to 250.0 cm^3. A 25.0 cm^3 portion requires 12.80 cm^3 of 0.100 mol dm^{-3} NaOH. Find the mass percentage of MgO (M_r = 40.31). One mole MgO uses two moles HCl.

3. Calcium carbonate in an antacid

Three antacid tablets (mean mass 1.200 g) contain $CaCO_3$ and inert material. Add 75.0 cm^3 of excess 0.500 mol dm^{-3} HCl and make up to 250.0 cm^3. A 25.0 cm^3 portion needs 10.50 cm^3 of 0.100 mol dm^{-3} NaOH. For each mole of $CaCO_3$, 2 mol HCl react. Find the mean mass of $CaCO_3$ per tablet in mg and its mass percentage (M_r = 100.09).

4. Identify a Group 2 metal

0.800 g of MCO_3 reacts with 50.0 cm^3 of excess 0.500 mol dm^{-3} HCl. Leftover acid needs 30.05 cm^3 of 0.300 mol dm^{-3} NaOH. One mole MCO_3 uses two moles HCl. Find $M_r(MCO_3)$ and identify M. A_r: Mg 24.31, Ca 40.08, Sr 87.62, Ba 137.33, C 12.01, O 16.00.

5. Concentration of a cleaner

Only Na_2CO_3 reacts in 25.0 cm^3 of cleaner. Add 50.0 cm^3 of excess 0.300 mol dm^{-3} HCl. The rest needs 25.00 cm^3 of 0.400 mol dm^{-3} NaOH. One mole Na_2CO_3 uses two moles HCl. Find the original concentration in mol dm^{-3} and g dm^{-3} (M_r = 105.99).

6. An oxide and excess sulfuric acid

Only ZnO in an 0.800 g sample reacts with 60.0 cm^3 of 0.200 mol dm^{-3} H_2SO_4. The rest uses 32.0 cm^3 of 0.250 mol dm^{-3} NaOH. H_2SO_4 reacts 1:1 with ZnO and 1:2 with NaOH. Find the mass percentage of ZnO (M_r = 81.38).

7. Purity from a redox titration

0.800 g of impure Na_2SO_3 reacts with 50.0 cm^3 of excess 0.100 mol dm^{-3} I_2. Leftover I_2 takes 10.00 cm^3 of 0.100 mol dm^{-3} thiosulfate. Na_2SO_3 reacts 1:1 with I_2, which reacts 1:2 with thiosulfate. Find the mass percentage of Na_2SO_3 (M_r = 126.04).

8. Hydrogen peroxide by redox titration

25.0 cm^3 H_2O_2 reacts with 25.0 cm^3 of excess acidified 0.0400 mol dm^{-3} MnO_4^-. The rest needs 20.00 cm^3 of 0.100 mol dm^{-3} Fe^{2+}. MnO_4^- reacts 2:5 with H_2O_2 and 1:5 with Fe^{2+}. Find the H_2O_2 concentration in mol dm^{-3} and g dm^{-3} (M_r = 34.0).

9. Extra challenge · Recover a mass percentage from two reactions

Dissolve 2.50 g drink powder to make 100.0 cm^3. Add 25.0 cm^3 of excess 0.0500 mol dm^{-3} I_2 to a 20.0 cm^3 portion. Vitamin C reacts with I_2 in a 1:1 ratio. Leftover I_2 needs 14.40 cm^3 of 0.1000 mol dm^{-3} thiosulfate. $I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$. Calculate the mass percentage of vitamin C (M_r = 176.12). How would oxidation by air before the iodine addition affect the result?

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