

Back titration questions and answers

Eight checked A-level Chemistry questions. Questions first; worked answers begin on a new page.

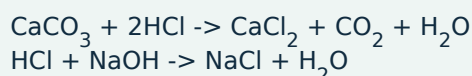
Name _____

Date _____

1. Limestone: direct back titration

A 0.500 g limestone sample is treated with 50.0 cm³ of 0.200 mol dm⁻³ hydrochloric acid. The acid is in excess.

The acid remaining requires 20.00 cm³ of 0.100 mol dm⁻³ sodium hydroxide for complete neutralisation.

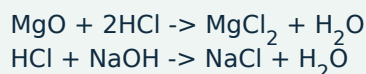


Calculate the percentage by mass of CaCO₃ in the limestone. [6 marks]

2. Magnesium oxide: dilution and measured portion

A 1.00 g sample containing MgO is treated with 50.0 cm³ of 1.00 mol dm⁻³ HCl. The mixture is made up to 250 cm³.

A 25.0 cm³ portion requires 12.80 cm³ of 0.100 mol dm⁻³ NaOH.



Calculate the percentage by mass of MgO in the sample. [8 marks]

3. Antacid tablets: mass per tablet

Three antacid tablets, each with a mean mass of 1.200 g, are crushed. Their active ingredient is CaCO₃.

The powder is treated with 75.0 cm³ of 0.500 mol dm⁻³ HCl. The mixture is made up to 250 cm³. A 25.0 cm³ portion requires 10.50 cm³ of 0.100 mol dm⁻³ NaOH.



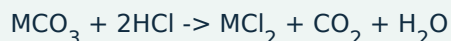
Calculate (a) the mass of CaCO₃ in one tablet, in mg, and (b) the percentage by mass of CaCO₃ in a tablet. [7 marks]

4. Unknown Group 2 carbonate

A pure Group 2 carbonate has the formula MCO_3 . A 0.800 g sample is treated with 50.0 cm^3 of 0.500 mol dm^{-3} HCl.

The HCl remaining requires 30.05 cm^3 of 0.300 mol dm^{-3} NaOH.

A_r : Mg = 24.31; Ca = 40.08; Sr = 87.62; Ba = 137.33; C = 12.01; O = 16.00.

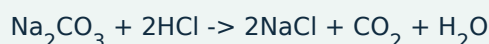


Calculate M_r of MCO_3 and identify M. [6 marks]

5. Sodium carbonate concentration

A cleaner contains dissolved Na_2CO_3 . A 25.0 cm^3 sample is mixed with 50.0 cm^3 of 0.300 mol dm^{-3} HCl.

The HCl remaining requires 25.00 cm^3 of 0.400 mol dm^{-3} NaOH. $M_r(\text{Na}_2\text{CO}_3) = 105.99$.

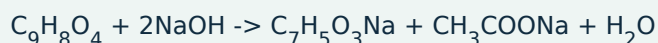


Calculate the concentration of Na_2CO_3 in mol dm^{-3} and g dm^{-3} . [6 marks]

6. Aspirin: excess sodium hydroxide

A 0.600 g powdered tablet sample contains aspirin, $\text{C}_9\text{H}_8\text{O}_4$, and inert ingredients.

The powder is heated with 50.0 cm^3 of 0.200 mol dm^{-3} NaOH. The NaOH is in excess. The NaOH remaining requires 20.00 cm^3 of 0.200 mol dm^{-3} HCl. $M_r(\text{aspirin}) = 180.16$.

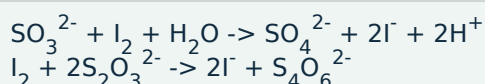


Calculate the percentage by mass of aspirin in the tablet powder. [7 marks]

7. Sodium sulfite: redox back titration

A 0.800 g powder contains Na_2SO_3 and an inert solid. It is treated with 50.0 cm^3 of 0.100 mol dm^{-3} iodine solution. Iodine is in excess.

The iodine remaining requires 10.00 cm^3 of 0.100 mol dm^{-3} sodium thiosulfate. $M_r(\text{Na}_2\text{SO}_3) = 126.04$.

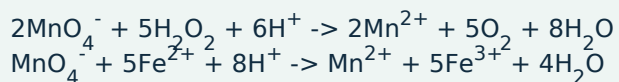


Calculate the percentage by mass of Na_2SO_3 in the powder. [7 marks]

8. Hydrogen peroxide: multi-stage redox

25.0 cm³ of hydrogen peroxide solution is treated with 25.0 cm³ of 0.0400 mol dm⁻³ acidified MnO₄⁻. The MnO₄⁻ is in excess.

The MnO₄⁻ remaining requires 20.00 cm³ of 0.100 mol dm⁻³ Fe²⁺. M_r(H₂O₂) = 34.0.



Calculate the concentration of H₂O₂ in mol dm⁻³ and g dm⁻³. [7 marks]

Worked answers

A correct route is shown for each question. Small differences caused by rounding are acceptable.

1. Limestone: direct back titration

HCl added = 0.0100 mol. HCl left = 0.00200 mol. HCl reacted = 0.00800 mol. CaCO_3 = 0.00400 mol.
Mass = 0.40036 g. Percentage = 80.1%.

2. Magnesium oxide: dilution and measured portion

HCl added = 0.0500 mol. HCl in 25.0 cm³ = 0.001280 mol. HCl in 250 cm³ = 0.01280 mol. HCl reacted = 0.03720 mol. MgO = 0.01860 mol. Mass MgO = 0.7496 g. Percentage = 75.0%.

3. Antacid tablets: mass per tablet

HCl added = 0.03750 mol. HCl left in 250 cm³ = 0.01050 mol. HCl reacted = 0.02700 mol. CaCO_3 in three tablets = 0.01350 mol = 1.351 g. Mass per tablet = 450 mg; percentage = 37.5%.

4. Unknown Group 2 carbonate

HCl added = 0.02500 mol. HCl left = 0.009015 mol. HCl reacted = 0.015985 mol. MCO_3 = 0.0079925 mol. M_r = 0.800 / 0.0079925 = 100.1. $A_r(\text{M})$ = 40.1. M is calcium, Ca.

5. Sodium carbonate concentration

HCl added = 0.01500 mol. HCl left = 0.01000 mol. HCl reacted = 0.00500 mol. Na_2CO_3 in 25.0 cm³ = 0.00250 mol. Concentration = 0.100 mol dm⁻³ = 10.6 g dm⁻³.

6. Aspirin: excess sodium hydroxide

NaOH added = 0.01000 mol. NaOH left = HCl used = 0.004000 mol. NaOH reacting with aspirin = 0.006000 mol. Aspirin = 0.003000 mol. Mass aspirin = 0.5405 g. Percentage = 90.1%.

7. Sodium sulfite: redox back titration

I_2 added = 0.00500 mol. Thiosulfate = 0.00100 mol, so I_2 left = 0.000500 mol. I_2 reacting with sulfite = 0.00450 mol. Na_2SO_3 = 0.00450 mol = 0.5672 g. Percentage = 70.9%.

8. Hydrogen peroxide: multi-stage redox

MnO_4^- added = 0.00100 mol. Fe^{2+} = 0.00200 mol, so MnO_4^- left = 0.000400 mol. MnO_4^- reacting = 0.000600 mol. H_2O_2 = 0.00150 mol in 25.0 cm³. Concentration = 0.0600 mol dm⁻³ = 2.04 g dm⁻³.