

Stoichiometry Practice

Limiting and excess reagents | Gas volume | Percentage yield | Titration | Water of crystallisation | Atom economy

Contents	4 sets x 5 questions (20 questions) with full worked answers
Level	Closely matched to the methods and numerical level in the supplied examples
Suggested use	Complete Sets A-D in order, then check the worked answers at the back

Reference data

$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$; $1 \text{ m}^3 = 10^6 \text{ cm}^3$

Relative atomic masses: H 1.01, C 12.01, O 16.00, Na 22.99, Mg 24.31, Al 26.98, Cl 35.45, K 39.10, Ca 40.08, Fe 55.85, Zn 65.38

Use $PV = nRT$ where required. Give answers to 3 significant figures unless stated otherwise.

Name: _____ Date: _____

Practice Set A

Core practice

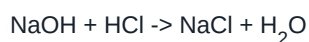
1. Limiting reagent, gas volume and yield



0.623 g of magnesium is reacted with 27.3 cm³ of 1.25 mol dm⁻³ hydrochloric acid. (a) Identify the limiting reagent. (b) Calculate the maximum volume of hydrogen at 273 K and 1.00 x 10⁵ Pa, in cm³. (c) The actual volume collected is 342 cm³. Calculate the percentage yield.

2. Acid-base titration

25.00 cm³ of sodium hydroxide solution requires 23.65 cm³ of 0.100 mol dm⁻³ hydrochloric acid for complete neutralisation. Calculate the concentration of the sodium hydroxide solution.



3. Back titration and percentage by mass

A 2.016 g eggshell sample is treated with 50.0 cm³ of 1.00 mol dm⁻³ HCl. After reaction, the mixture is made up to 100 cm³. A 10.0 cm³ portion requires 11.40 cm³ of 0.100 mol dm⁻³ NaOH for neutralisation. Calculate the percentage by mass of CaCO₃ in the eggshell.



4. Water of crystallisation

12.402 g of (COOH)₂·xH₂O crystals is dissolved and made up to 200 cm³. A 20.0 cm³ portion requires 19.68 cm³ of 0.100 mol dm⁻³ NaOH for neutralisation. Oxalic acid is dibasic. Determine x.

5. Atom economy

For 2Al + Fe₂O₃ → 2Fe + Al₂O₃, calculate the atom economy when iron is the desired product.

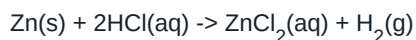
Checklist

Did you use the balanced equation? Did you convert cm³ to dm³? In back titration, did you scale the excess acid to the full solution volume?

Practice Set B

Core variation

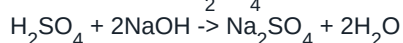
1. Limiting reagent, gas volume and yield



1.31 g of zinc is reacted with 45.0 cm³ of 0.800 mol dm⁻³ HCl. (a) Identify the limiting reagent. (b) Calculate the maximum volume of hydrogen at 298 K and 1.00 x 10⁵ Pa. (c) The actual volume is 410 cm³. Calculate the percentage yield.

2. Acid-base titration

20.00 cm³ of sulfuric acid requires 18.40 cm³ of 0.150 mol dm⁻³ NaOH for complete neutralisation. Calculate the concentration of H₂SO₄.



3. Back titration and percentage by mass

A 0.650 g chalk sample is treated with 25.0 cm³ of 1.00 mol dm⁻³ HCl. The mixture is made up to 250 cm³. A 25.0 cm³ portion requires 12.60 cm³ of 0.100 mol dm⁻³ NaOH. Calculate the percentage by mass of CaCO₃ in the chalk.

4. Water of crystallisation

9.453 g of (COOH)₂.xH₂O is dissolved and made up to 150 cm³. A 25.0 cm³ portion requires 25.00 cm³ of 0.100 mol dm⁻³ NaOH. Determine x.

5. Atom economy

For CaCO₃ → CaO + CO₂, calculate the atom economy when CaO is the desired product.

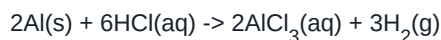
Checklist

Did you use the balanced equation? Did you convert cm³ to dm³? In back titration, did you scale the excess acid to the full solution volume?

Practice Set C

Intermediate

1. Limiting reagent, gas volume and yield



0.540 g of aluminium is reacted with 40.0 cm³ of 1.20 mol dm⁻³ HCl. (a) Identify the limiting reagent. (b) Calculate the maximum hydrogen volume at 293 K and 1.05 x 10⁵ Pa. (c) The actual volume is 525 cm³. Calculate the percentage yield.

2. Acid-base titration

25.00 cm³ of sulfuric acid requires 24.80 cm³ of 0.200 mol dm⁻³ NaOH. Calculate the concentration of H₂SO₄.

3. Back titration and percentage by mass

A 1.20 g impure MgCO₃ sample is treated with 40.0 cm³ of 0.800 mol dm⁻³ HCl. The mixture is made up to 200 cm³. A 20.0 cm³ portion requires 14.20 cm³ of 0.100 mol dm⁻³ NaOH. Calculate the percentage by mass of MgCO₃.

4. Water of crystallisation

15.755 g of (COOH)₂·xH₂O is dissolved and made up to 250 cm³. A 25.0 cm³ portion requires 25.00 cm³ of 0.100 mol dm⁻³ NaOH. Determine x.

5. Atom economy

For 2KClO₃ → 2KCl + 3O₂, calculate the atom economy when oxygen is the desired product.

Checklist

Did you use the balanced equation? Did you convert cm³ to dm³? In back titration, did you scale the excess acid to the full solution volume?

Practice Set D

Mixed review

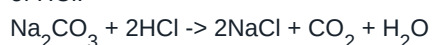
1. Limiting reagent, gas volume and yield



1.12 g of iron is reacted with 30.0 cm³ of 1.50 mol dm⁻³ HCl. (a) Identify the limiting reagent. (b) Calculate the maximum hydrogen volume at 298 K and 9.80 × 10⁴ Pa. (c) The actual volume is 465 cm³. Calculate the percentage yield.

2. Acid-base titration

20.00 cm³ of HCl requires 16.80 cm³ of 0.100 mol dm⁻³ Na₂CO₃ for complete neutralisation. Calculate the concentration of HCl.



3. Back titration and percentage by mass

A 1.50 g antacid sample is treated with 60.0 cm³ of 0.500 mol dm⁻³ HCl. The mixture is made up to 250 cm³. A 25.0 cm³ portion requires 8.00 cm³ of 0.100 mol dm⁻³ NaOH. Assuming CaCO₃ is the active ingredient, calculate its percentage by mass.

4. Water of crystallisation

10.802 g of (COOH)₂·xH₂O is dissolved and made up to 200 cm³. A 20.0 cm³ portion requires 20.00 cm³ of 0.100 mol dm⁻³ NaOH. Determine x.

5. Atom economy

For 2NaHCO₃ → Na₂CO₃ + CO₂ + H₂O, calculate the atom economy when Na₂CO₃ is the desired product.

Checklist

Did you use the balanced equation? Did you convert cm³ to dm³? In back titration, did you scale the excess acid to the full solution volume?