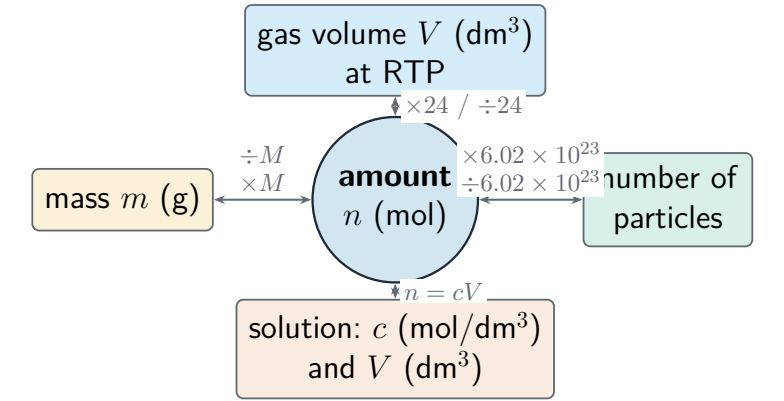
Exercise walk-through

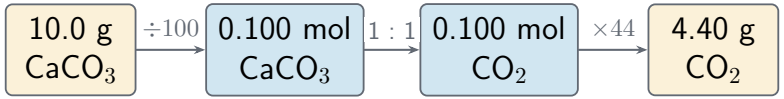
3.4 Concentrations of solutions (4.3.4)

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Figure: Moles and reacting masses (higher tier)



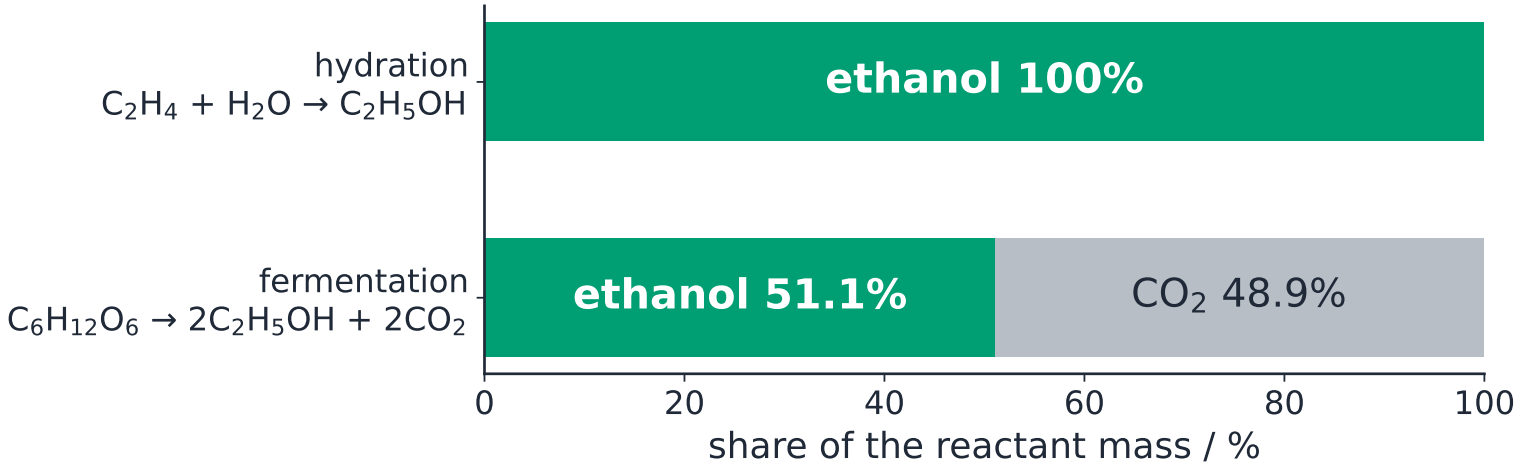
worked chain: $CaCO_3 \rightarrow CaO + CO_2$



the equation ratio links amounts in moles, never masses

- Mass $\div$ M gives moles; moles $\times$ M gives mass.
- Use the equation's ratio in moles.

Figure: Yield and atom economy (chemistry only)



- **Atom economy** = mass of desired product ÷ total reactant mass × 100.
- Addition reactions waste nothing.

Concentrations in mol/dm^3 (chemistry only, higher tier)

- **Molar concentration** is the number of moles of **solute** in each dm^3 of solution:
- To change it into **mass concentration** , multiply by the Mr: 0.20 mol/dm^3 NaOH is $0.20 \times 40 = 8.0$ g/dm^3.
- In a **titration** , you measure the exact volumes of an acid and an alkali that react.
- If you know one **concentration**, you can calculate the other, using the mole ratio in the equation.

$$\text{moles} = \text{concentration (mol/dm}^3\text{)} \times \text{volume (dm}^3\text{)}$$

Exercise 2.1

2.1 How many moles are in 500 cm^3 of 0.200 mol/dm^3 solution? [2]



500 cm^3, 0.200 mol/dm^3

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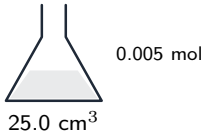


500 cm^3, 0.200 mol/dm^3

2.1 0.500 dm^3 $\times$ 0.200 $=$ 0.100 mol.

Exercise 2.2

2.2 Convert 0.005 mol in 25.0 cm^3 into a concentration. [2]

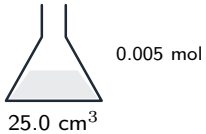


2.3 In $H_2SO_4 + 2\ NaOH$, one mole of acid neutralises how many moles of alkali? [1]



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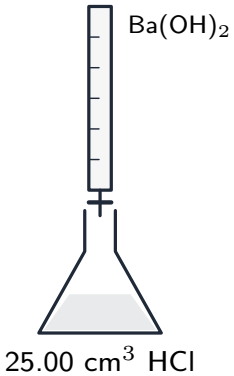


2.2 $0.005 \div 0.0250\ dm^3 = 0.200\ mol/dm^3$.

2.3 Two.

Exercise 3.1

3.1 *(HT)* 23.50 cm^3 of 0.100 mol/dm^3 barium hydroxide neutralises 25.00 cm^3 of hydrochloric acid: $Ba(OH)_2 + 2\ HCl \rightarrow BaCl_2 + 2\ H_2O$. Calculate the acid concentration. [4]



Exercise 3.1

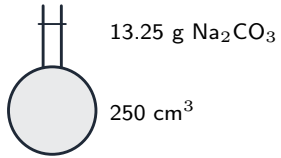
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3.1 Moles $Ba(OH)_2 = 0.100 \times 0.02350 = 2.35 \times 10^{-3}$; ratio 1 : 2, so moles HCl = 4.70×10^{-3}; volume acid = 0.02500 dm^3; C = $4.70 \times 10^{-3} \div 0.02500 = 0.188$ mol/dm^3.

Exercise 3.2

3.2 *(HT)* A student makes 250 cm^3 of sodium carbonate solution containing 13.25 g of Na_2CO_3 (Mr = 106). Calculate the concentration in mol/dm^3. [3]

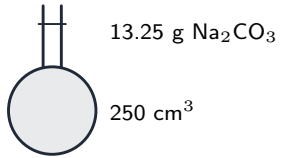


3.3 *(HT)* The final trial overshot the end point and its recorded result must be excluded. The trials read 21.10, 21.20, 21.15 and 24.60 cm^3. Give the mean titre, and the moles of 0.100 mol/dm^3 acid it represents. [4]



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3.2 Moles = 13.25 ÷ 106 = 0.125; volume = 0.250 dm^3; C = 0.125 ÷ 0.250 = 0.500 mol/dm^3.

3.3 Exclude the recorded overshoot, 24.60; mean = (21.10 + 21.15 + 21.20) ÷ 3 = 21.15 cm^3; = 0.02115 dm^3; moles = $0.100 \times 0.02115 = 2.115 \times 10^{-3} \approx 2.12 \times 10^{-3}$ mol.