Mole Calculations Map

Edexcel A Level Chemistry · Topic 5 Formulae, Equations and Amounts of Substance · Mole Calculations

1 Relative masses

1.6, 1.7, 5.3

- A_r: weighted mean mass vs 1/12 of ^{12}C
- M_r: add the A_r of every atom
- Giant structures: **formula mass**
- Brackets multiply everything inside
- Hydrates: add n × 18.0



2 The mole

5.1–5.3

- **Mole**: the unit of amount
- **n = m ÷ M**; m = n × M
- M in g mol^{-1}
- **L = 6.02 × 10^{23} mol^{-1}**
- Particles = n × L

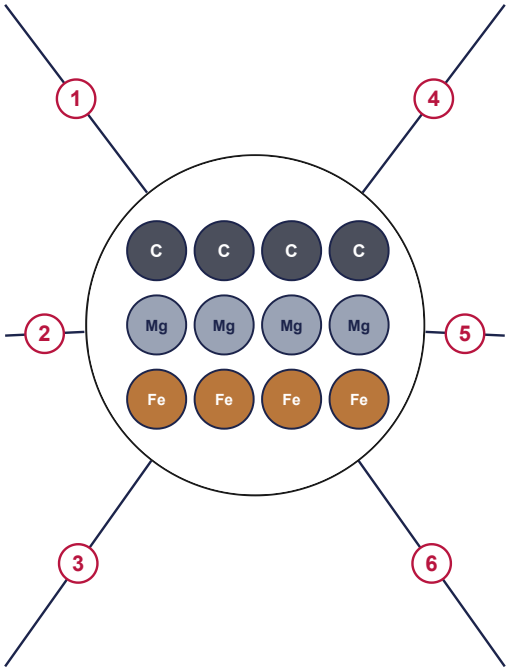


3 Counting particles

5.2

- Read the formula first
- $CaCl_2$: 3 ions per formula
- H_2O: 3 atoms per molecule
- Multiply moles by the count
- 1.00 g H_2 has 4 × the atoms of 1.00 g He





4 Reacting masses

5.7, 5.8

- **Moles** of what you know
- **Ratio** from the equation
- **Mass** of what you want
- **Limiting reactant**: used up first
- Masses → moles → ratio: confirms an equation



5 Yield and atom economy

5.14

- **% yield** = actual ÷ theoretical × 100
- Losses: incomplete, side reactions, transfers
- **Atom economy** = M(desired) × 100 ÷ ΣM(products)
- Addition reactions: 100 %
- Industry weighs both, plus cost and energy



6 Formulae by experiment

5.5 a, 5.8

- Heat to **constant mass**
- Water lost ÷ anhydrous: **mole ratio**
- $CuSO_4 \cdot 5H_2O$ from 2.50 g → 1.60 g
- Predict residues to **confirm an equation**
- Water left in: x too low; spitting: x too high



The equations of mole calculations

n in mol, m in g, M in g mol^{-1}, L = 6.02 × 10^{23} mol^{-1}

Quantity	Equation	Worked example
Amount from mass	n = m ÷ M	4.40 g CO_2: 4.40 ÷ 44.0 = 0.100 mol
Mass from amount	m = n × M	0.250 mol NaOH: 0.250 × 40.0 = 10.0 g
Number of particles	N = n × L	0.200 mol H_2O: 1.20 × 10^{23} molecules
Percentage yield	actual ÷ theoretical × 100	5.04 g of 5.60 g CaO: 89.9 %
Atom economy	M(desired) × 100 ÷ ΣM(products)	CaO from $CaCO_3$: 56.1 ÷ 100.1: 56.0 %
Water of crystallisation	x = n(H_2O) ÷ n(salt)	0.0500 ÷ 0.0100: $CuSO_4 \cdot 5H_2O$

Worked examples

Reacting mass

- 25.0 g $CaCO_3$: 0.250 mol
- 1 : 1, so 0.250 mol CaO
- **14.0 g CaO**

Limiting reactant

- 0.200 mol Mg, 0.150 mol HCl
- Mg needs 0.400: HCl limits
- **0.0750 mol H_2**

Confirm an equation

- 4.20 g $NaHCO_3$ leaves 2.65 g
- Na_2CO_3 predicts 2.65 g
- **$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$**

Moles link to empirical and molecular formulae and to solutions, gases and titrations, the next two sections of Topic 5.

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