Moles and Masses Map

OCR A Level Chemistry A · 2.1.3 Amount of substance · Moles and masses

1 The mole

2.1.3 (a)(i)–(ii)

- **Amount of substance**: counts particles
- Its unit: the **mole**, mol
- 1 mol of particles: as many as in 12 g of ^{12}C
- Always say which particle
- Give amounts to 3 significant figures



2 Molar mass

2.1.3 (a)(iv)

- **Molar mass M**: mass per mole, **g mol^{-1}**
- Same number as M_r or formula mass
- **n = m ÷ M**; m = n × M
- Brackets multiply everything inside
- Hydrates: add n × 18.0

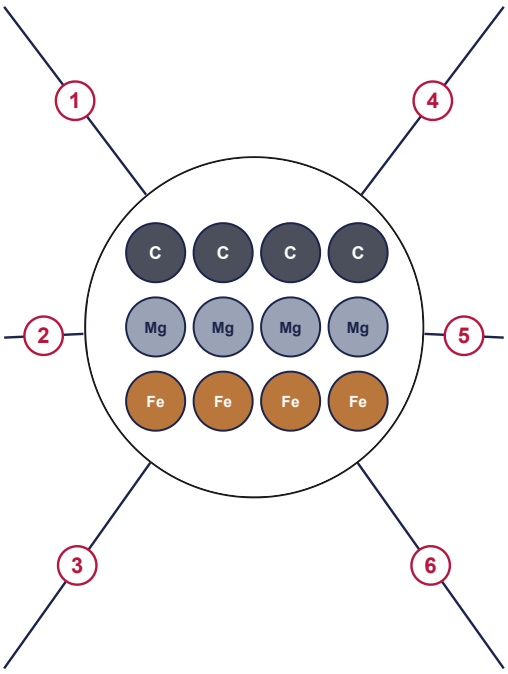


3 Counting particles

2.1.3 (a)(iii)

- **N_A = 6.02 × 10^{23} mol^{-1}**
- Particles = n × N_A
- $CaCl_2$: 3 ions per formula
- H_2O: 3 atoms per molecule
- Multiply moles by the count

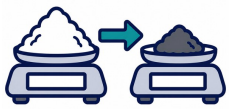




4 Reacting masses

2.1.3 (e)(i), (g)

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



5 Yield and atom economy

2.1.3 (h)

- **% yield** = actual ÷ theoretical × 100
- Losses: incomplete, side reactions, transfers
- **Atom economy** = M(desired) × 100 ÷ ΣM(products)
- Fixed by the balanced equation
- Addition reactions: 100 %



6 Sustainability

2.1.3 (j)

- High atom economy: **less waste**
- **Fewer raw materials**, often finite
- Less energy spent on by-products
- Use or sell the by-products
- Recycle unreacted reactants



The equations of Moles and masses

n in mol, m in g, M in g mol^{-1}, N_A = 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 × N_A	0.200 mol H_2O: 1.20 × 10^{23} molecules
Reacting mass	moles, ratio, mass	25.0 g $CaCO_3$ → 0.250 mol → 14.0 g CaO
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 %

Worked examples

Working backwards

- 51.0 g Al_2O_3: 0.500 mol
- 4 Al : 2 Al_2O_3: 1.00 mol Al
- **27.0 g Al**

Limiting reactant

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

Two routes to ethanol

- fermentation: 51.1 %
- hydration: 100 %
- **hydration wastes no atoms**

Moles link to formulae and hydrated salts, and to solutions and gases (2.1.3).

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