

AQA GCSE Chemistry: Topic 3

"Grade 7" Examiner Cheat Sheet — Quantitative Chemistry

Section 1: The Rosetta Stone of Mass

The Law of Conservation of Mass: No atoms are lost or made during a chemical reaction.

$$\text{Total Mass of Reactants} = \text{Total Mass of Products}$$

EXAM TRAP: Explaining Mass Changes

- **Mass Decreases?** A gas was produced (e.g. CO_2) and escaped from an **open system**.
- **Mass Increases?** A gas from the air (e.g. O_2) reacted with a solid reactant (e.g. Magnesium burning).

Section 2: Relative Formula Mass (M_r) Algorithm

The Rule: The sum of the relative atomic masses (A_r) of the atoms in the numbers shown in the formula.
Percentage by Mass Algorithm:

$$\% \text{ Mass} = \frac{\text{Total } A_r \text{ of specific element}}{M_r \text{ of the whole compound}} \times 100$$

Worked Example: M_r of $(NH_4)_2SO_4$
 $(14 + [1 \times 4]) \times 2 + 32 + (16 \times 4) = 132$.

Note: The large balancing numbers in an equation are NEVER used for M_r calculations.

Section 3: Precision & Uncertainty

Uncertainty Definition: The interval within which the true value is expected to lie.

$$\text{Uncertainty} = \pm \frac{\text{Range}}{2}$$

Example: If titration results are 25.1, 25.3, 25.2 cm³:

Range = 25.3 - 25.1 = 0.2. Uncertainty = ± 0.1 . Mean = 25.2 \pm 0.1.

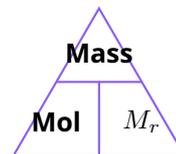
Section 4: The Mole Concept (Higher Tier)

The Mole (mol): The unit for the amount of substance. **Avogadro constant:** 6.02×10^{23} particles per mole.

The Master Calculation:

$$\text{Moles } (n) = \frac{\text{Mass } (m)}{M_r}$$

Example: Moles in 10g of NaOH ($M_r = 40$)?
 $10 \div 40 = \mathbf{0.25}$ mol.



Section 5: Reacting Mass Algorithm (The Table Method)

The Challenge: Given the mass of one substance, find the mass of another.

Step	Known Substance	Unknown Substance
1. Find Moles	Mass $\div M_r$	Wait for ratio...
2. Use Ratio	Balancing # (large)	Balancing # (large)
3. Find Mass	Result from step 1	Moles $\times M_r$

GRADE 7 TIP: Always use the **molar ratio** from the large balancing numbers in the equation to move from the Known column to the Unknown column.

Section 6: Deriving Equations from Mass (HT Only)

Algorithm to find balancing numbers:

1. Calculate the moles of **every** substance ($m \div M_r$).
2. Divide every mole value by the **smallest** mole value calculated.
3. If you get decimals, multiply all values by a common factor (e.g., $\times 2$ or $\times 3$) to get whole numbers.
4. These whole numbers are the **balancing coefficients** for the equation.

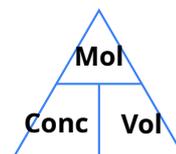
Section 7: The Concentration Matrix

Concentration can be calculated in two ways:

- **Mass concentration:** Mass (g) \div Volume (dm^3)
- **Molar concentration (HT):** Moles (mol) \div Volume (dm^3)

THE VOLUME TRAP: Volume must ALWAYS be in dm^3 for these formulas.

$$\text{cm}^3 \div 1000 = \text{dm}^3$$



Section 8: Limiting Reactant Logic (HT Only)

The Concept: The reactant that is completely used up is called the **limiting reactant**.

- The reaction stops as soon as the limiting reactant is exhausted.
- Any reactant left over is described as being in **excess**.
- **Calculation Rule:** To find the amount of product, you **must** base your calculation on the moles of the limiting reactant.

Section 9: Titration Calculation Algorithm (Triple Science)

Scenario: You know the volume and concentration of one solution (A), and only the volume of the other (B).

1. **Moles of Known (A):** $n = C \times V$ (remember dm^3 !).
2. **Stoichiometric Ratio:** Use the equation to find moles of (B).
3. **Concentration of Unknown (B):** $C = n \div V$.

Mark Scheme Gold: Use concordant results only (within 0.10cm^3 of each other) to calculate your mean volume.

Section 10: Percentage Yield (Triple Science)

Comparing what you actually made with the maximum possible amount.

$$\% \text{ Yield} = \frac{\text{Actual Mass produced}}{\text{Maximum Theoretical Mass}} \times 100$$

Why is yield never 100%? (Common 3-Marker)

- The reaction may be **reversible** (doesn't go to completion).
- Some product is **lost** when it is separated from the mixture (e.g. on filter paper).
- Reactants may react in **different ways** than expected (side reactions).

Section 11: Atom Economy Algorithm (Triple Science)

A measure of the amount of starting materials that end up as **useful products**.

$$\% \text{ Atom Economy} = \frac{M_r \text{ of Desired Product}}{\text{Sum of } M_r \text{ of ALL Reactants}} \times 100$$

Sustainability Connection: High atom economy is vital for **sustainable development** because it minimizes waste and reduces costs for raw materials.

Section 12: Molar Gas Volume (Triple HT Only)

The Constant: Equal amounts (moles) of gases occupy the same volume under the same temperature and pressure. **At RTP (20°C):** 1 mole of any gas occupies **24dm³**.

Formula:

$$\text{Volume of gas (dm}^3\text{)} = \text{Amount (mol)} \times 24$$

*Example: What is the volume of 0.5 moles of CO₂? 0.5 × 24 = **12dm³**.*