

# AQA GCSE Chemistry: Topic 1

## "Grade 7" Examiner Cheat Sheet — Atomic Structure & Periodic Table

### Section 1: The "Rosetta Stone" of Definitions

**Examiner Note:** You must use precise AQA terminology. Vague answers receive 0 marks.

Term	Precise AQA Definition
<b>Element</b>	A substance made of only one type of atom. All atoms have the same number of protons.
<b>Compound</b>	Two or more elements <b>chemically combined</b> in fixed proportions.
<b>Mixture</b>	Two or more elements or compounds <b>not chemically combined</b> together.
<b>Isotope</b>	Atoms of the same element with the same number of protons but <b>different numbers of neutrons</b> .

#### **GOLDEN RULE: The "Chemical Property" Trap**

In a **mixture**, chemical properties of each substance are unchanged. In a **compound**, properties are entirely different (e.g., toxic  $Cl_2$  gas vs edible  $NaCl$  salt).

### Section 2: The Universal Separation Matrix

**Examiner Task: Suggest a method to separate...**

- Insoluble solid from a liquid?** → **Filtration** (e.g., sand from water).
- Soluble solid from a liquid?** → **Crystallisation** (e.g., salt from water). Heat to evaporate some water, then leave to cool and crystalize.
- Liquid from a solution (solvent)?** → **Simple Distillation** (e.g., pure water from ink). Based on different boiling points.
- Miscible liquids with different boiling points?** → **Fractional Distillation** (e.g., crude oil). Uses a **fractionating column**.
- Soluble substances in a solvent?** → **Chromatography**.

### Section 3: Chromatography Master Rules

- **Stationary Phase:** The paper.
- **Mobile Phase:** The solvent (water or ethanol).
- **Separation depends on:** Solubility in the solvent and attraction to the paper.
- **The Baseline:** Must be drawn in **pencil** (ink would dissolve and run).
- **The Solvent Level:** Must be below the pencil line (so the spots don't wash off).

## Section 4: The Universal Atomic Model Timeline

**Comparison Note:** Be prepared to explain why a model was replaced (new experimental evidence).

Scientist	Discovery	Key Features
Dalton	Tiny Spheres	Atoms are indivisible 'billiard balls'.
Thomson	<b>Plum Pudding</b>	A ball of positive charge with negative electrons embedded.
Rutherford	<b>Nuclear Model</b>	Mass concentrated in a tiny, positive <b>nucleus</b> ; atom is mostly empty space.
Bohr	Energy Levels	Electrons orbit in specific shells at fixed distances.
Chadwick	<b>Neutrons</b>	Neutral particles in the nucleus; explained the "missing" mass.

## Section 5: The Turning Point — Alpha Scattering

**The Experiment:** Rutherford fired alpha particles (+) at thin gold foil.

Observation	Conclusion
Most particles passed straight through.	The atom is <b>mostly empty space</b> .
Some particles were deflected.	The center ( <b>nucleus</b> ) is positively charged.
Very few bounced straight back.	The nucleus is <b>tiny</b> and contains <b>most of the mass</b> .

## Section 6: Subatomic Particle Master Table

Particle	Relative Mass	Relative Charge	Position
<b>Proton</b>	1	+1	In the nucleus
<b>Neutron</b>	1	0	In the nucleus
<b>Electron</b>	Very small (1/2000)	-1	In shells (energy levels)

**The Math Rules:**

- **Atomic Number** = Number of protons.
- **Mass Number** = Protons + Neutrons.
- **Neutral Atoms:** Protons = Electrons.

## Section 7: Evolution of the Periodic Table

### How Mendeleev fixed the "Weight" Problem:

- **Early Tables:** Arranged by atomic weight. Elements were often in groups with different properties.
- **Mendeleev's Intervention:**
  1. He left **gaps** for undiscovered elements.
  2. He **swapped** elements (e.g., Tellurium and Iodine) so they sat in groups with similar properties, even if it broke the weight order.
  3. He **predicted** the properties of the missing elements correctly.
- **The Modern Upgrade:** Elements are now arranged by **Atomic Number** (Protons).

## Section 8: Group 1 — The Alkali Metals

Reactivity **INCREASES** as you go **DOWN** the group.

### The 4-Mark Explanation Algorithm:

1. Atoms get larger (more shells).
2. The outer electron is **further from the nucleus**.
3. There is a **weaker electrostatic attraction** between the positive nucleus and negative outer electron.
4. Therefore, the outer electron is **lost more easily**.

*Properties: Soft, low density, react with water to produce Hydrogen and an Alkaline solution.*

## Section 9: Group 0 — The Noble Gases

### Key Concept: Inert Nature

- They are **unreactive** because they have a **stable, full outer shell** of electrons.
- They exist as **monatomic** gases (single atoms).
- They are non-flammable.
- **Trend:** Boiling point **increases** as you go down (atoms get heavier, intermolecular forces increase).

## Section 10: Group 7 – The Halogens

Reactivity **DECREASES** as you go **DOWN** the group.

The Explanation Algorithm:

1. Atoms get larger (more shells).
2. The outer shell is **further from the nucleus**.
3. There is a **weaker attraction** to pull in an incoming electron.
4. Therefore, an electron is **gained less easily**.

Properties: Diatomic ( $F_2$ ,  $Cl_2$ ). Melting/Boiling points increase down the group.

## Section 11: Transition Metals (Triple Only)

Comparison with Group 1:

Property	Transition Metals (Fe, Cu, Ni)
Physical	Harder, stronger, and much higher melting points than Group 1.
Ions	Can form <b>ions with different charges</b> (e.g., $Fe^{2+}$ , $Fe^{3+}$ ).
Compounds	Form <b>coloured compounds</b> (Group 1 makes white compounds).
Uses	Very useful as <b>catalysts</b> .

## Section 12: Relative Atomic Mass ( $A_r$ ) Algorithm

Formula:

$$A_r = \frac{(\text{mass}_1 \times \text{abundance}_1) + (\text{mass}_2 \times \text{abundance}_2)}{100}$$

Worked Example: Chlorine

- Isotope 1: Cl-35 (75%)    Isotope 2: Cl-37 (25%)
- $A_r = \frac{(35 \times 75) + (37 \times 25)}{100} = \frac{2625 + 925}{100} = 35.5$

## Section 13: Electronic Configuration Master Rule

The 2, 8, 8 Rule:

- 1st Shell: max 2    2nd Shell: max 8    3rd Shell: max 8.

The Table Connection:

- **Group Number** = Electrons in outer shell.
- **Period Number** = Number of energy levels (shells).

Example: Calcium (At No. 20) → 2, 8, 8, 2. (Group 2, Period 4).