AQA GCSE Chemistry: Topic 8

"Grade 7" Examiner Cheat Sheet — Chemical Analysis

Section 1: Purity vs. Formulations

Pure Substance (Chemistry): A single element or compound, not mixed with any other substance.

- **The Purity Test:** Pure substances melt and boil at **specific, fixed temperatures**.
- **Impure substances:** Melt/boil over a **range** of temperatures and lower the melting point.

Formulations: A mixture that has been **designed as a useful product**.

- Components are mixed in **carefully measured quantities** to ensure the product has required properties.
- **Examples:** Fuels, cleaning agents, paints, medicines, alloys, fertilisers, and foods.

Section 2: Identification of Common Gases

Examiner Note: You must state both the **test** and the **result** for full marks.

Gas	The Test	Positive Result
Hydrogen	Burning splint at mouth of tube.	Loud **'squeaky pop'**.
Oxygen	Glowing splint inside the tube.	Splint **relights**.
Carbon Dioxide	Bubble through limewater.	Limewater turns **milky (cloudy)**.
Chlorine	Damp litmus paper.	Paper is **bleached white**.

Section 3: Paper Chromatography Logic

Used to separate mixtures and identify substances.

- **Stationary Phase:** The paper. **Mobile Phase:** The solvent.
- **Separation:** Depends on the distribution of substances between the phases.

TRAP CHECK: Experimental Errors

1. **Pencil Line:** Baseline must be in pencil because ink would dissolve and move.
2. **Solvent Depth:** Must be **below** the pencil line so the spots don't wash off.

The R_f Calculation:

$$R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}}$$

Note: R_f values are always ≤ 1.0.

Section 4: Flame Tests Algorithm

Method: Use a nichrome wire loop cleaned in HCl, dip in sample, place in blue Bunsen flame.

Metal Ion	Flame Colour
Lithium (Li^+)	**Crimson** (Don't just say 'red')
Sodium (Na^+)	**Yellow**
Potassium (K^+)	**Lilac**
Calcium (Ca^{2+})	**Orange-red**
Copper (Cu^{2+})	**Green**

EXAM TRAP: Mixture of Ions
If a sample contains a mixture of ions, some flame colours can be **masked** (hidden) by others (e.g. Sodium's yellow often hides Potassium's lilac).

Section 5: Sodium Hydroxide ($NaOH$) Precipitates

Metal ions in solution react with $NaOH$ to form insoluble metal hydroxides.

Ion	Colour of Precipitate	Addition of EXCESS NaOH
Aluminium (Al^{3+})	**White**	**Redissolves** (becomes colourless).
Calcium (Ca^{2+})	**White**	No change.
Magnesium (Mg^{2+})	**White**	No change.
Copper (Cu^{2+})	**Blue**	No change.
Iron(II) (Fe^{2+})	**Green**	No change.
Iron(III) (Fe^{3+})	**Brown**	No change.

Grade 7 Logic: How to distinguish Ca^{2+} from Mg^{2+} if both give white ppts? $\rightarrow$ You **must** perform a flame test (Ca^{2+} is orange-red, Mg^{2+} has no colour).

Section 6: Carbonates & Sulfates

1. Carbonates (CO_3^{2-}):

- **Test:** Add **dilute acid** (e.g. HCl).
- **Observation:** Effervescence (fizzing) as CO_2 is produced.
- **Verification:** Bubble the gas through limewater.

2. Sulfates (SO_4^{2-}):

- **Test:** Add **dilute Hydrochloric acid** (HCl), then add **Barium Chloride** solution ($BaCl_2$).
- **Observation:** A **white precipitate** forms ($BaSO_4$).

TRAP CHECK: Why add acid first? To remove any carbonate ions that would also give a white precipitate and cause a false positive.

Section 7: Halide Ions (Group 7)

Test: Add **dilute Nitric acid** (HNO_3), then add **Silver Nitrate** solution ($AgNO_3$).

Halide Ion	Precipitate Colour	Formula
Chloride (Cl^-)	**White**	$AgCl$
Bromide (Br^-)	**Cream**	$AgBr$
Iodide (I^-)	**Yellow**	AgI

*Mnemonic: **W**endy **C**an **Y**ell (White, Cream, Yellow).*

Section 8: Ionic Equations for Analysis (HT Only)

Halide Example: $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ **Sulfate Example:** $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$
Carbonate Example: $CO_3^{2-}(s) + 2H^+(aq) \rightarrow CO_2(g) + H_2O(l)$

Section 9: Instrumental Methods — The Big 3 Pros

Elements and compounds can be detected using instrumental methods (machines).
Advantages over manual tests (Learn these!):

1. **Rapid:** Results are obtained very quickly.
2. **Sensitive:** They can detect even tiny amounts (small samples) of a substance.
3. **Accurate:** They are much more likely to identify a substance correctly than human eyes.

Section 10: Flame Emission Spectroscopy (Triple Only)

An instrumental method used to identify metal ions in solutions and determine their **concentration**.
How it works:

1. The sample is put into a flame.
2. The light given out is passed through a **spectroscope**.
3. The output is a **line spectrum**.

Analysis Logic:

- **Identity:** Every metal ion produces a **unique pattern** of lines.
- **Concentration:** The **intensity** (brightness) of the lines is proportional to the concentration.
- **Mixtures:** Unlike flame tests, this can identify multiple different ions in a single mixture.

Section 11: Summary Identification Algorithm

If you have an unknown solid...

1. **Check Cation:** Perform a **Flame Test**.
2. **If no colour:** Add **NaOH** to look for white or coloured ppts.
3. **Check Anion:** Add **acid** first (Carbonates).
4. **If no fizzing:** Use $BaCl_2$ (Sulfates) or $AgNO_3$ (Halides).

"Chemical analysis is about evidence. Test + Observation = Identity."