8) Analysis

Pure substances

•In chemistry, a **pure** substance is a single element or compound, **not mixed with any other substance**.
• Pure elements and compounds melt and boil at **specific temperatures**.
•Melting point and boiling point data can be used to distinguish pure substances from mixtures.

Formulations

•A formulation is a **mixture** that has been designed as a useful product.
•Formulations include fuels, cleaning agents, paints, medicines, alloys, fertilisers and foods.

Testing for gases

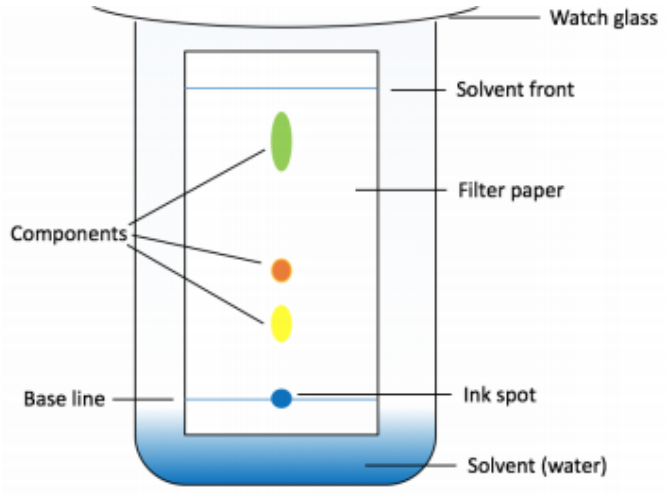
•The test for **hydrogen** uses a burning splint held at the open end of a test tube of the gas. Hydrogen burns rapidly with a **pop** sound.
•The test for **oxygen** uses a **glowing splint** inserted into a test tube of the gas. The splint **relights** in oxygen.
•The test for **carbon dioxide** uses lime water. When carbon dioxide is shaken with or bubbled through limewater the limewater turns **milky (cloudy)**.
•The test for **chlorine** uses **litmus paper**. When damp litmus paper is put into chlorine gas the litmus paper is **bleached** and turns white.

Chromatography – required practical

•Chromatography can be used to **separate** mixtures and can give information to help **identify** substances.
•Chromatography involves a **stationary phase** and a **mobile phase**.
•The ratio of the distance moved by a compound (centre of spot from origin) to the distance moved by the solvent can be expressed as its R_f value:

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

•Different compounds have different R_f values in different solvents, which can be used to help identify the compounds.
•The compounds in a mixture may separate into different spots depending on the solvent but a pure compound will produce a single spot in all solvents.



Triple only

Flame tests

•Flame tests can be used to identify some metal ions (cations).
•**lithium** compounds result in a **crimson** flame
•**sodium** compounds result in a **yellow** flame
•**potassium** compounds result in a **lilac** flame
•**calcium** compounds result in an **orange-red** flame
•**copper** compounds result in a **green** flame.

•If a sample containing a **mixture** of ions is used, some flame colours can **be masked**.

Testing for cations with sodium hydroxide

•Solutions of **aluminium, calcium and magnesium** ions form **white precipitates** when sodium hydroxide solution is added but only the aluminium hydroxide precipitate dissolves in excess sodium hydroxide solution.

•**Copper(II)** forms a **blue** precipitate,
•**iron(II)** a **green** precipitate
•**iron(III)** a **brown** precipitate.

Instrumental methods

•Instrumental methods are **accurate, sensitive and rapid**.
•**Flame emission spectroscopy** is an example of an instrumental method used to analyse metal ions in solutions.
•The sample is put into a flame and the light given out is passed through a **spectroscope**. The output is a line spectrum that can be analysed to identify the metal ions in the solution and measure their concentrations.

Carbonates

Carbonates react with dilute acids to form **carbon dioxide gas.**
Carbon dioxide turns limewater cloudy.

Sulfate ions

Sulfate ions in solution produce a **white precipitate** with **barium chloride** solution in the presence of **dilute hydrochloric acid.**

The halides

Add **silver nitrate** solution and dilute **nitric acid**. The colour of the precipitate (solid) tells you which halide is present:
Silver **chloride** is **white**,
Silver **bromide** is **cream** and Silver **iodide** is **yellow**.