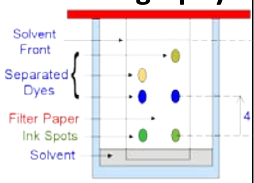
4.8 Chemical analysis - Knowledge Organiser

4.8.1	**Purity, formulations and chromatography**
4.8.1.1 **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. In everyday language, a pure substance can mean a substance that has had nothing added to it, so it is unadulterated and in its natural state, eg pure milk.
4.8.1.2 **Formulations**	A **formulation** is a **mixture** that has been **designed** as a **useful** product. Many products are complex mixtures in which each chemical has a particular purpose. Formulations are made by mixing the components in carefully measured quantities to ensure that the product has the required properties. Formulations include **fuels, cleaning agents**, **paints, medicines**, **alloys**, **fertilisers** and **foods.**
4.8.1.3 **Chromatography**  	**Chromatography** can be used to **separate mixtures** and can give information to help identify substances. Chromatography involves a **stationary phase** and a **mobile phase.** Separation depends on the distribution of substances between the phases. 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 **Rf value:** ***R f = <u>distance moved by substance</u>*** ***distance moved by solvent*** **Different compounds** have **different Rf** 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.
4.8.2	Identification of common gases
4.8.2.1 **Test for hydrogen**	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.
4.8.2.2 **Test for oxygen**	The test for oxygen uses a **glowing splint** inserted into a test tube of the gas. The splint **relights** in oxygen.
4.8.2.3 **Test for carbon dioxide**	The test for carbon dioxide uses an aqueous solution of **calcium hydroxide (lime water**). When carbon dioxide is shaken with or bubbled through limewater the **limewater** turns **milky (cloudy).**
4.8.2.4 **Test for chlorine**	The test for chlorine uses litmus paper. When **damp litmus paper** is put into chlorine gas the litmus paper is **bleached** and **turns white.**
4.8.3	Identification of ions by chemical and spectroscopic means (chemistry only)
4.8.3.1 **Flame tests**	**Flame tests** can be used to **identify** some **metal ions** (cations). • **lithium** compounds result in a **crimson** flame. **Li(e) → crimson** • **sodium** compounds result in a **yellow** flame .**<u>S</u>un is yellow** • **potassium** compounds result in a lilac flame. **<u>P</u>otassium, <u>P</u>urple (lilac)** • **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.**
4.8.3.2 **Metal hydroxides**	**Sodium hydroxide solution** can be used to identify some **metal ions** (cations). 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.

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	Solutions of copper(II), iron(II) and iron(III) ions form coloured precipitates when sodium hydroxide solution is added. **Copper(II)** forms a **blue precipitate**, **iron(II)** a **green precipitate** and **iron(III)** a **brown precipitate.** Balanced equations: $Cu(II)SO_4 + NaOH \rightarrow Cu(OH)_2 + Na_2SO_4$
4.8.3.3 Carbonates	**Carbonates** react with **dilute acids** to form **carbon dioxide** gas. Carbon dioxide can be identified with **limewater** goes cloudy
4.8.3.4 Halides	**Halide ions** (from halogens – group 7) in solution produce precipitates with **silver nitrate** solution in the **presence** of **dilute nitric acid**. **Silver <u>chloride</u>** is **white**, **silver <u>bromide</u>** is **cream** and **silver <u>iodide</u>** is **yellow.**
4.8.3.5 Sulfates	**Sulfate ions** in solution produce a **white precipitate** with **barium chloride** solution in the **presence** of **dilute hydrochloric acid**. **Required practical 7:** use of chemical tests to identify the ions in unknown single ionic compounds using the above tests.
4.8.3.6 Instrumental methods	Elements and compounds can be detected and identified using **instrumental methods**. Instrumental methods are **accurate**, **rapid** and **sensitive** (ARS).
4.8.3.7 Flame emission spectroscopy	**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.