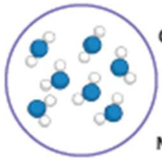
AQA GCSE Chemistry (Combined Science) Unit 8: Chemical Analysis

Pure Substances

Pure substances, in chemistry, only contain **one type of element** or **one type of compound**. For example, pure water will just contain water (a compound).

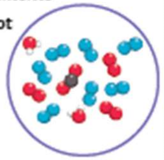
In our everyday language, we use the word 'pure' differently to how it is used in chemistry. Pure can mean a **substance** that has had **nothing else added to it** and is in its natural state. An example of this is pure orange juice. This means that the bottle will just contain orange juice and no other substances.

Elements are made up of **one type of atom**. For example, oxygen is made up of oxygen atoms. Carbon is made up of carbon atoms.



Compounds are **two or more elements** that are **chemically joined** together. For example, NaCl which is sodium chloride.

Mixtures are **two or more elements or compounds** that are **not chemically joined** together. An example of this is a standard cup of coffee. Coffee contains water, milk, coffee and possibly sugar. The components of the cup of coffee are not bonded together.



Pure Substances have a **sharp melting point** compared to **impure** substances which **melt over a range** of temperatures.

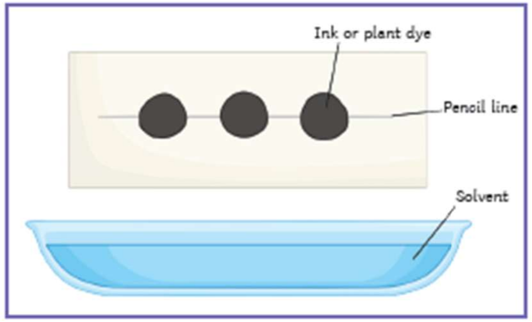
Formulations

Formulations are **mixtures of compounds or substances** that **do not react together**. They do **produce a useful product** with desirable characteristics or properties to suit a particular function.

There are examples of formulations all around us such as medicines, cleaning products, deodorants, hair colouring, cosmetics and sun cream.

Chromatography

Paper chromatography is a separation technique that is used to **separate** mixtures of **soluble substances**. How soluble a substance is determines how far it will travel across the paper.



In chromatography, there are **two phases**: the mobile and **stationary** phase.

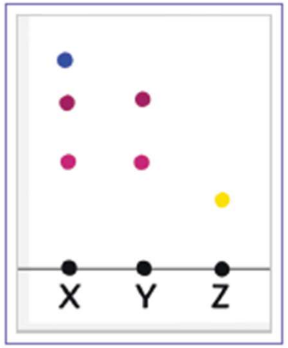
The **mobile phase moves** through the stationary phase. The **solvent** is the **mobile phase**. It moves through the paper carrying the different substances with it.

The **stationary phase** in paper chromatography is the **absorbent paper**.

Separation of the dissolved substances produces what is called a **chromatogram**. In paper chromatography, this can be used to **distinguish** between those substances that are **pure** and those that are **impure**.

Pure substances have **one spot** on a chromatogram as they are made from a single substance. **Impure substances** produce **two or more spots** as they contain multiple substances.

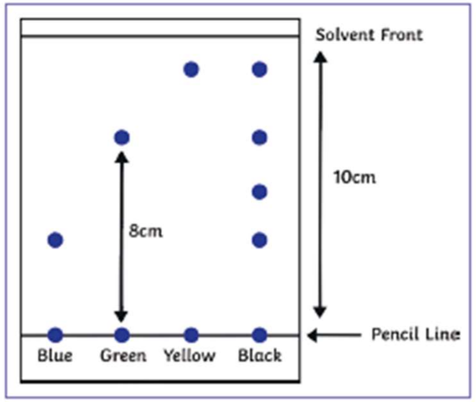
By calculating the **R_f values** for each of the spots, it is possible to identify the unknown substances. Similarly, if an unknown substance produces the **same number** and **colour of spots**, it is possible to match it to a known substance.



R Value

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

Different compounds have different R_f values in different solvents. The R_f values of known compounds can be used to help identify unknown compounds.



Purity and formulations

Chromatography

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Required Practical – Paper Chromatography

Investigate how paper chromatography can be used to separate and distinguish between coloured substances.

Step 1 – Using a ruler, measure 1cm from the bottom of the chromatography paper and mark with a small dot using a pencil. Rule a line across the bottom of the chromatography paper with a pencil, going through the dot you have just made.

Step 2 – Using a pipette, drop small spots of each of the inks onto the pencil line. Leave a sufficient gap between each ink spot so that they do not merge.

Step 3 – Pour a suitable solvent into the bottom of a container such as a beaker. The solvent should just touch the chromatography paper. The solvent line must not go over the ink spots as this will cause the inks to run into each other.

Step 4 – Place the chromatography paper into the container and allow the solvent to move up through the paper.

Step 5 – Just before the solvent line reaches the top of the paper, remove the chromatogram from the container and allow to dry.

Step 6 – Once the chromatogram has dried, measure the distance travelled by the solvent.

Step 7 – Measure the distance travelled by each ink spot.

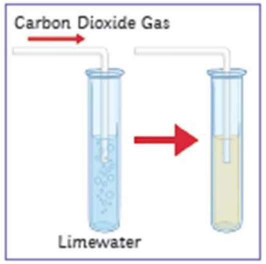
Step 8 – Calculate the R_f value. Compare the R_f values for each of the spots of ink.

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

Identification of the Common Gases

The Test for Hydrogen
Place a burning splint at the opening of a test tube. If hydrogen gas is present, it will burn rapidly with a **squeaky-pop sound**.

The Test for Oxygen
Place a glowing splint inside a test tube. The **splint will relight** in the presence of oxygen.



The Test for Carbon Dioxide
Calcium hydroxide (lime water) is used to test for the presence of carbon dioxide. When carbon dioxide is bubbled through or shaken with limewater, the limewater turns **cloudy**.

The Test for Chlorine
Damp litmus paper is used to test for chlorine gas. The litmus paper becomes **bleached and turns white**.