Trilogy C12 – Chemical Analysis

A **pure substance** is a simgle element or compound.

A **mixture** is made up of two or more different elements or compounds that are not chemically joined together.

A **formulation** is a mixture that has been specifically designed to produce a useful product. Examples include paints and medicinal drugs.

Identifying pure substances

The melting and boiling point of a substance can be used to tell whether it is pure or not.

There are two ways you can use the melting and boiling point to tell if the sample is pure.

1) The **range** of the melting and boiling points will be very small if the sample is pure. Example:

	Pure caffeine	Impure caffeine
Melting point/ °C	234-237	180-220

2) Alternatively, once you have recorded the melting/boiling point for a substance you can **compare** it to a **database** of known values.

- If the melting point you recorded matches the melting point given in the database, it is pure.
- If the melting point does not match the value in the database, your sample is impure.
- Generally impure substances will have a lower melting point and a higher boiling point than the pure substance.

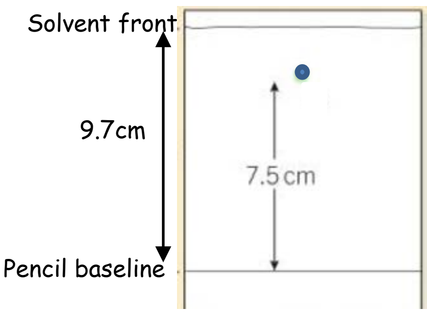
Chromatography is used to identify unknown compounds in a sample.

- The **mobile phase** moves and carries the different compounds in the sample through the **stationary phase**.
- In **paper chromatography**, the mobile phase is a solvent such as water which carries the sample along the paper (stationary phase).
- The **different compounds** in the sample will **travel different distances** along the paper.
- If a compound is more **strongly attracted** to the mobile phase (very soluble in it) than the stationary phase, it will **travel further** up the paper.

Pure or a mixture? Read the chromatogram vertically. If there is **only** one spot above the point where the sample was placed the sample is **pure**, more than one spot means a mixture.

Calculating the Retention Factor value:

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



Example

$$\frac{7.5\text{cm}}{9.7\text{cm}} = 0.77$$

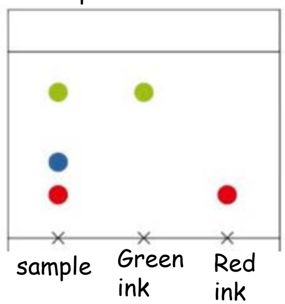
Identifying unknown compounds

To identify the unknown compounds we calculate the Rf value (see left).

When we have calculated the Rf value we can **compare** that to **Rf values** of known substances which are **stored in databases**.

Alternatively, when we carry out the chromatography we can also run known samples and see if any spots travel the same distance.

Example:



In this example, two known compounds (red and green ink) have been added to the chromatography paper. We can use them to confirm that the unknown sample contains red and green ink because the spots in the sample have travelled the same vertical distance.

- The baseline is **drawn in pencil** and not ink because ink will dissolve in water and run.
- The pencil baseline must be **above** the surface of the water otherwise the sample will dissolve into the beaker of water and be lost.

Testing for gases

Hydrogen — Hold a lit splint near the sample of gas.

Positive test: Hydrogen will burn with a squeaky pop sound.

Carbon dioxide — Bubble gas through limewater

Positive test: If carbon dioxide is present it will turn limewater cloudy.

Oxygen — Hold a glowing splint near the sample of gas.

Positive test: If oxygen is present a glowing splint will relight.

Chlorine — Use damp blue litmus paper

Positive test: Chlorine will bleach damp blue litmus paper white.