AQA Chemistry A-Level

3.3.16: Chromatography

Detailed Notes

3.3.16.1 - Chromatography

Chromatography is an **analytical technique** used to separate and identify component molecules of a mixture. It uses a **mobile phase** and a **stationary phase**.

Mobile and Stationary Phases

The mobile phase is a substance that allows molecules to **move over or through** the stationary phase. It can be in the form of a **liquid or a gas** depending on the type of chromatography being carried out. **More soluble** products **move further** with the mobile phase.

The stationary phase is a substance that has **affinity** to molecules in the mixture being analysed. The **greater the affinity** of a molecule to the stationary phase, the **shorter the distance** it moves with the mobile phase.

Rf Values

This is a value that is unique to each different component molecule in the mixture being analysed. It is calculated by comparing the **distance moved by the mobile phase and the molecule**.

Example:

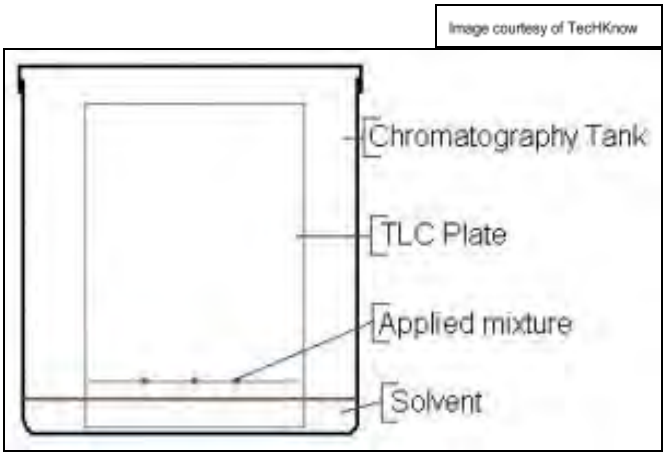
$$Rf = \frac{\text{Distance moved by molecule}}{\text{Distance moved by solvent}}$$

There are four main types of chromatography that use different mobile and stationary phases to obtain Rf values for the molecules present.

Thin-Layer Chromatography

In this method of chromatography, a **metal plate** is coated with a **thin layer of silica** and solvent moves up the plate. The plate is then dried in a fume cupboard to reduce toxic fumes. The chemical traces can then be viewed using a **UV lamp** and the distances travelled can be measured. Alternatively, a **developing agent** can be added, such a **iodine**, to allow the traces to be seen by the naked eye.

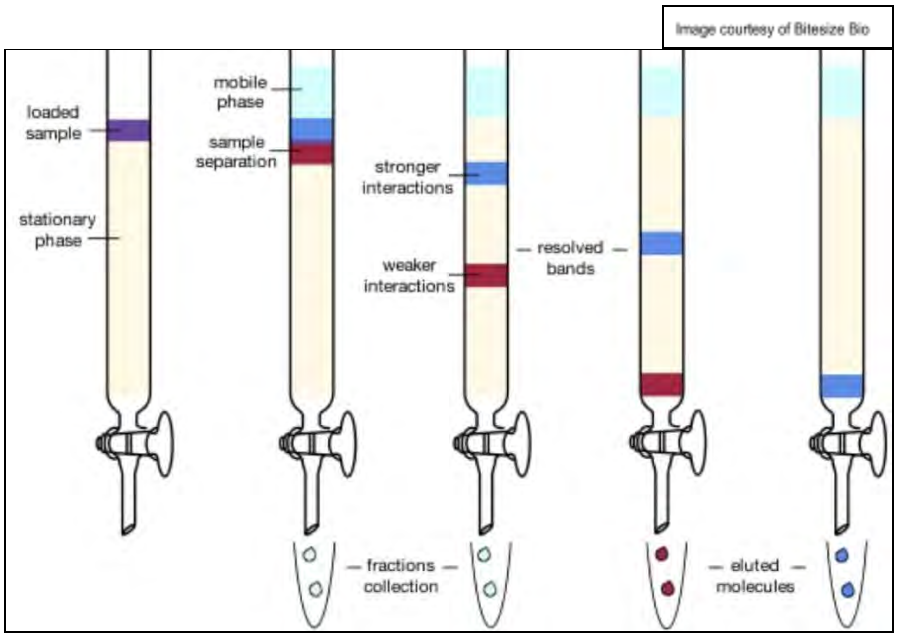
Example:



Column Chromatography

For this method, a **vertical column** is packed with a **solid, powdered substance** which acts as the stationary phase. A **solvent** containing the mixture being analysed is then added and moves down the column as the mobile phase.

Example:

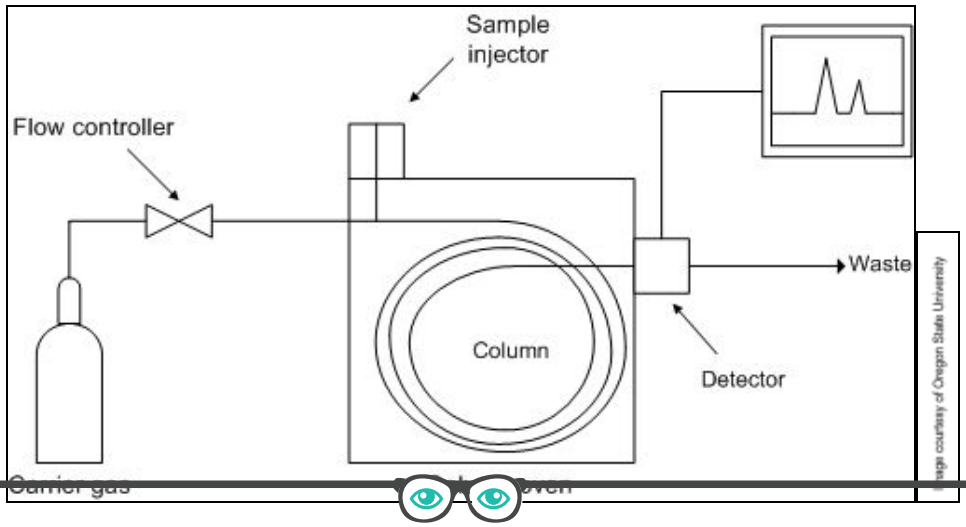


The varying affinities of the molecules present means they **drain out of the column at different times**, allowing them to be collected as **separate samples**. The time taken to drain out of the column like this is measured as the **retention time**. Similar to Rf values, retention times allow the individual molecules in the mixture to be identified.

Gas Chromatography

In this form of chromatography, a **thin tube** is packed with a **solid, powdered substance** which acts as the stationary phase. Instead of a solvent, a **high pressure gas** is passed through this tube as the mobile phase. This method is used to separate mixtures of **volatile liquids** which are fed into the gas chromatography machine as vapours.

Example:



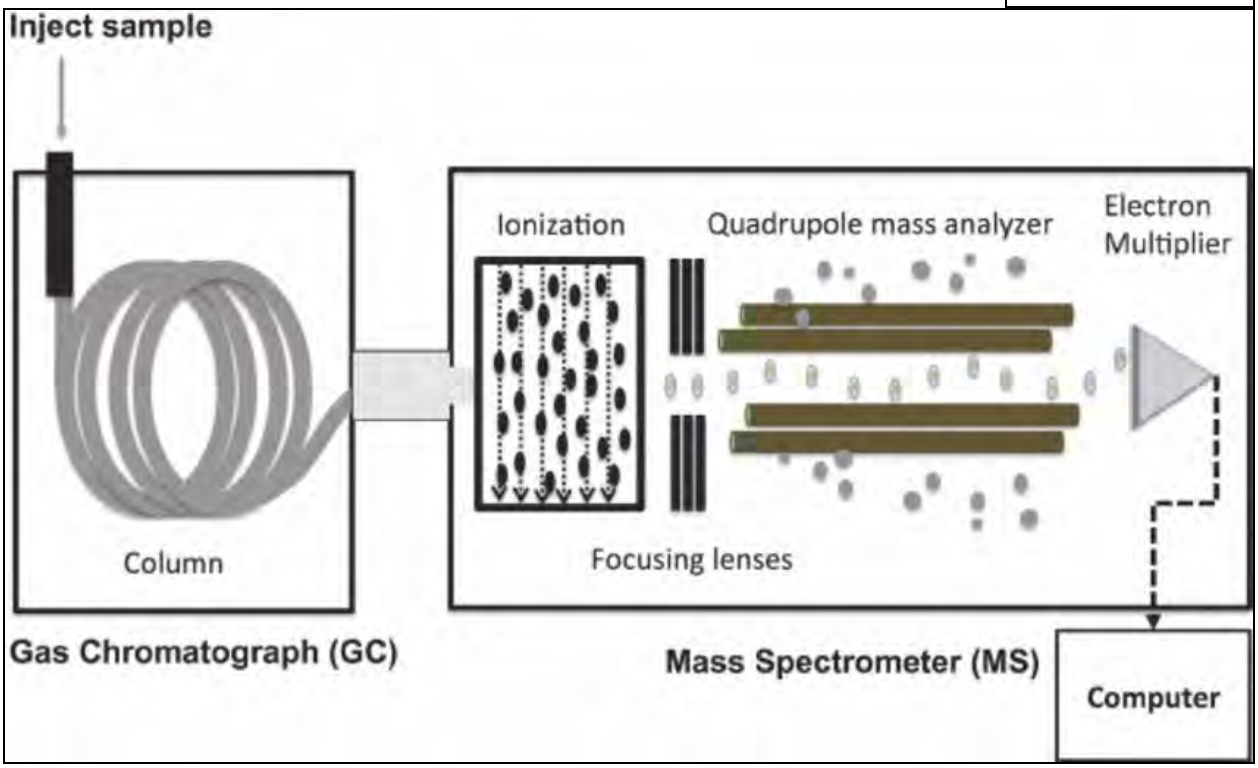
The analysis machine **records a retention time** for each component molecule in the mixture, allowing them to be identified.

GC-MS

This is a **combination** of analytical techniques, **gas chromatography and mass spectrometry**, allowing for a more advanced level of molecule analysis. The molecules present are first separated using the gas chromatography technique. Then each molecule present is fed directly into a mass spectrometer so it can be accurately identified.

Example:

Image courtesy of ResearchGate



GC-MS is a **much faster** analytical process that produces **more accurate** results for molecule analysis and identification.