AQA Chemistry A-level

3.3.7: Optical Isomers

Detailed Notes

3.3.7.1 - Optical Isomers

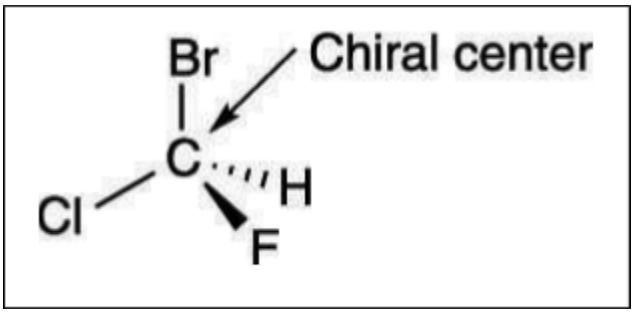
Optical isomerism is a type of **stereoisomerism** where molecules have the **same molecular formula** but a different **spatial arrangement** of atoms in space. It occurs when there is an **asymmetrical** carbon within an organic molecule known as a **chiral centre**.

Chiral Centres

A chiral centre is a carbon atom with **four different groups** bonded around it so there is **no line of symmetry** to the molecule.

Example:

Image courtesy of Dummies.com



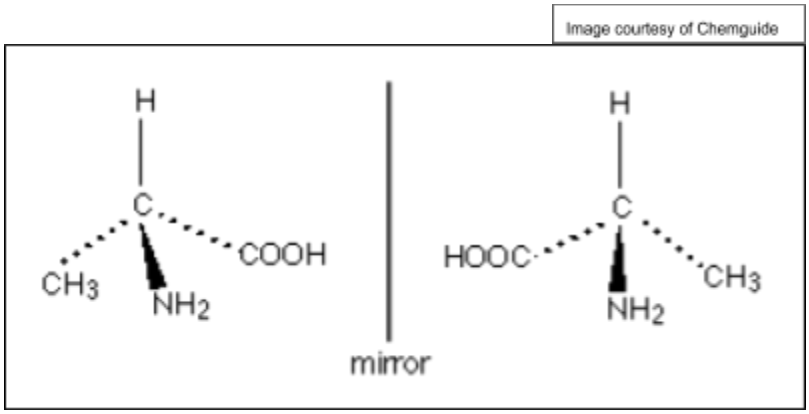
The chiral centre is commonly **indicated using *** next to the asymmetric carbon.

Optical Isomers

The presence of a chiral centre leads to the presence of **two possible isomers** that are **mirror images** of each other. These are optical isomers.

Example:

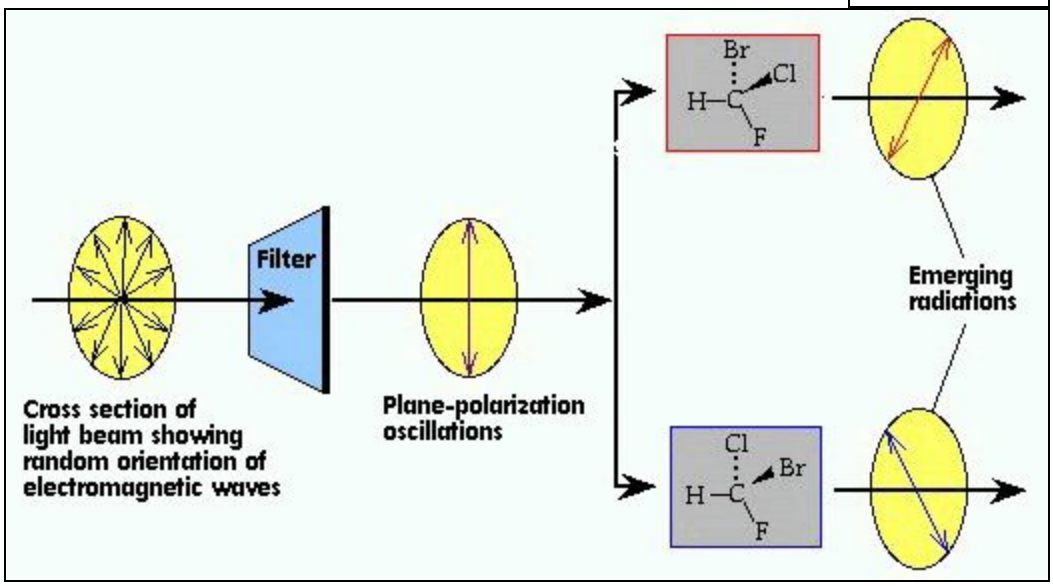
Image courtesy of Chemguide



The two different isomers are called **enantiomers** and are unique due to their effect on **plane polarised light**. Each enantiomer causes the rotation of plane polarised light by **90° in opposite directions.**

Example:

Image courtesy of Pinterest



Racemic Mixtures

A **racemate** is formed when optical isomers are produced as a **pair of enantiomers** in a **1:1 ratio**. The optical rotational effect on polarised light caused by each enantiomer causes the overall effect to be **zero** as the opposite directions of rotation cancel out. As a result the mixture produced is **optically inactive**, known as a racemic mixture.

These two isomers are able to form in this way due to a **nucleophilic addition reaction**.

Nucleophilic Addition

In these reactions, nucleophiles are able to attack a molecule with a **carbonyl group** from **above or below** the carbon-oxygen double bond. This means the two possible products of the reaction are **mirror images** and therefore **optical isomers**.

Mechanism

Image courtesy of Wikipedia