

4.1 Stereoisomerism

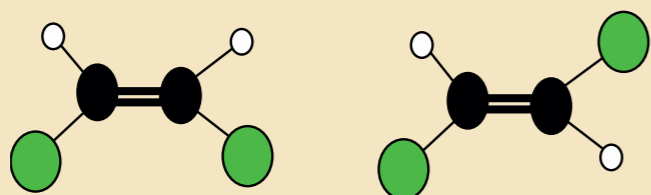
Stereoisomerism occurs in compounds that have the same molecular and structural formulae, but which have a **different arrangement of their atoms in space**.

There are two types of stereoisomerism that can occur.

Geometric (E-Z) isomerism

In an alkene, the double bond is made up of a sigma and a pi bond. The pi bond prevents any free rotation **about** the carbon to carbon double bond.

For E-Z isomers to exist a C=C bond must be present and the carbon atoms at both ends of the double bond both have to have two different groups bonded to them.

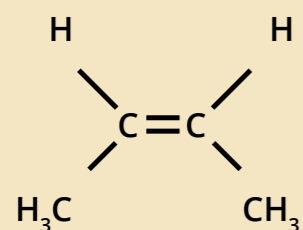


The first step in identifying the isomers is to look at the two groups attached to both carbon atoms and rank them in terms of the atomic number of their atoms. The atom with the higher atomic number takes higher priority. If the higher priority groups are on the same side of the double bond then it is the Z isomer and if they are on opposite sides then it is the E isomer.

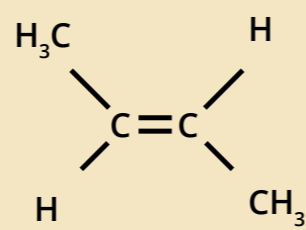
But-2-ene

A carbon atom has a higher priority than a hydrogen atom. The carbons (in the methyl groups) are on the same side of the double bond in the left-hand isomer below, so this is the Z isomer. In the right-hand isomer they are on opposite sides, so this is the E isomer.

(Z) - but-2-ene



(E) - but-2-ene

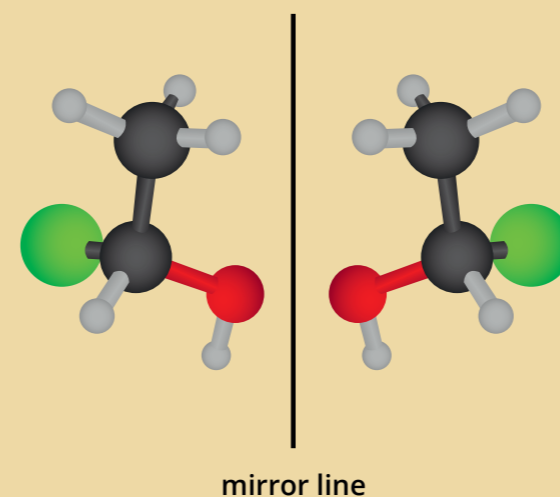


Optical isomerism

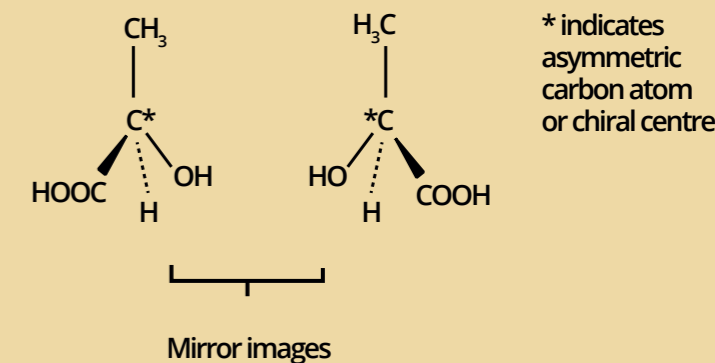
Optical isomerism can occur in molecules which have four different atoms or groups attached to a tetrahedral carbon atom (an **asymmetric carbon atom**). The carbon atom is called a chiral centre. The isomers are non-superimposable mirror images of each other. The pair of optical isomers are called enantiomers.

The isomers are optically active, which means they rotate the plane of polarised light in opposite directions.

Ball and stick models show the mirror image relationship and the fact that the isomers cannot be superimposed upon each other.



2-hydroxypropanoic acid



An equimolar mixture of the two optical isomers will be optically inactive as the plane of polarised light is not rotated. This is called a **racemic mixture** or **racemate**.