STEREOISOMERISM

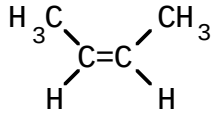
Stereoisomers have identical chemical formulae, and the atoms are bonded together in the same order, but the arrangement of atoms in space is different, making them non-superimposable - it is impossible to fit one isomer directly on top of the other, just as it is impossible to superimpose your left hand on top of your right hand.

There are two kinds of stereoisomers: geometric and optical.

Geometric Isomers

These arise due to lack of rotation about a group in the molecule - frequently around a C=C bond.
Isomers are labelled cis and trans according to whether the substituent groups are on the same side or on different sides of the group.

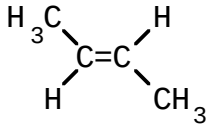
Example 1



cis-But-2-ene

M.P. - 139 ^{0}C

ΔH_f - 5.7 kJ mol^{-1}



trans-But-2-ene

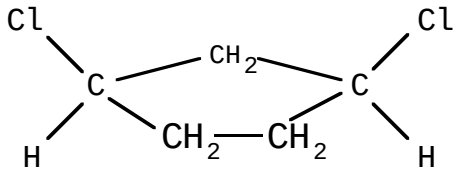
M.P. - 106 ^{0}C

ΔH_f - 10.1 kJ mol^{-1}

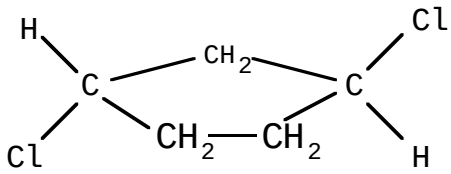
Note the higher melting point of the trans isomer reflecting the greater surface area of the molecules and consequently stronger van der Waals forces.

The less negative enthalpy of formation of the cis isomer confirms that the cis isomer is less stable than the trans. The instability of the cis isomer is due to repulsion between the two CH_3 groups.

Example 2

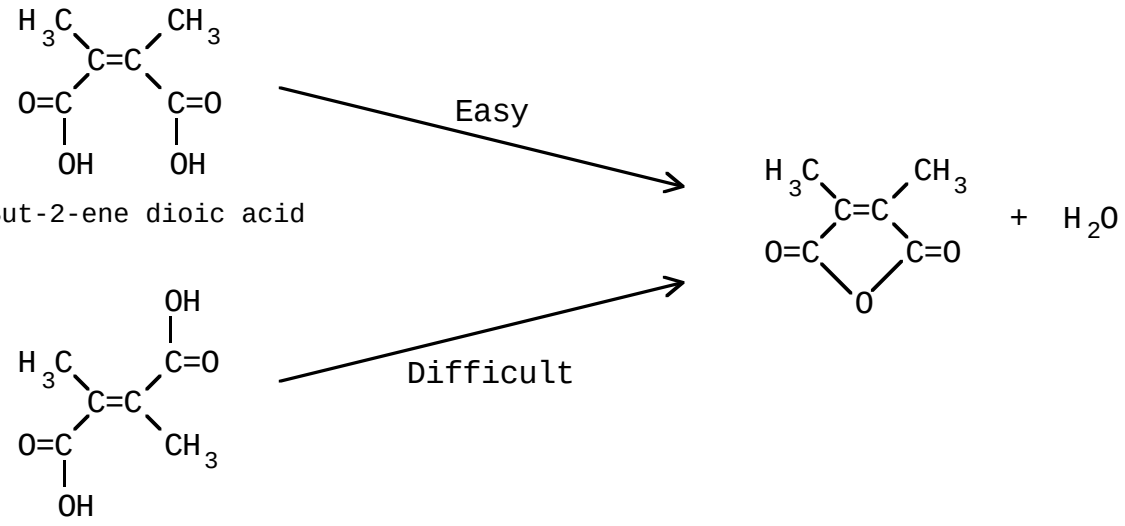


cis-1,3-Dichlorocyclopentane



trans-1,3-Dichlorocyclopentane

Geometric isomerism can influence the chemical reactions of the isomers e.g. cis-But-2-ene dioic acid is more readily dehydrated than trans-But-2-ene dioic acid because of the close proximity of the two OH groups in the cis isomer:

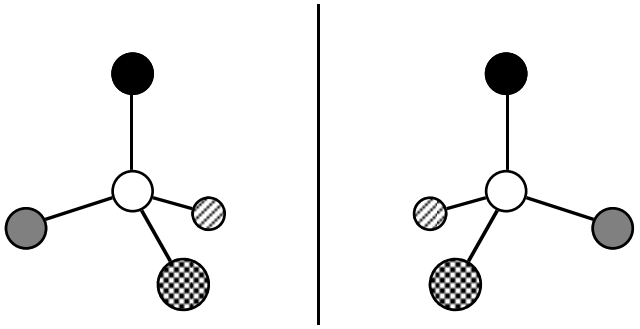


cis-But-2-ene dioic acid

trans-But-2-ene dioic acid

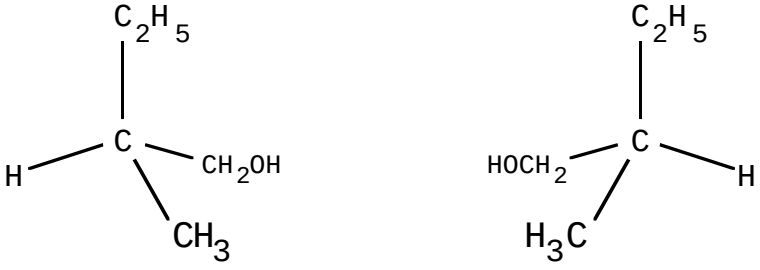
Optical Isomers

Optical isomers are non-superimposable mirror images of each other and are described as **chiral**. Chiral molecules contain **FOUR** different groups attached to the same Carbon atom:



mirror

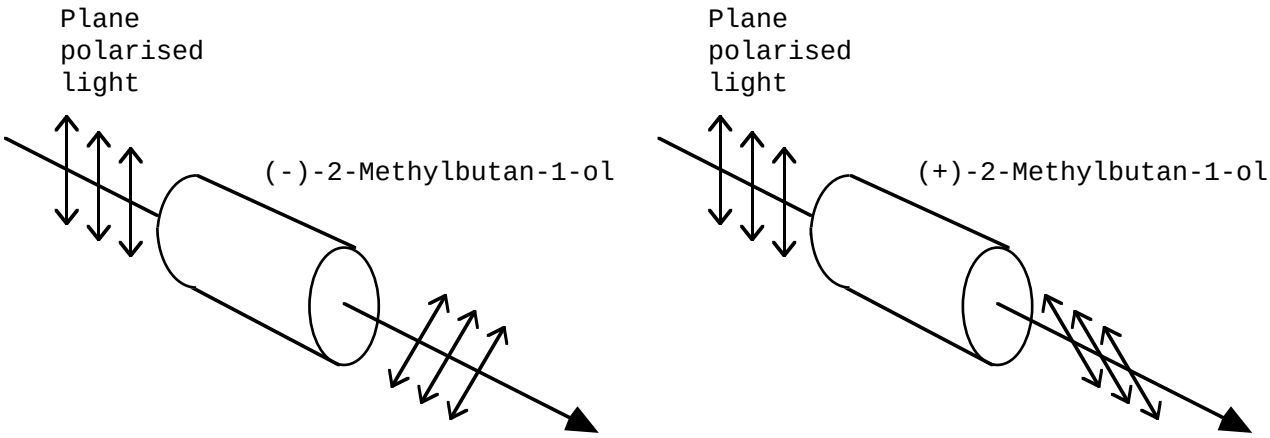
Example: 2-Methylbutan-1-ol contains a 1:1 mixture of two optical isomers:



(-)-2-Methylbutan-1-ol (+)-2-Methylbutan-1-ol

Solutions of optical isomers are 'optically active' - they rotate the plane of plane polarised light - light whose waves vibrate in one plane only.

(-)-2-Methylbutan-1-ol rotates the plane 5.9 ^{0} to the left.
(+)-2-Methylbutan-1-ol rotates the plane 5.9 ^{0} to the right.



A 1:1 mixture of both optical isomers has no overall effect on plane polarised light - the mixture is 'optically inactive'.

Optical isomers have identical chemical and physical properties except when they are acted upon by another chiral molecule e.g. an enzyme (see 'Medicines').