STEREO ISOMERISM AND ITS TYPES

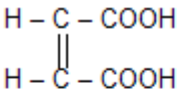
Stereo isomerism

When isomers have the same structural formula but differ in relative arrangement of atoms or groups in space within the molecule, these are known as stereoisomers and the phenomenon as stereoisomerism. The spatial arrangement of atoms or groups is also referred to as configuration of the molecule and thus we can say that the stereoisomers have the same structural formula but different configuration. Stereoisomerism is of two types.

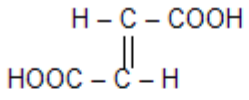
(i) Geometrical isomerism

The isomers which possess the same structural formula but differ in the spatial arrangement of the groups ***around the double bond*** *are known as geometrical isomers and the phenomenon is known as* *geometrical isomerism. This isomerism is shown by alkenes or their derivatives. When similar groups lie on the same side, it is the cis-isomer; while when the similar groups lie on opposite sides, the isomer is* *trans. For example,*

(a)

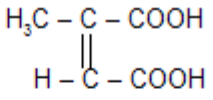


Maleic acid *(cis)*

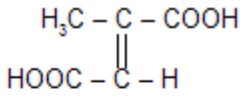


Fumaric acid *(trans)*

(b)

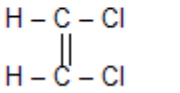


Citraconite acid *(cis*-isomer)

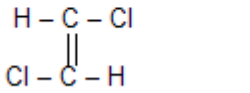


Mesaconic acid (*trans*-isomer)

(c)

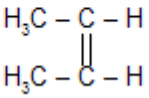


cis-1, 2-Dichloroethylene

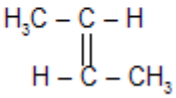


trans-1, 2-Dichloroethylene

(d)

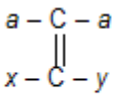


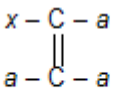
cis-Butene-2

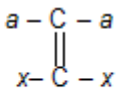


trans-Butene-2

Remember that geometrical isomerism is possible only when each of the doubly bonded carbon atom has two different groups (see examples above). Thus compounds of the following type will not show geometrical isomerism.

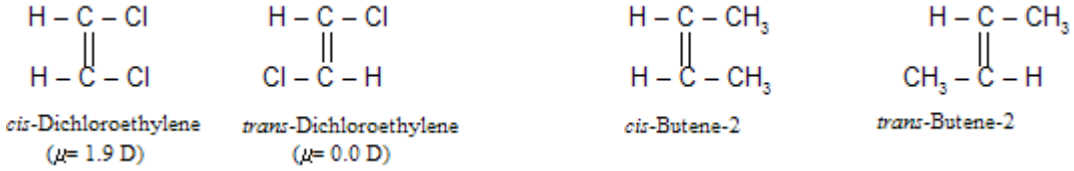






Note the similar atoms (groups) on one or both of the carbon atoms.

***Distinction between** cis **-and** trans- **isomers**. (a) Generally, the cis-isomer (e.g. maleic acid) cyclises on heating to form the corresponding anhydride while the trans-isomer does not form its anhydride at all.*
(b) The cis-isomer of a symmetrical alkene (alkenes in which both the carbon atoms have similar groups) has a definite dipole moment, while the trans-isomer has zero dipole moment. For example, 1, 2-dichloroethylene and butene-2.

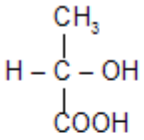


In trans-isomer of the symmetrical alkenes, the effect produced in one half of the molecule is cancelled by that in the other half of the molecule.
In case of unsymmetrical alkenes, the cis-isomer has higher dipole moment than the corresponding trans-isomer. For example,

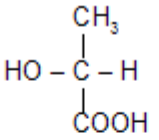
(ii) Optical isomerism
*This type of isomerism arises from different arrangements of atoms or groups in three dimensional space resulting in two isomers which are mirror image of each other. **Optical isomers contain an asymmetric (chiral) carbon atom** (a carbon atom attached to four different atoms or groups) in their molecules.*
For example, lactic acid having four different groups on the central carbon atom is optically active;
while succinic acid having two similar atoms on the central carbon atom is optically inactive.
Optical isomers have similar chemical and physical properties and differ only in their behaviour towards plane polarised light
. The isomer which rotates the plane polarised light to left is known as laevo (l)
while that which rotates the plane polarised light to the right is known as dextro (d).

For example,

(a)

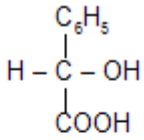


d – Lactic acid

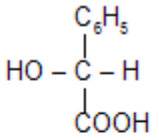


l – Lactic acid

(b)

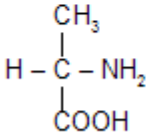


d – Mandelic acid

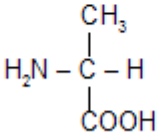


l – Mandelic acid

(c)

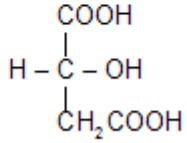


d – Alanine

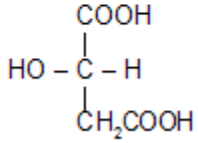


l – Alanine

(d)



d – Malic acid



l – Malic acid

Source : http://ciseche10.files.wordpress.com/2013/12/isomerism.pdf