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M. Sc. Sem. I

CC - III, UNIT : II

Stereochemistry

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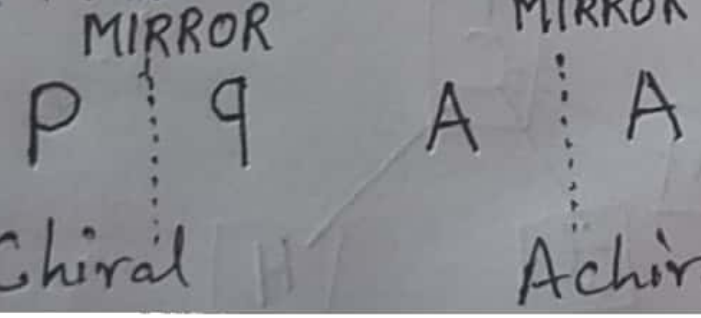
Chirality

An object or a molecule is said to be chiral or dissymmetric, if it is not superimposable on its mirror image and the property of non-superimposability is called chirality.

Achiral : An object or a molecule which is superimposable on its mirror-image ~~and the property of non-superimposability~~ is called achiral.

For Example : To understand the term Chiral and Achiral.

Let 'P' is Chiral and 'A' is Achiral as shown in the following Fig.

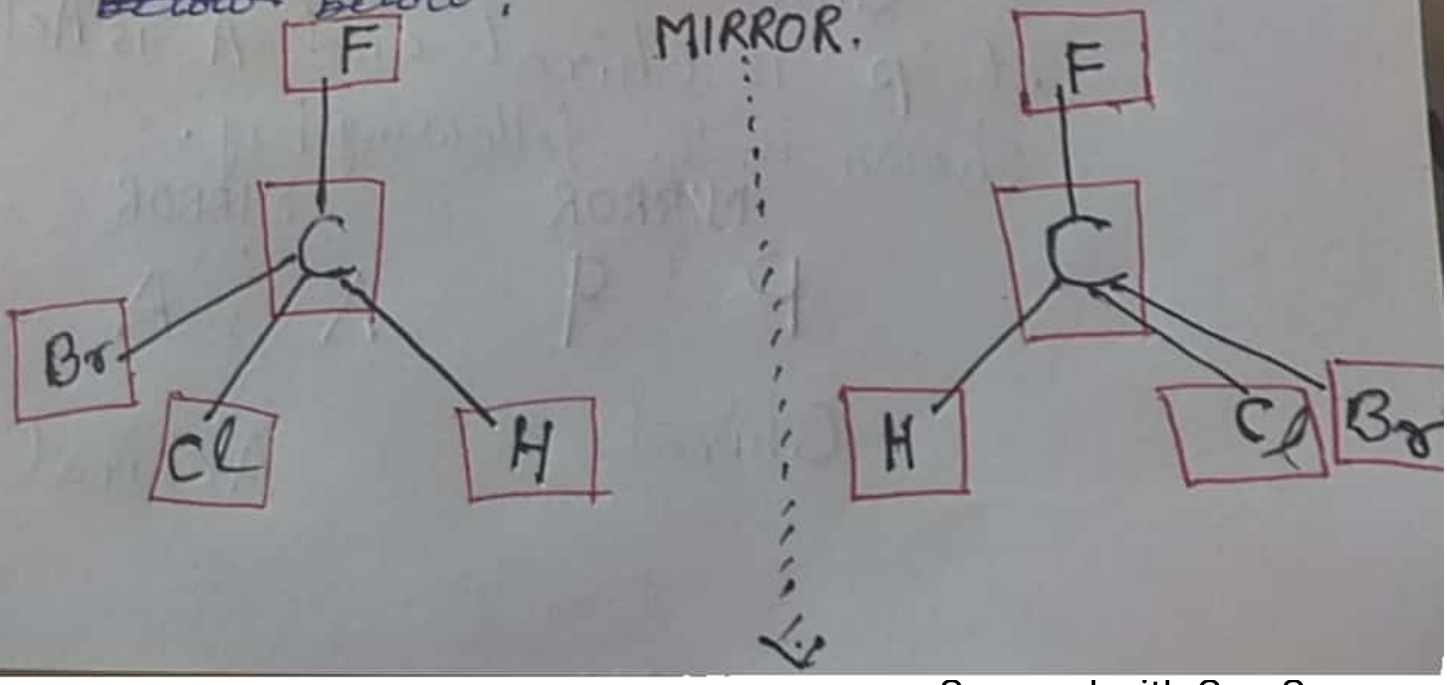


Molecular Chirality and Asymmetric Carbon

Chirality in organic molecules arises due to tetrahedral geometry of sp^3 - hybridized carbon.

For Example: The molecule of bromochlorofluoromethane. In this molecule, the four atoms attached to the carbon atom are all different and carbon atom which is attached to four different atoms or groups is called an asymmetric carbon atom or a Chiral-carbon atom.

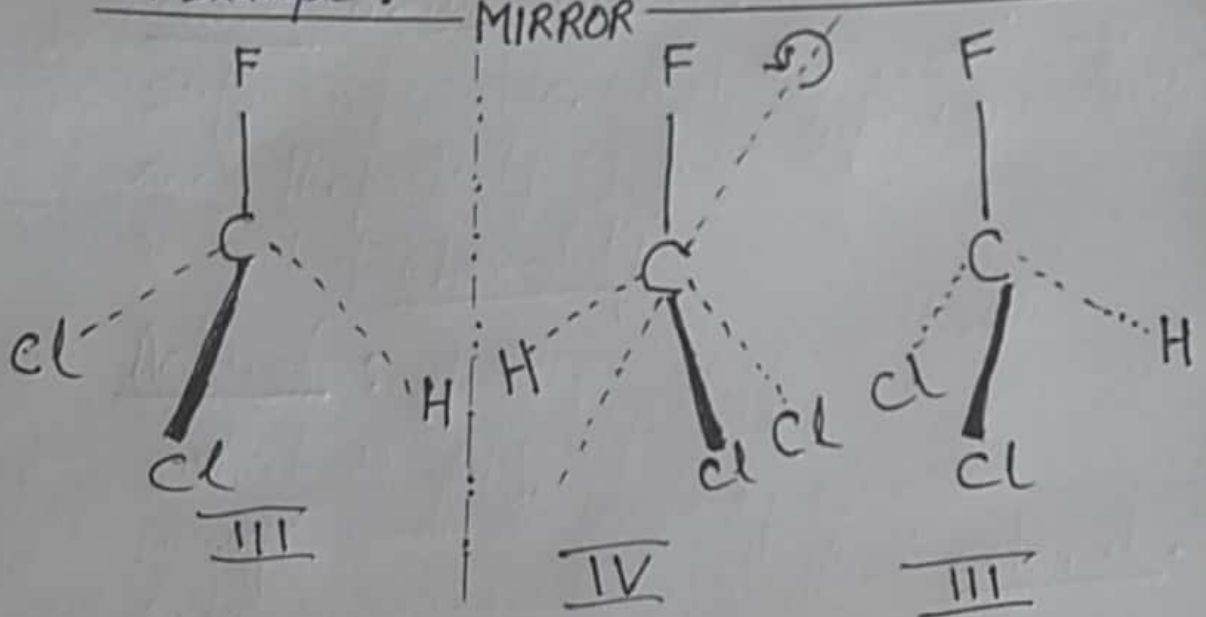
The molecule of bromochlorofluoromethane can be represented by two different tetrahedral models, I and II, which differ in the spatial arrangement of the four atoms attached to the chiral carbon atom as shown ~~below~~ below:



The bromochlorofluoromethane is a chiral and hence shows optical activity.

On the other hand, if the two atoms or groups are similar, the chirality is lost and the molecule becomes Achiral since a simple rotation (through 180°) about its axis will make it superimposable on its mirror image.

For Example: dichloro-fluoromethane:



Two possible three-dimensional structures of dichlorofluoromethane.

If the model IV were rotated through an angle of 180° about a vertical axis, it coincides with model III. Hence the molecule is Achiral and hence is optically inactive.

From the above discussion, it follows that Chirality is the necessary and sufficient conditions for a molecule to exhibit optical-activity.