M.Sc. Semester - I
organic chemistry
Paper — C.C - III
unit — II
Dr. Rashmi Sinha
Deptt. of chemistry
H.D. Jain college, Ara

Elements of symmetry

All the optically active molecules are chiral and they exhibit enantiomerism. A chiral molecule can't be superimposed on its mirror image, whereas an achiral molecule can be superimposed on its mirror image. A molecule is chiral or achiral can thus be determined by constructing the models of a molecule and its mirror image and testing whether they are superimposable or not and usually this is not convenient. Elements of symmetry offer a simple device to decide whether a molecule is chiral or not. Thus there are four

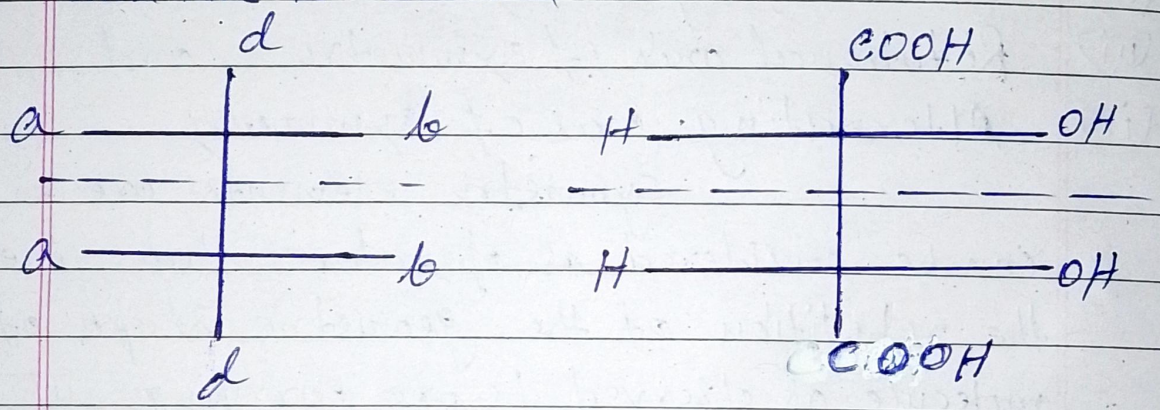
Fundamental elements of symmetry are encountered in organic molecules. These are given below :-

(i) Plane of symmetry
(ii) centre of symmetry
(iii) Rotational axis of symmetry and
(iv) Alternating axis of symmetry

symmetry elements are in fact can be considered as operators that generate the repetition of the geometric shape of the molecule as observed before carrying out symmetry operations.

(i) <u>Plane of symmetry (σ)</u> :- Plane of symmetry designated by sigma (σ) comes from the German word spiegel, meaning mirror. Plane of symmetry of a molecule represents a plane bisecting a molecule such that each atom on one side of the plane, when reflected through the plane encounters an equivalent (identical) atom on the other side. This is why plane of symmetry is also called

a mirror plane. The molecules having a plane of symmetry are achiral (optically inactive) e.g. meso-tartaric acid is optically inactive because the molecule has a plane of symmetry and thus is achiral



All planar molecules have at least one plane of symmetry, identical with the molecular plane. Linear molecules have an infinite number of σ planes which intersect along C_∞ and planes perpendicular to the principal axis are labelled σ_h (h = horizontal) while those containing the principal axis are labelled σ_v (v = vertical). Some molecules have plane of symmetry in addition to simple axis of symmetry (C_n) as their symmetry element, while some others have a plane

of symmetry as their only symmetry element.