B.Sc.(H) Chemistry
Semester - II
Core Course - III (CC-III)
Organic Chemistry - I

II. Stereochemistry

6. Prochirality

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Syllabus & Coverage

Syllabus

II Stereochemistry:

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions. Geometrical isomerism: cis–trans and syn-anti isomerism, E/Z notations with Cahn Ingold and Prelog (CIP) rules for determining absolute configuration.

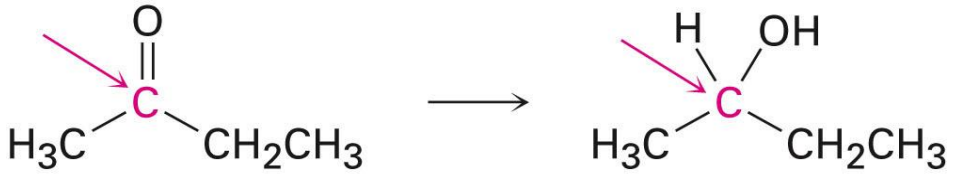
Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, Meso structures, Racemic mixture. Resolution of Racemic mixtures. Relative and absolute configuration: D/L and R/S designations.

Coverage:

1. Prochirality
2. Prochiral Distinctions
3. Nonmobile Conformers
4. Optical Activity of Allenes

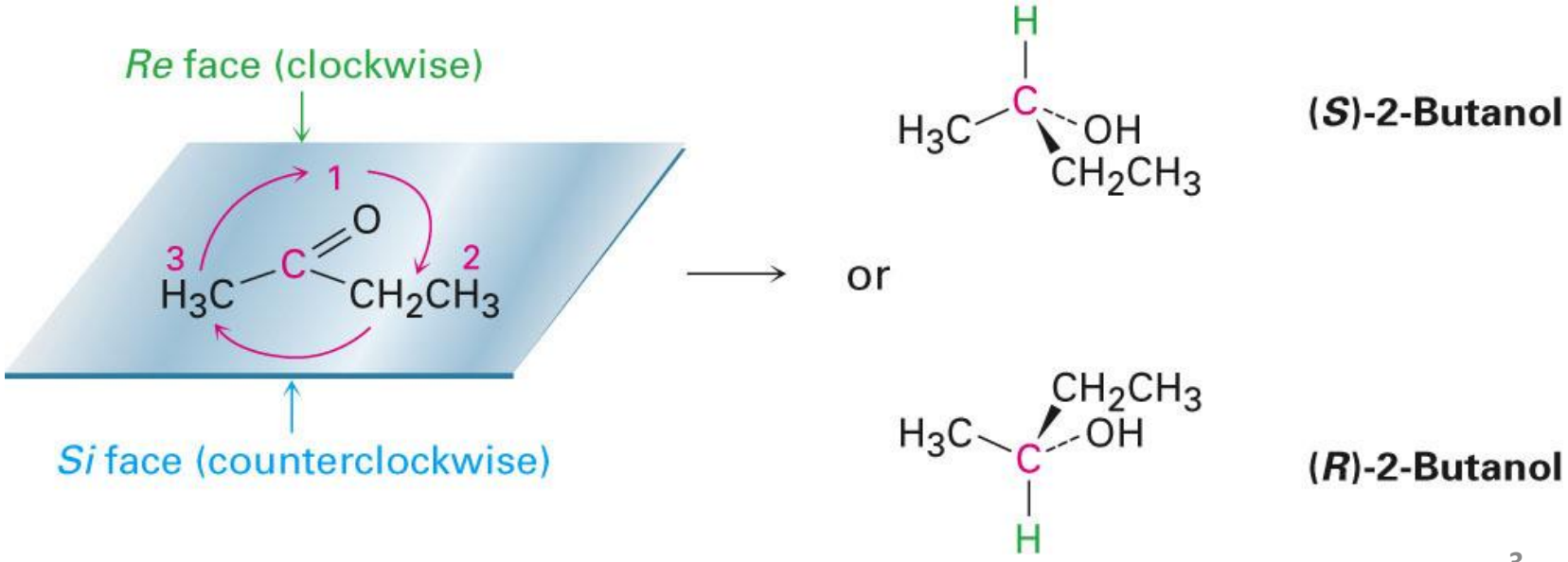
Prochirality:

A molecule that is achiral but that can become chiral by a single alteration is a prochiral molecule



2-Butanone (prochiral) → **2-Butanol (chiral)**

***Re* and *Si* are used to describe the faces of the prochiral sp^2 reactant**

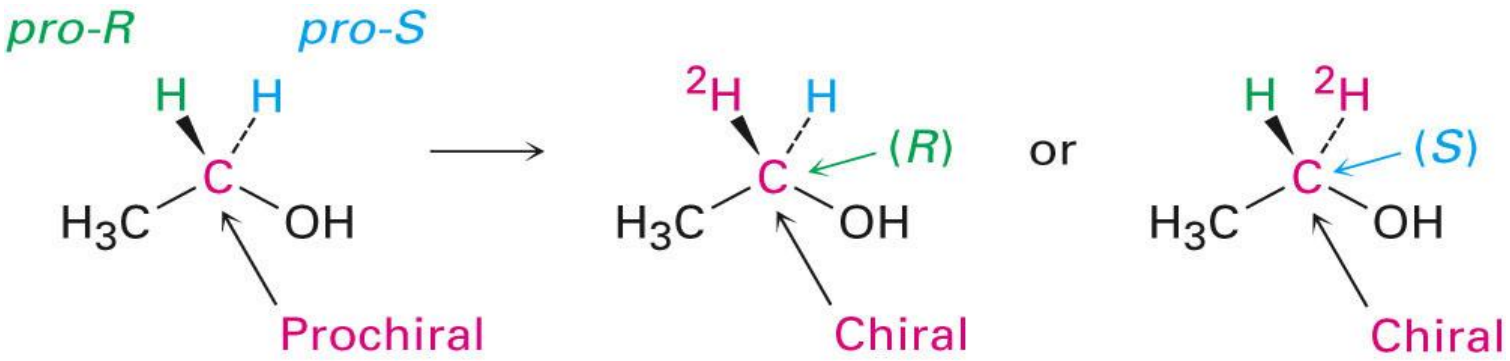


Prochiral distinctions, paired atoms or groups:

An sp^3 carbon with two groups the same is also a prochiral center.

The two identical groups are distinguished by considering either and seeing if it was increased in priority in comparison with the other.

If the center becomes *R* the group is *pro-R* and *pro-S* if the center becomes *S*.

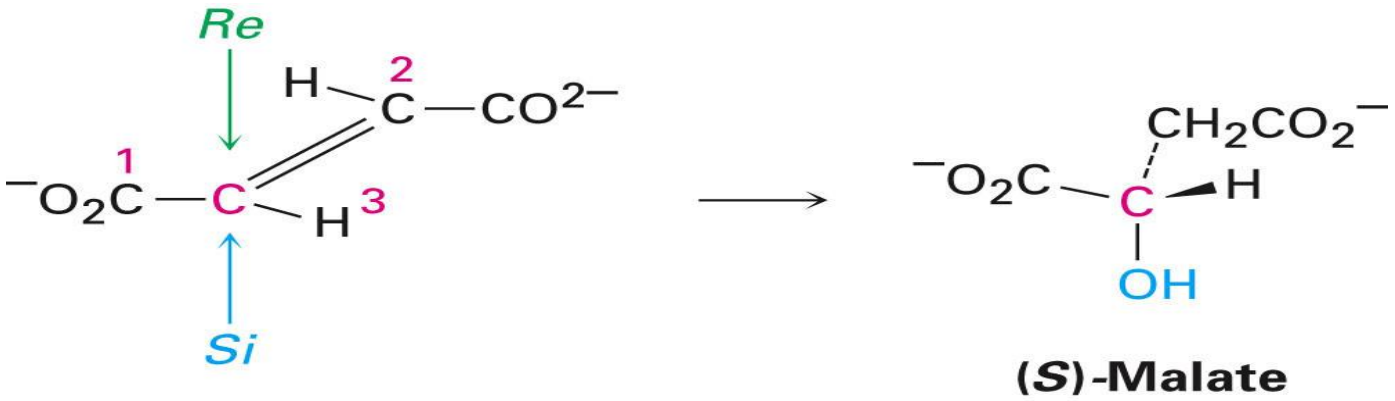


Prochiral distinctions in nature:

Biological reactions often involve making distinctions between prochiral faces or groups.

Chiral entities (such as enzymes) can always make such a distinction.

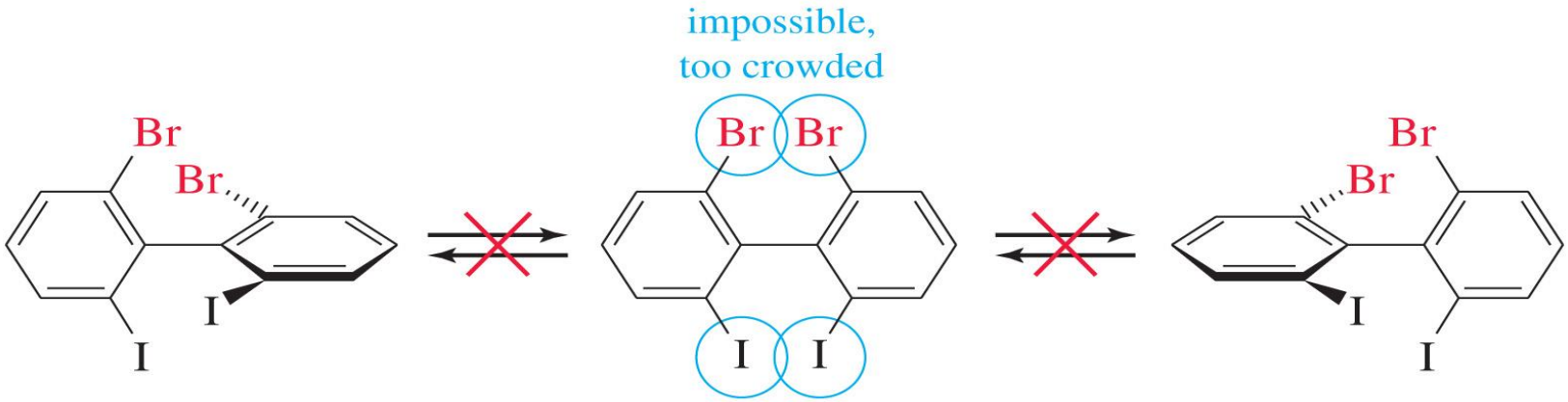
Example: Addition of water to fumarate



Nonmobile Conformers:

- **The planar conformation of the biphenyl derivative is too sterically crowded. The compound has no rotation around the central C—C bond and thus it is conformationally locked.**

- **The staggered conformations are chiral: They are nonsuperimposable mirror images.**

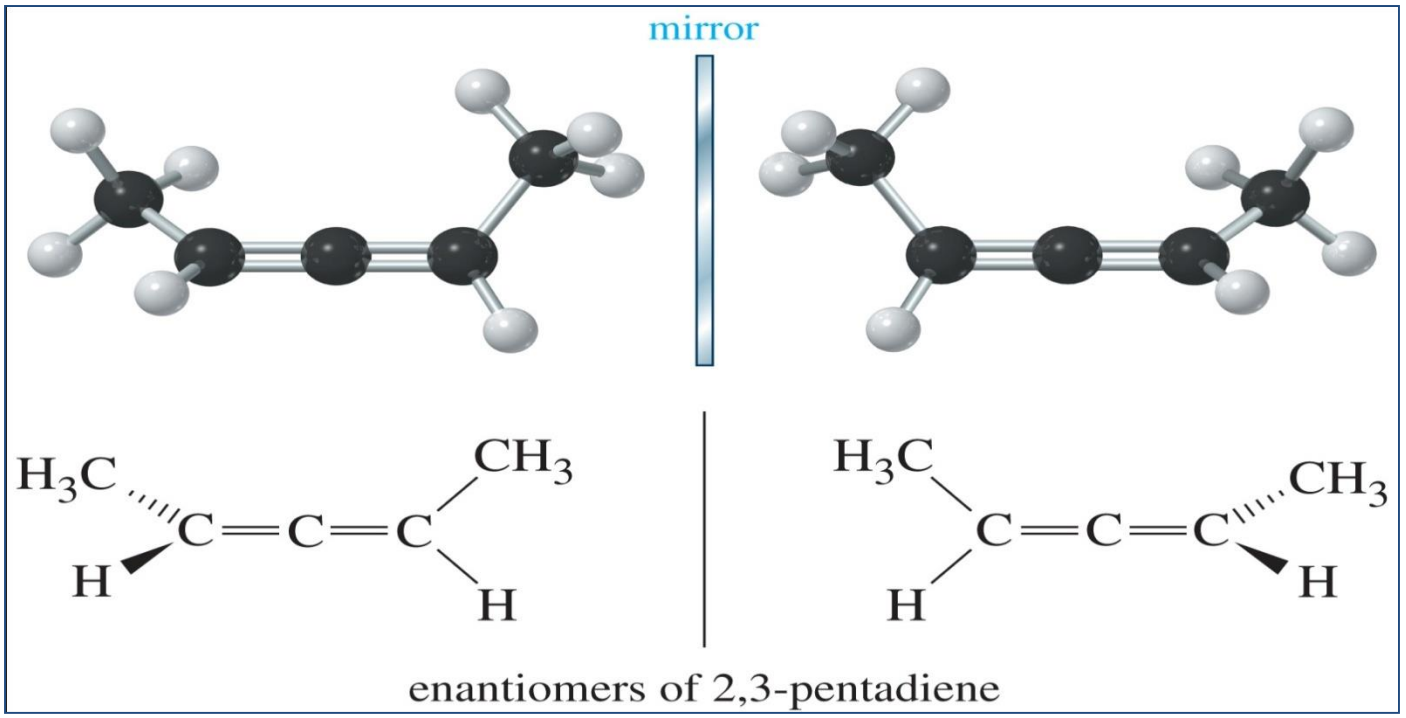


staggered conformation (chiral) | eclipsed conformation (symmetric, achiral) | staggered conformation (chiral)

Optical Activity of Allenes:

- **Some allenes are chiral even though they do not have a chiral carbon.**
- **Central carbon is *sp* hybridized.**
- **To be chiral, the groups at the end carbons must have different groups.**

2,3-Pentadiene

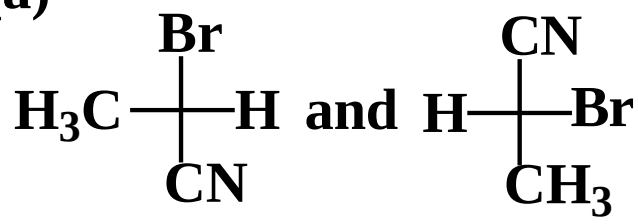


enantiomers of 2,3-pentadiene

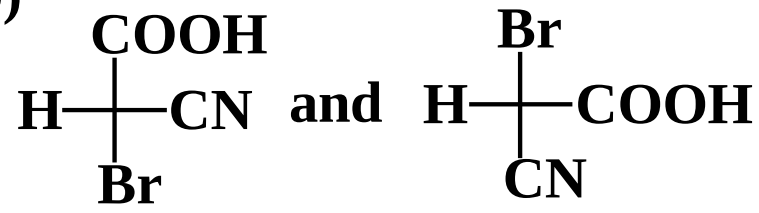
Problems:

1. Which of the following pairs of Fischer projection represent the same enantiomers, and which represent different enantiomers?

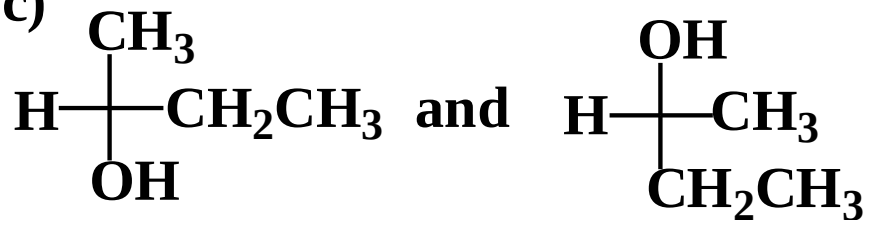
(a)



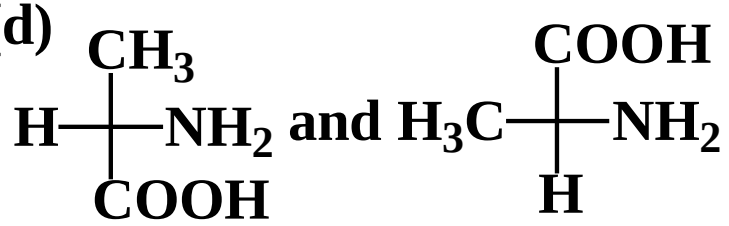
(b)



(c)

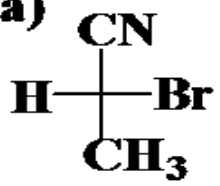


(d)

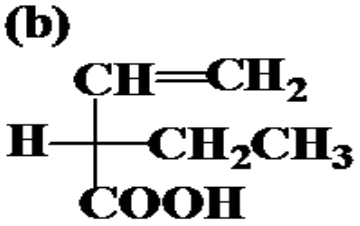


2. Assign R or S conformation to the following Fischer projections:

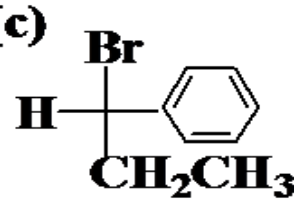
(a)



(b)



(c)



3. **Draw Fischer projections that fit the following descriptions:**
   (a) The R-enantiomer of alanine , $CH_3CH(NH_2)COOH$
   (b) The S-enantiomer of 3-methylhexane

4. Suppose that racemic lactic acid reacts with (S)-2-butanol to form an ester. What stereochemistry dose the product(s) have? What is the relationship of one product to another?

5. **Draw both and trans-1,4-dimethyl-cyclohexane in their most chair conformation.**
   (a) How many stereoisomers are there of cis-1,4 dimethylcyclohexane?
   (b) Are any of the structure chiral?
   (c) What are the stereochemistry relationships among the various stereoisomers of 1,4-dimethylcyclohexane

Thank You

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