Reading: Chapter 6
Practice problems: those in text and 30, 32-40, 42, 43, 45, 46

Isomers and Stereochemistry

Review of Isomerism

- **Isomers** – Different compounds that have the same molecular formula.
- **Constitutional Isomers** – differ because their atoms are connected in a different order.

\[ \text{CH}_3\text{CH}_2\text{-O-CH}_2\text{CH}_3 \text{ vs. } \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} \]
Review of Isomerism

➢ *Conformational Isomers* – differ because of rotation about single bonds (can interconvert).

\[
\begin{align*}
\text{Br} & \quad \text{CH}_3 \\
\text{CH}_3 & \quad \text{Br}
\end{align*}
\]

Review of Isomerism

➢ *Configurational Isomers* – differ in the arrangement of their atoms in space (cannot interconvert).

\[
\begin{align*}
\text{H} & \quad \text{C} = \text{C} & \quad \text{H} \\
\text{H}_3\text{C} & \quad \text{CH}_3 & \quad \text{H}_3\text{C} & \quad \text{CH}_3
\end{align*}
\]

* cis-2-butene  
* trans-2-butene
Review of Isomerism

- **Configurational Isomers** – differ in the arrangement of their atoms in space (cannot interconvert).

![cis-1,3-dichlorocyclopentane](image1) ![trans-1,3-dichlorocyclopentane](image2)

Stereoisomerism

- Another kind of configurational isomerism.
- **Chiral** – Nonsuperimposable on its mirror image.
- **Achiral** – Superimposable on its mirror image.
- If a molecule (or object) has a mirror plane or an inversion center, it cannot be chiral.
Chiral or Achiral?

- Hammer

Chiral or Achiral?

- Brandy snifter
Chiral or Achiral?

- Shears

Chiral or Achiral?

- Beer mug
Chiral or Achiral?

➢ Hiking boot

Chiral or Achiral?

➢ Baseball glove
Chiral or Achiral?

- Desk chair

Chiral or Achiral?

- School desk
Chiral or Achiral?

- *cis*-1,3-dimethylcyclopentane
Chiral or Achiral?

- *trans*-1,3-dimethylcyclopentane

Chiral or Achiral?

- 1,1-dimethylcyclohexane
Chiral or Achiral?

➢ 2-butanol

mirror image
Chiral or Achiral?

- 2-butanone

Chiral or Achiral?

- 2-bromopropane
Stereoisomerism

- A chiral compound and its mirror image are called **enantiomers**.
- 2-butanol:

  ![2-butanol enantiomers](image)

Stereoisomerism

- Asparagine:

  ![Asparagine enantiomers](image)

  - L-asparagine (from asparagus) bitter taste
  - D-asparagine (from vetch) sweet taste
Stereoisomerism

Camphor:

Absolute Configuration

- Look down the bond from the chiral carbon to the smallest group:
Absolute Configuration

➢ *R* and *S*
  • Assign priorities to the remaining groups based on atomic numbers.
  • Clockwise (highest to lowest priority) = *R*
  • Counterclockwise = *S*

Assign priority:
  • Atomic number of atom directly bonded.
  • If the same atom is bonded, go to the next atom, etc.
  • Groups containing multiple bonds are treated as though multiple atoms were attached:
Absolute Configuration

➢ Determine the absolute configuration of the following compounds:

Optical Activity

➢ Enantiomers cannot be distinguished based on physical properties such as boiling points, melting points, or densities.

➢ However—when plane-polarized light is passed through a solution of one of the enantiomers, the plane of polarization is rotated:
Optical Activity

- The other enantiomer rotates the plane of polarized light the same amount but in the opposite direction.
- **Optical Activity** – Rotates the plane of polarized light.
- A **polarimeter** is used to make such measurements:

Optical Activity

- The enantiomer that rotates the plane of polarized light in a clockwise direction is called **dextrorotatory** and is called the **(+)-enantiomer**.
- The other enantiomer (counterclockwise rotation) is **levorotatory**, the **(-)-enantiomer**.
- **Racemic Mixture:** A 50:50 mixture of two enantiomers – *no optical rotation!*