CHE 2060: Summary of key concepts for:
Module 3 - Conformation and stereoisomerism

Conformations of open-chain compounds:

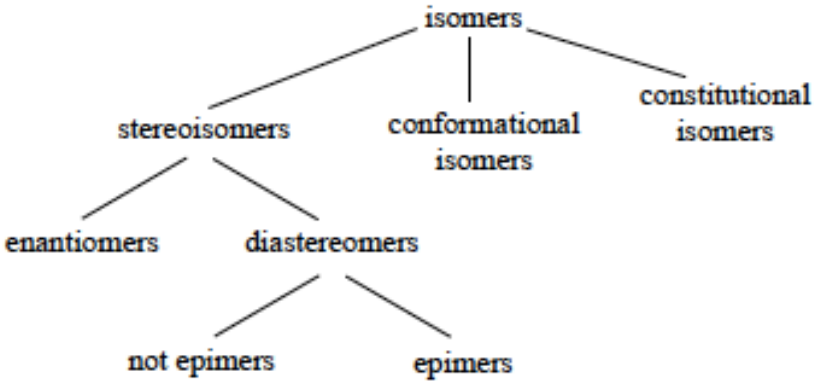
- Be able to distinguish between **eclipsed**, **staggered**, **gauche**, and **anti** conformations, and the rational for **trends in stability**.
- Be able to draw and interpret **Newman projections**.

Conformations of cyclic compounds:

- Understand the concept of **angle strain** in 3- and 4-membered rings.
- Be able to draw the **envelope** conformation of five-membered rings
- Be able to draw the **chair and boat** conformations of six-membered rings.
    - In the chair conformation, be able to draw **equatorial** and **axial** substituents.
    - Understand that large groups in the axial position experience considerable 1,3-diaxial repulsion, and thus are more **stable** in the equatorial position.

Stereochemistry:

Hierarchy of isomeric relationships:



You should understand the relevant terms and concepts:

- A **chiral** object or molecule is **cannot be superimposed** on its mirror image.
    - A chiral center is a sp^3-hybridized (tetrahedral) carbon bonded to **four different groups**.
    - A chiral center can be labeled **R or S**.
- A **stereogenic alkene** is an alkene is one in which both sides of the alkene are asymmetric, and which can therefore be labeled **E or Z**.
- **Stereoisomers** have the same molecular formula and same connectivity, but a different orientation of atoms in space.
- **Enantiomers** are stereoisomers which are mirror images.
    - In practice, the enantiomer of a compound is the one in which all chiral centers are in the **opposite configuration**.
    - Every chiral molecule has one and only one enantiomer.
    - **Achiral** molecules are superimposable on their mirror image, and thus cannot have an enantiomer.

  - Enantiomers have equal but opposite specific **rotations**, but identical physical properties otherwise.
- **Diastereomers** are stereoisomers which are not mirror images. They have different physical properties.
  - In practice, a diastereomer of a chiral molecule with have at least one, but not all chiral centers in the opposite configuration.
  - Alternatively, two diastereomers may contain a stereogenic alkene with the opposite E/Z configuration.
  - A molecule has 2^n diastereomers, where n is the number of chiral centers plus stereogenic alkene groups.
- **Meso** compounds are an exception to this rule.
  - A meso compound has multiple chiral centers but, because it has a plane of symmetry, is **achiral**.
- **Epimers** are diastereomers which differ at only one chiral center.
- A **racemic mixture** is a 50:50 mixture of two enantiomers.
- You should know how to assign **R/S** and **E/Z** configuration to chiral centers and stereogenic alkenes, respectively.
- You should understand the concept of **optical rotation** and the definition of specific
- rotation.
- You should recognize that in general, a **protein** can distinguish between its natural ligand and a stereoisomer of that ligand.
  - You should also recognize that **enzymes** are highly specific with respect to stereochemistry, catalyzing the formation of only one stereoisomer of their products.
- You should be able to recognize and label **pro-R** and **pro-S** groups on prochiral tetrahetral carbons.
- You should be able to recognize **re** and **si faces** of carbonyl and imine groups