Readiness Review Series

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Tips for Chemistry Success

Believe that your intelligence can grow.

The first battle in learning anything is believing you're capable. Cultivating a growth mindset (i.e. believing you're fully capable of mastering new material) will help immeasurably in achieving academic success.

Practice by teaching someone else a difficult concept.

Explaining a concept to someone else will help you work through the material yourself and reinforce the information in your own mind. Once you can successfully teach someone else the concept, you know you've mastered it.

Get tutoring weekly.

ACE, CARE, and Libraries' Learning District all offer free help for math courses. Visit tutoring.fsu.edu for more information on what you can get help with and how to access those programs.

Memorize key formulas/theorems/reactions/etc.

Having crucial formulas and concepts on hand will help you navigate the more complex concepts to come.

Tips for Chemistry Success

Always attend class.

This is the best chance to hear extra explanations, ask questions, and gain a stronger understanding of how each concept fits into the overall subject matter.

Start homework the day it is assigned.

The best practice is to complete homework problems without using example problems as a guide or copying answers from another source. Also, even when it is not worth points, you should focus on mastering the content of these assignments.

Make your schedule work for you.

If you are taking 15 credits this semester, create a weekly study schedule with 25 hours of study time during the week. It's also better to create 30-minute time blocks per class throughout the week as opposed to cramming. You'll remember a lot more when exposed to the material multiple times by practicing problems 2 or 3 times outside of class each week.

Be an active reader.

When you read your textbook, paraphrase each paragraph or section to ensure you understand. It can also help to color code your notes to help you identify what you do not understand and give you the chance to ask for clarification later.

Tips for Chemistry Success

Ask for help.

Spend a little bit of time trying to resolve it yourself, but don't spin your wheels. If something doesn't make sense or you feel stuck on a problem or concept, reach out to the instructor or the TAs for guidance. Visiting your instructors regularly in office hours will help you to develop better communication channels and to master the content you do not understand.

If you work with a tutor, make sure you have done some legwork before the tutoring session.

Make sure you know where you could use the additional help so that your tutoring session is effective and efficient.

Work well in advance of deadlines.

Last-minute emergencies and conflicts can never be predicted. You don't want to miss out on earning points because of procrastination.

Learn to be comfortable being uncomfortable.

Learning takes time, and until we have mastered something, we may often lack confidence in our abilities and our knowledge. The more time you spend studying something, the more comfortable you will become with the topic. However, be patient with yourself as you are learning.

CHM2210 – Organic Chemistry I

Review these concepts before CHM2211

- Lewis Structures
- Nomenclature
- Chirality
- Resonance
- Isomers
- Chair Structures
- Functional Groups
- Principles of Synthesis
- Mechanisms

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Vocabulary Review

Test your knowledge with these key terms.

- **Lewis Structures**: A way of representing atoms or molecules by showing electrons as dots surrounding the element symbol
- **Formal Charges**: charge assigned to each atom in a molecule assuming even electron distribution
- **Resonance**: a way of describing a molecules with delocalized electrons using more than one structure
- **Functional Groups**: a group of atoms in a molecule that are responsible for reaction-behavior
- **Nomenclature**: set of rules to generate names for chemical compounds
- **Chirality**: property to describe a molecule different from its mirror image
- **Chair Structures**: orientation of a six membered ring where atoms 2,3,5, and 6 are in the same plane; while 1 is above and 4 is below or vice versa

Vocabulary Review

Test your knowledge with these key terms.

- **Isomers**: compounds with the same chemical formula but different arrangement of atoms and different corresponding properties
  - **Constitutional**: different connectivity
  - **Stereoisomers**: same connectivity, different arrangement
  - **Enantiomers**: stereoisomers that are mirror images each other
  - **Diastereomers**: stereoisomers that are not mirror images each other

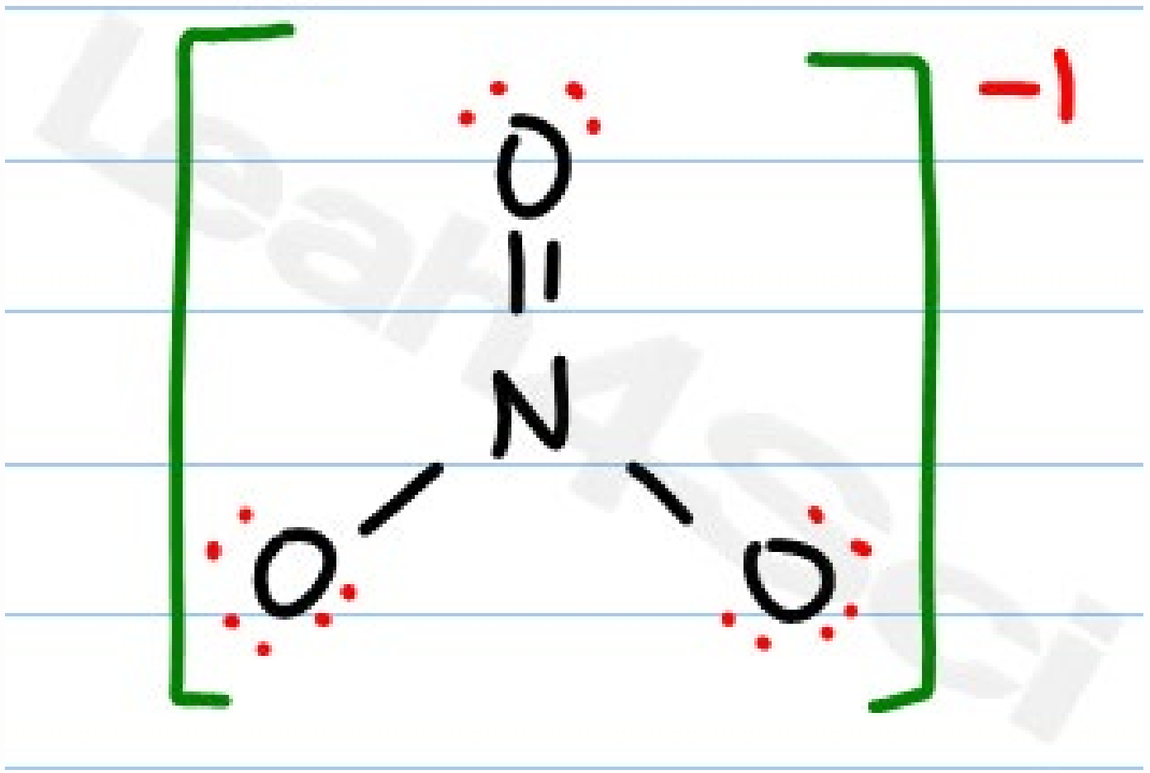
- **Mechanisms**:
  - **SN1**: One step substitution reaction
  - **SN2**: Two step substitution reaction
  - **E1**: One step elimination reaction
  - **E2**: Two step elimination reaction

Lewis Structures & Formal Charges

Common Rules for Formal Charges:

- Oxygen: 2 bonds, 2 lone pairs
- Nitrogen: 3 bonds, 1 lone pair
- Carbon: 4 bonds, 0 lone pairs
- Halogens: 1 bond, 3 lone pairs
- Hydrogen: 1 bond, 0 lone pairs

Octet Rule: Atoms prefer to have 8 electrons in valence shell



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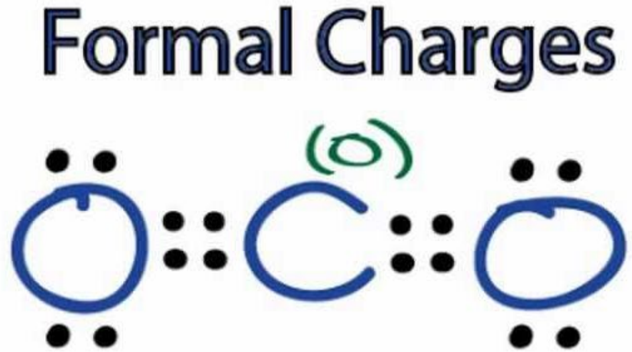
CO_2

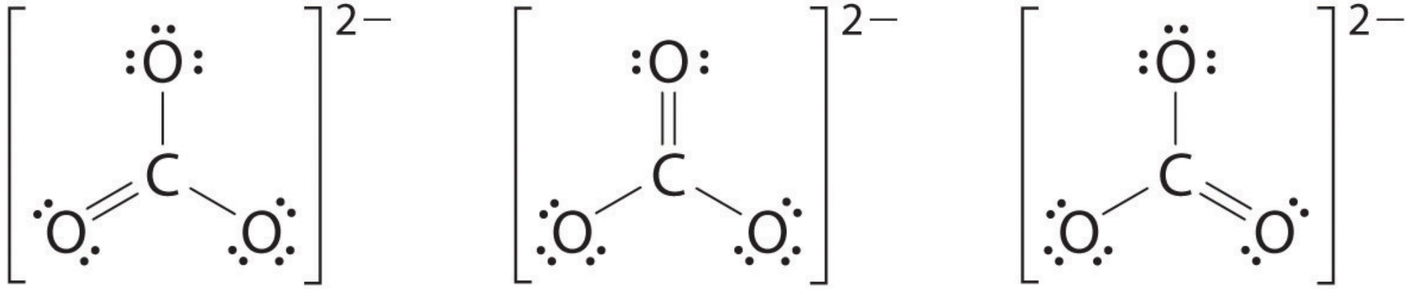


$$\text{Formal Charge} = \text{Valence Electrons} - \text{NonBonding Val Electrons} - \frac{\text{Bonding Electrons}}{2}$$

$$0 = 6 - 4 - 4/2 = $$

Resonance

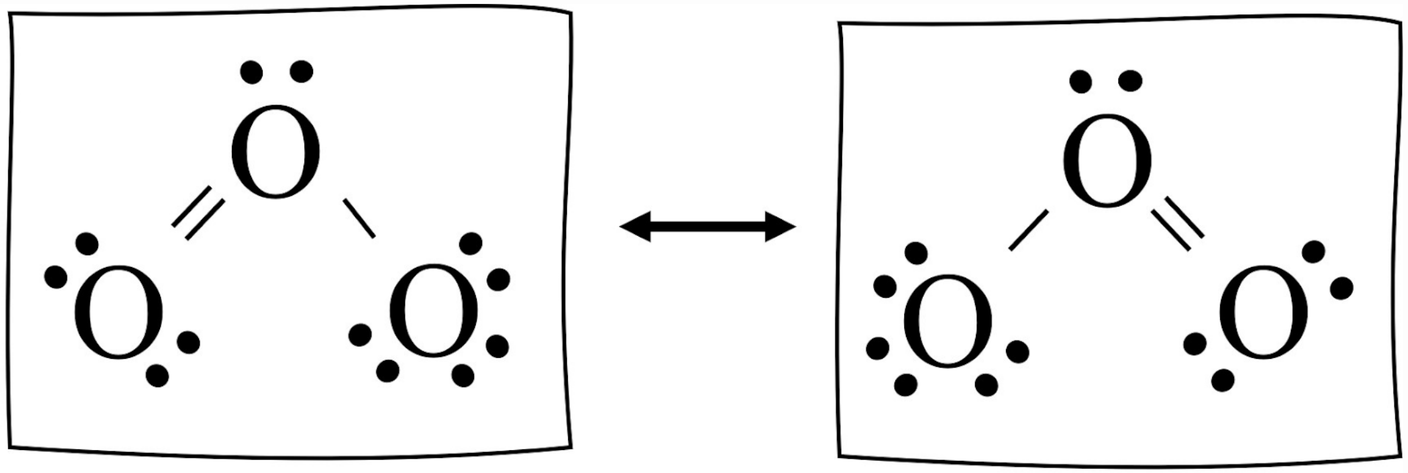
Definition: a way of describing bonding in molecules where delocalized electrons are present



- Describe delocalization of electrons
- Combination of resonance structures = Resonance Hybrid
- More resonance structures = more stable

When drawing resonance structures, **keep the position of the atoms the same**. The position of the electrons changes.

Know the difference between resonance arrows and arrows for mechanisms

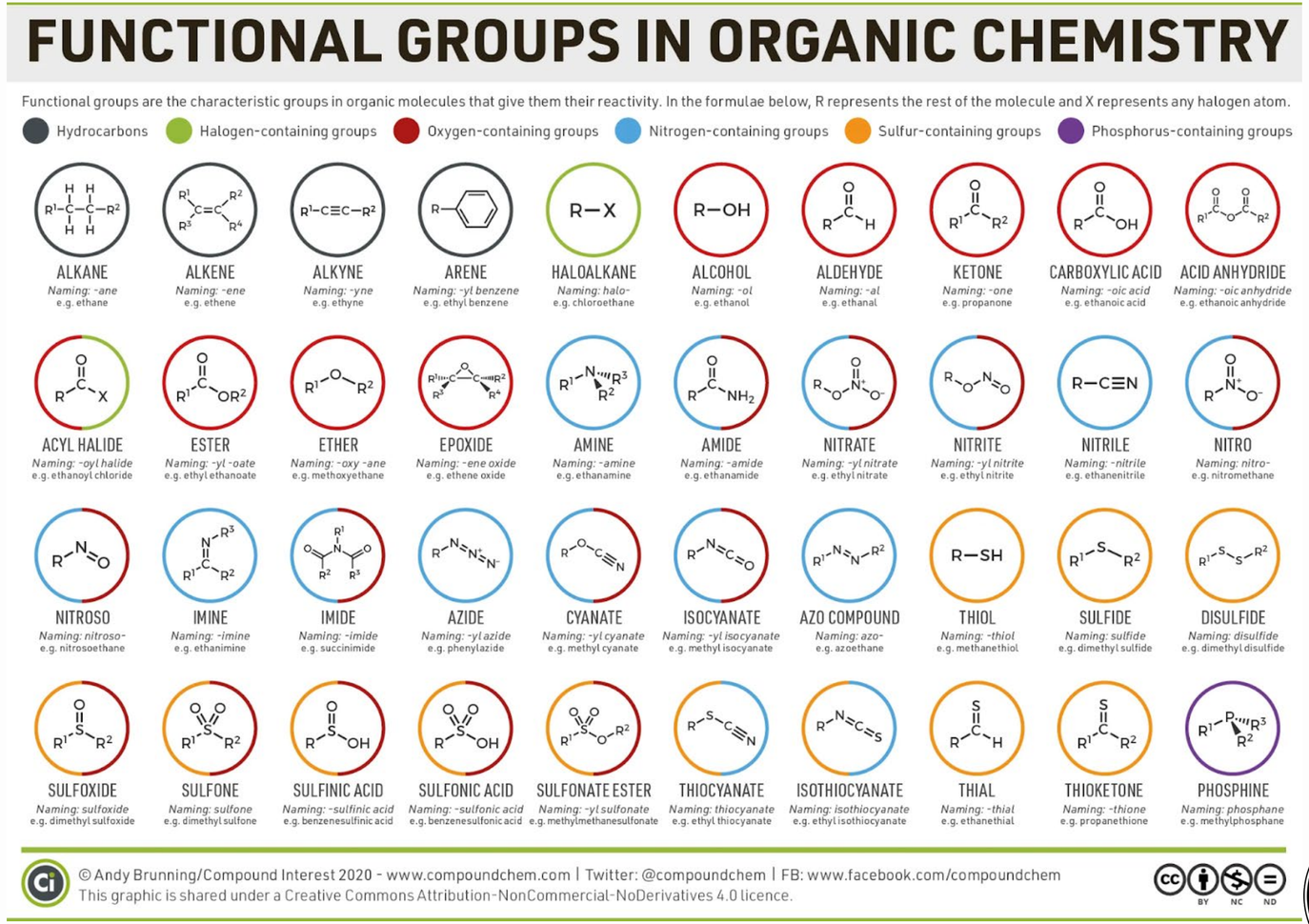


Functional Groups

Definition: Group of atoms in a molecule responsible for characteristic reaction

You NEED to have these memorized.

Professors will be using this terminology extensively. If you don't know them, you won't have a clue what they're talking about.



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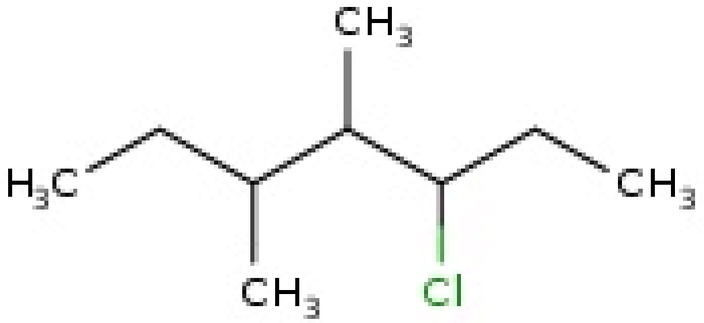
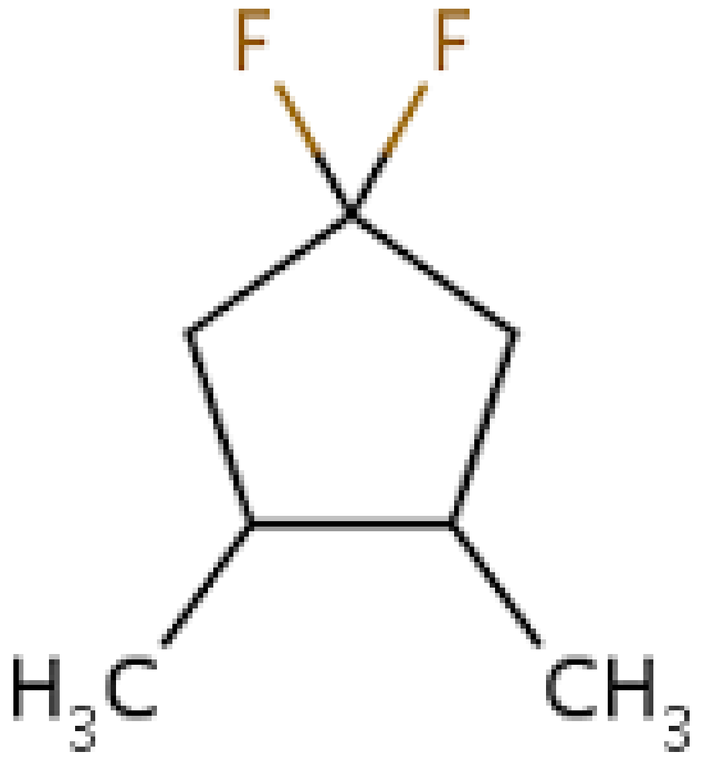
Nomenclature

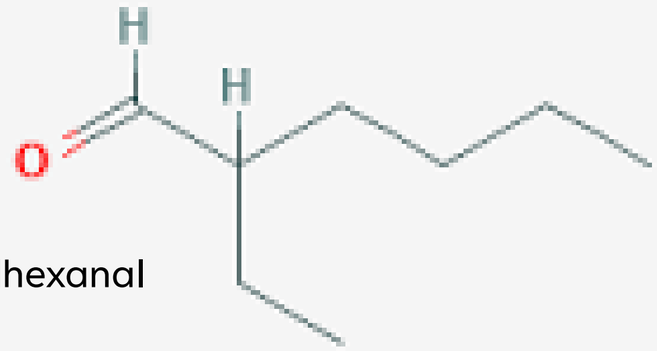
1. Find the parent chain
2. Number the carbons on the parent chain so that the substituents have the lowest numbers possible
3. Name the substituents
4. Put everything in alphabetical order
   - Substituents come first, followed by parent chain
5. Add suffixes to the parent chain if needed (aldehydes, ketones, alcohols, etc.)



3-chloro-4,5-dimethylheptane

1,1-difluoro-3,5-dimethylcyclopentane





2-ethylhexanal

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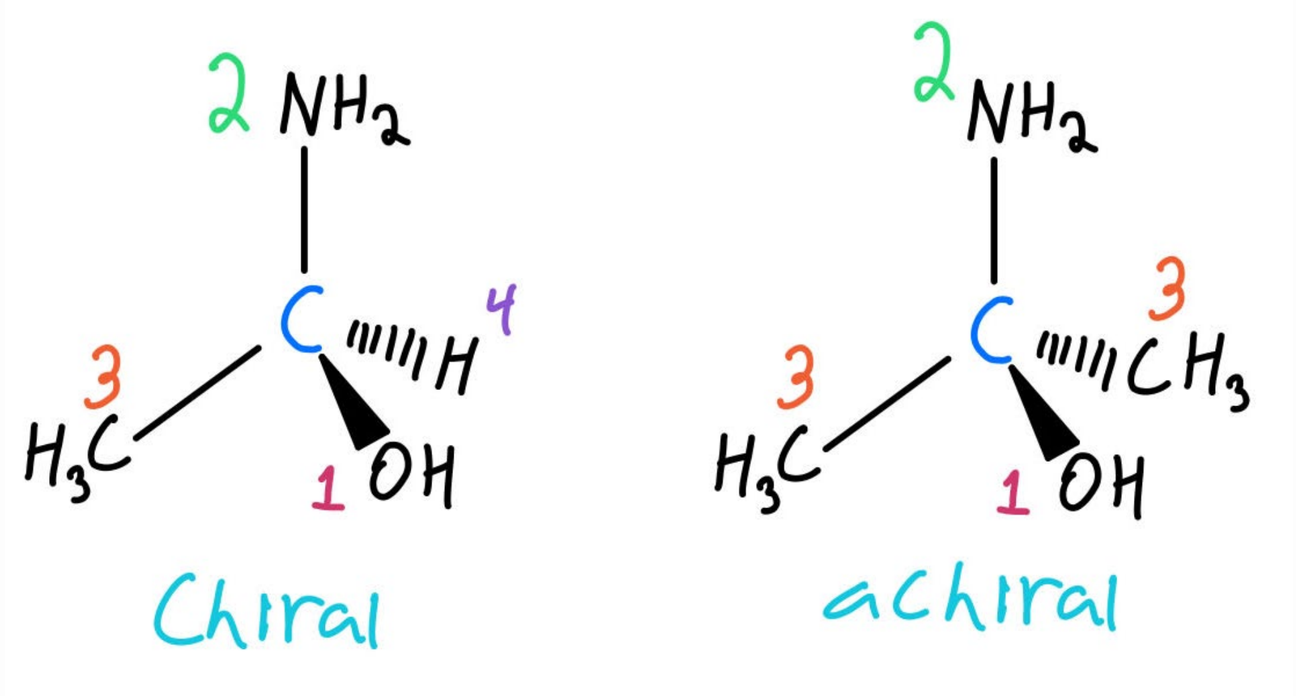
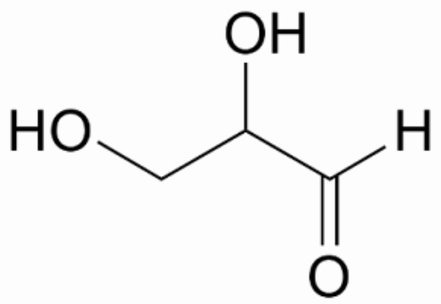
Chirality

Definition: property that describes a molecule that is not identical to its mirror image

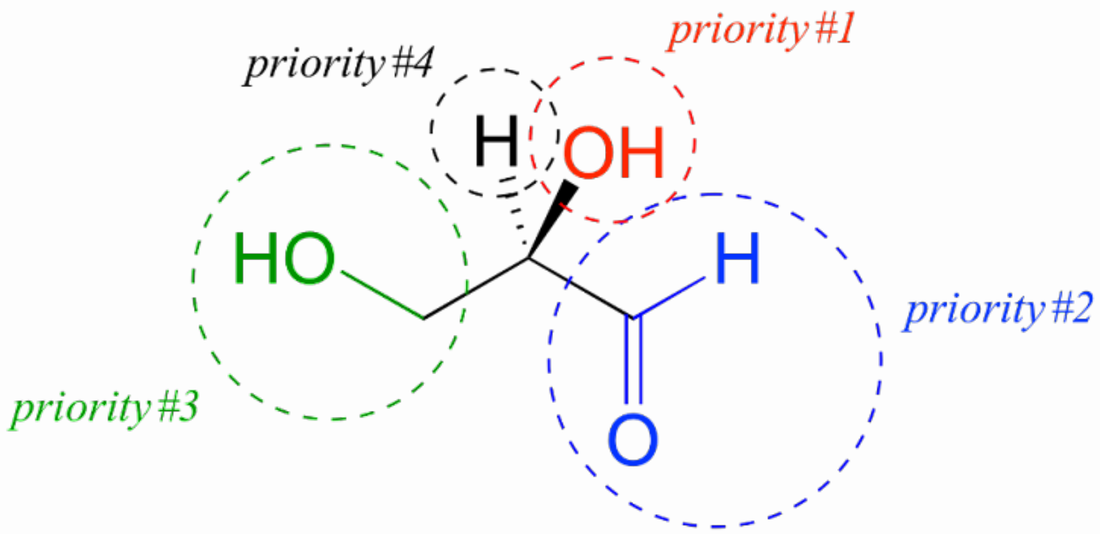
- "Handedness"
- A carbon must have (1) four single bonds and (2) different substituents on each bond in order to be considered a chiral center
- R and S configurations
  - Determined using priority groups
  - Hydrogen is always the lowest priority



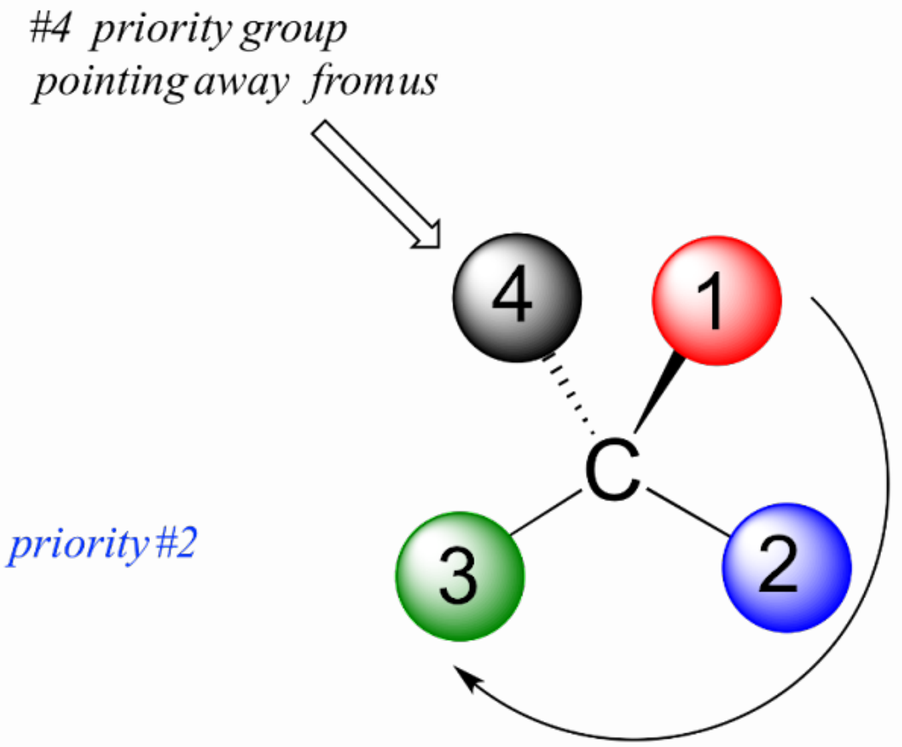
Chirality



glyceraldehyde



(*R*)-glyceraldehyde



clockwise = *R*

Chirality

Determination Process:

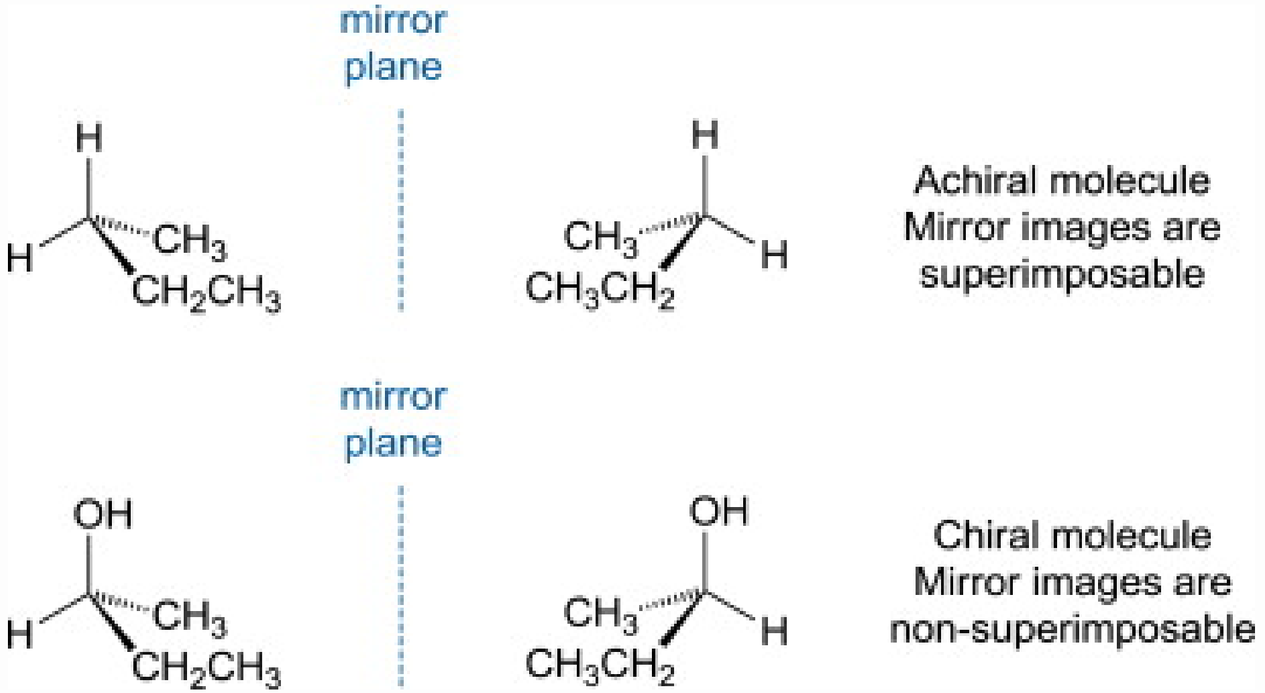
Step 1: Determine priority groups

Step 2: Determine direction (clockwise or counterclockwise) of priority groups 1 to 4

Step 3: Determine if the 4 group is pointed towards or away from you

Determining R and S after Step 1-3:

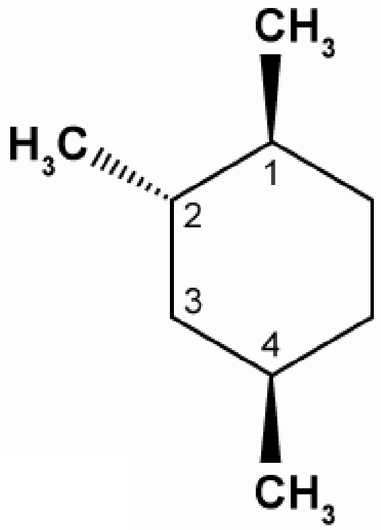
- Clockwise w/ 4 group away = R
- Clockwise w/ 4 group toward = S
- Counterclockwise w/ 4 group away = S
- Counterclockwise w/ 4 group toward = R

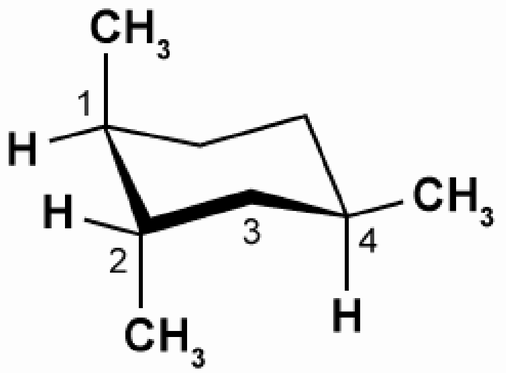


Chair Structures

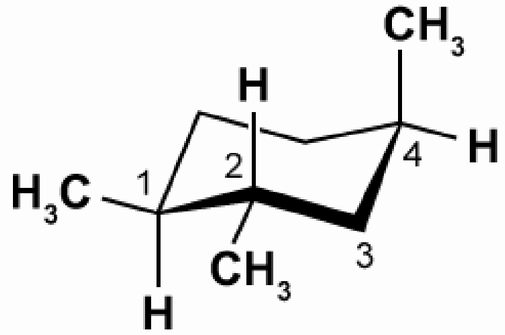
Definition: conformation of a six membered ring where atoms 2,3,5, and 6 are in the same plane

- Axial vs Equatorial
  - Equatorial more stable than axial

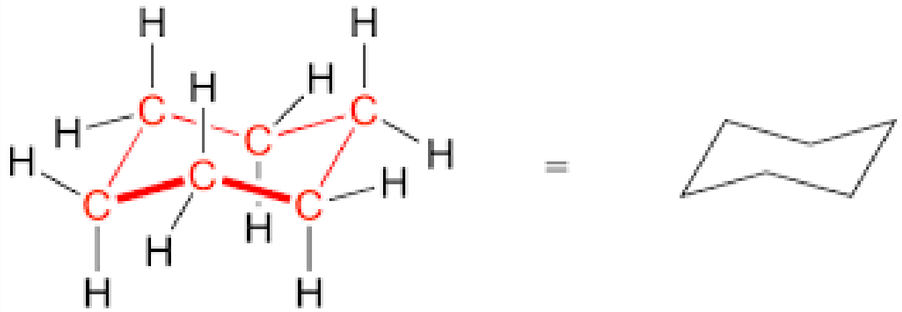




Two axial, one equatorial

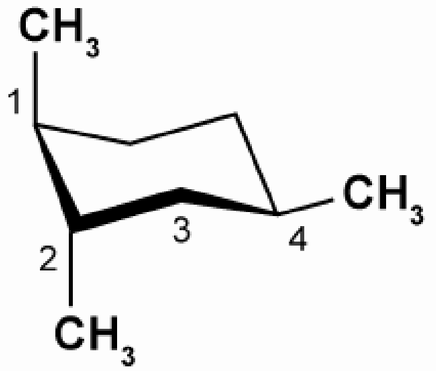


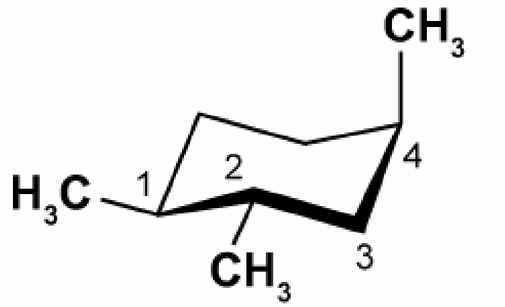
Two equatorial, one axial
Most stable conformation



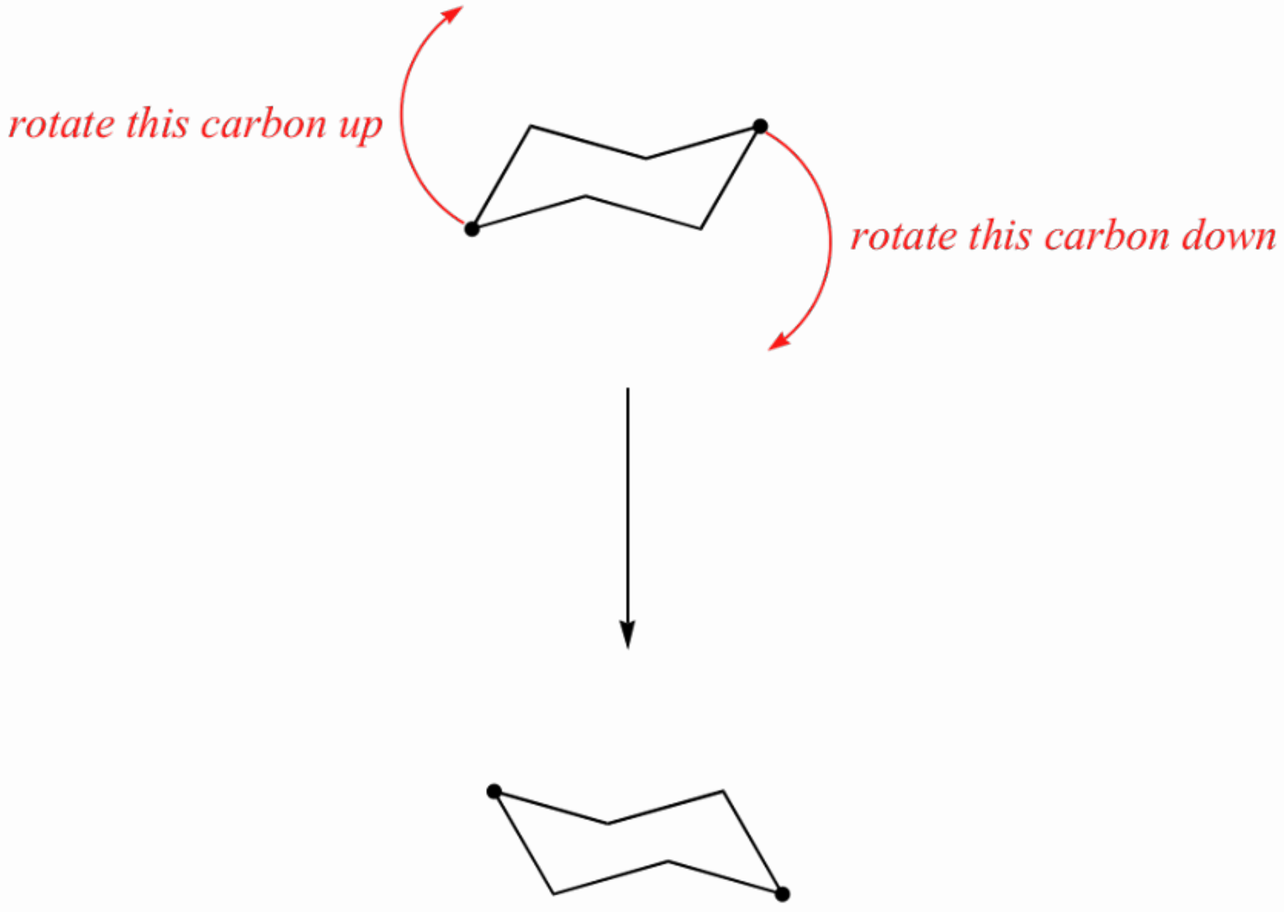
'chair' conformation of cyclohexane

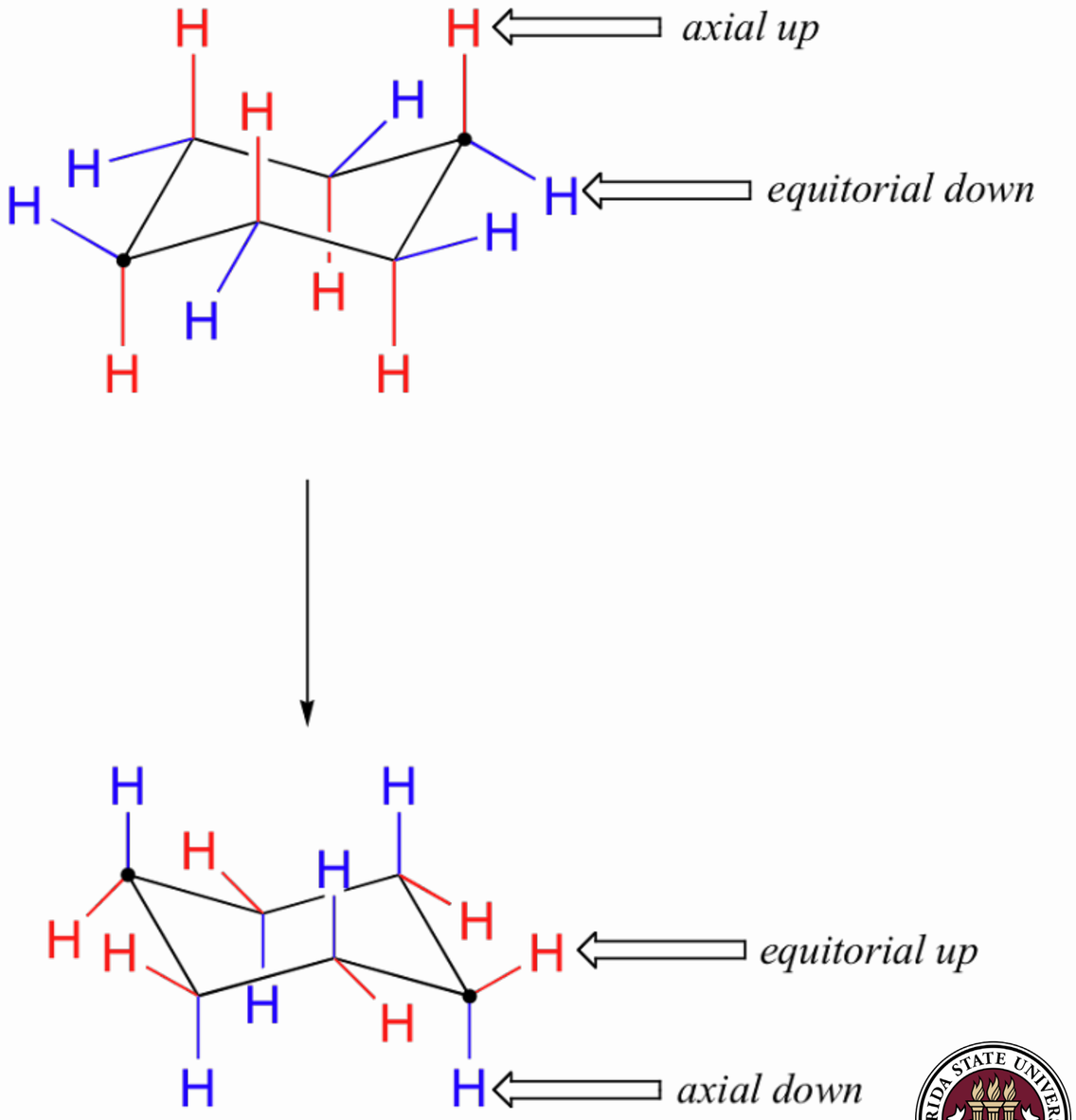
can also be drawn without hydrogens





Chair Structures





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Isomers

A review of isomer types

Isomers

Same molecular formula- different compounds

Constitutional

same formula, different connectivity

Stereo

same formula, same connectivity, different arrangement

Enantiomers

mirror images

Diastereomers

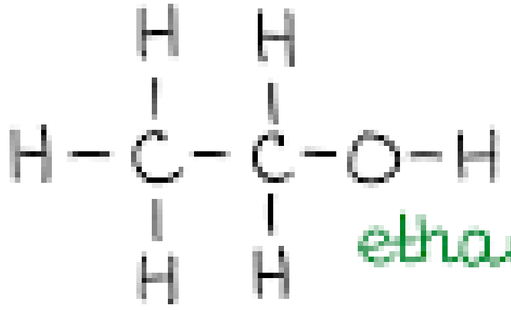
not mirror images

Constitutional Isomers

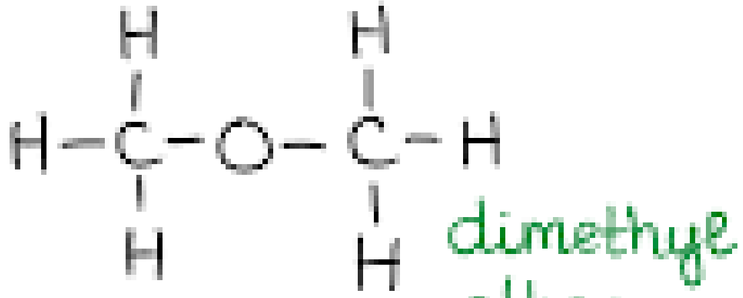
Definition: same formula, different connectivity

Molecular formula: C_2H_6O

Possible structures:



ethanol



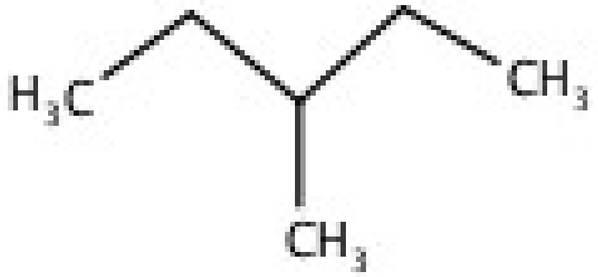
dimethyl ether

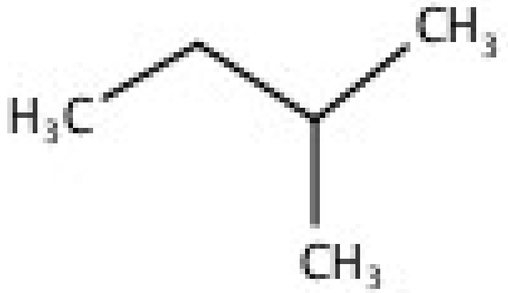
SAME COMPOSITION

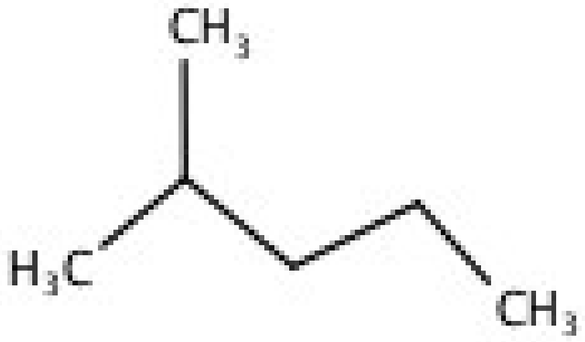
but

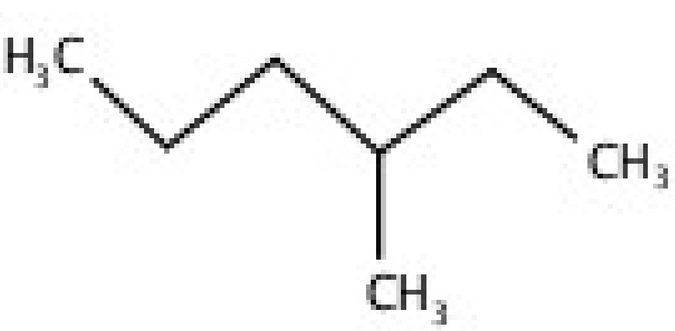
DIFFERENCE IN BONDING

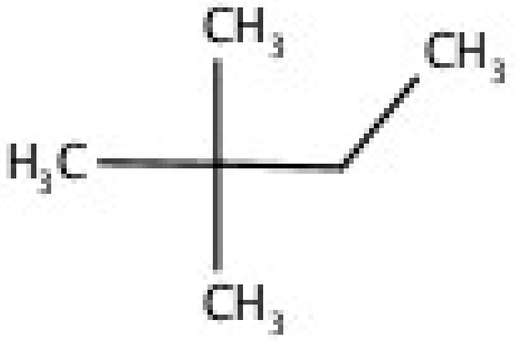
Constitutional Isomers





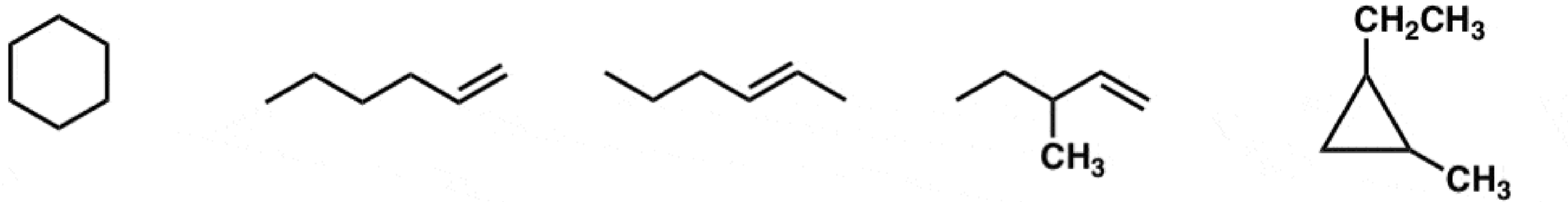






Constitutional Isomers

Constitutional isomers: Same molecular formula, different connectivity



C_6H_{12}	C_6H_{12}	C_6H_{12}	C_6H_{12}	C_6H_{12}
Cyclohexane	1-hexene	2-hexene	3-methyl-1-pentene	1-ethyl-2-methyl cyclopropane

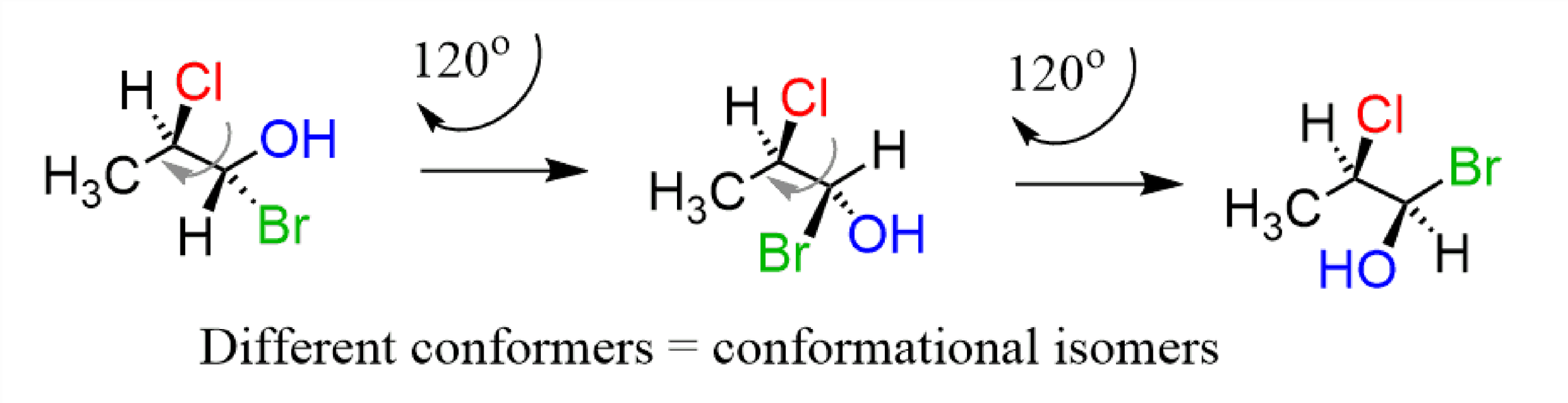
Hint: If the molecular formulae are the same, but the IUPAC names and/or numbering are different*, they are **constitutional isomers.**

* not counting (R)/(S), (E)/(Z), *cis/trans*

Stereoisomers – Conformational

Definition: same connectivity, different arrangement

INTERCONVERTED BY ROTATING BONDS

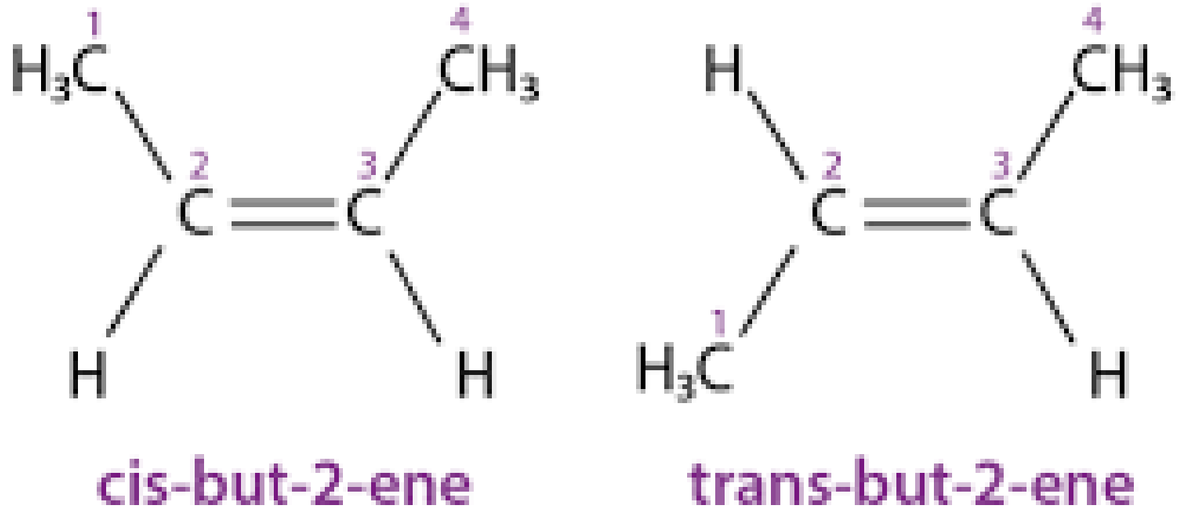


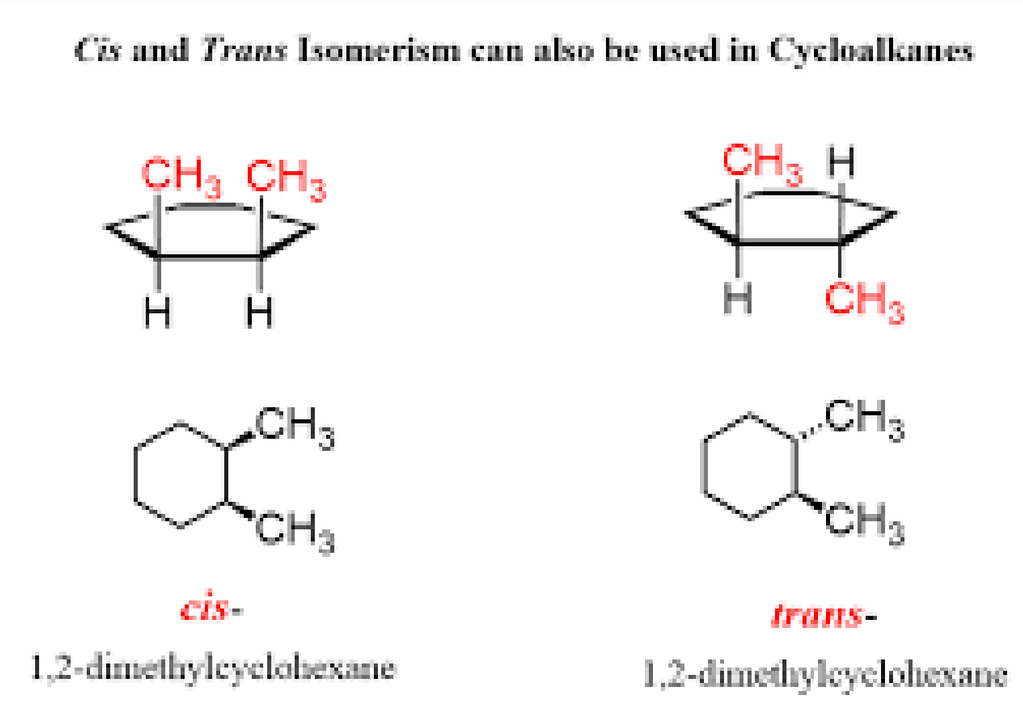
Different conformers = conformational isomers

Stereoisomers – Configurational

INTERCONVERTED BY BREAKING BONDS

Ex. cis vs trans

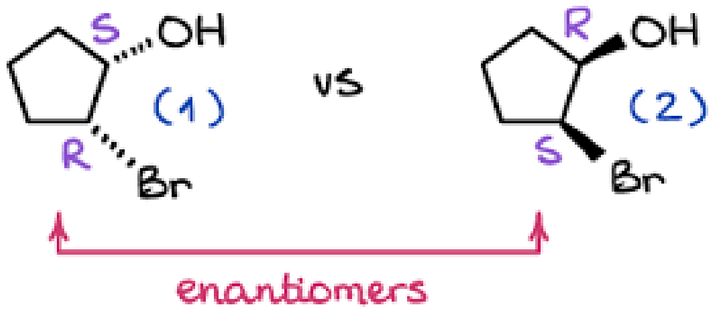


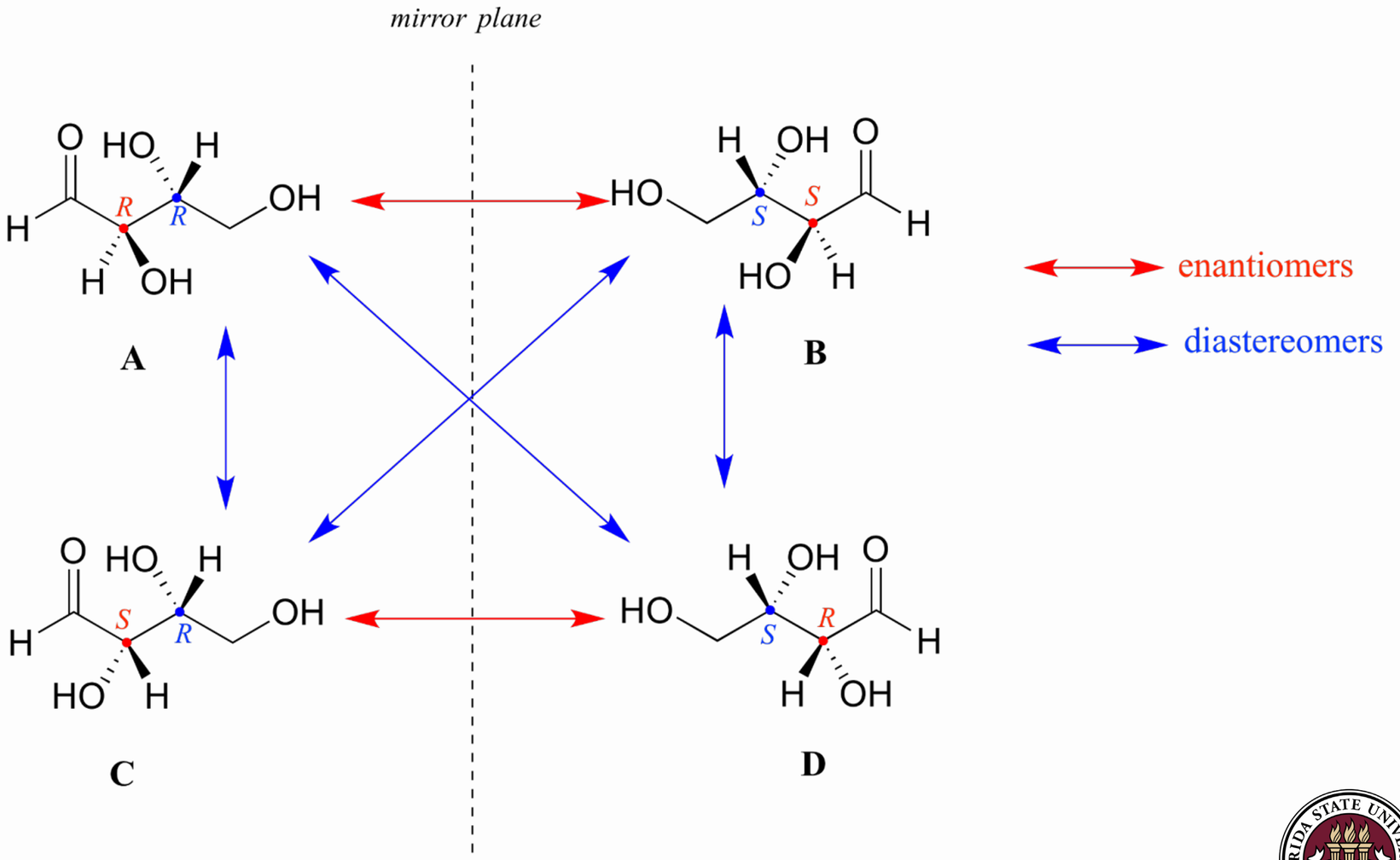


Stereoisomers – Enantiomers

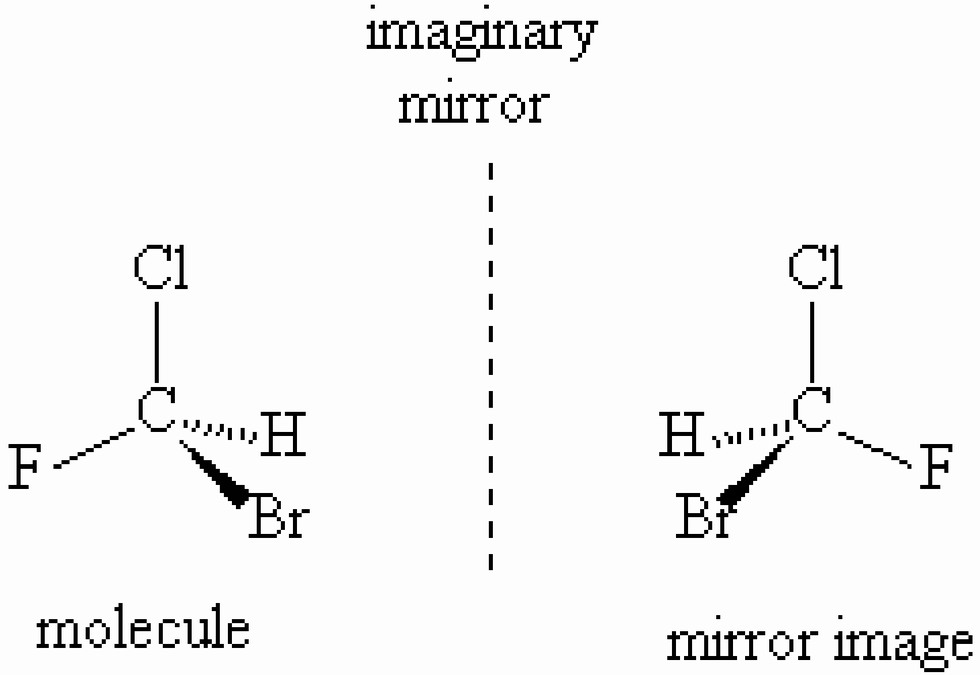
NON-SUPERIMPOSABLE MIRROR IMAGES

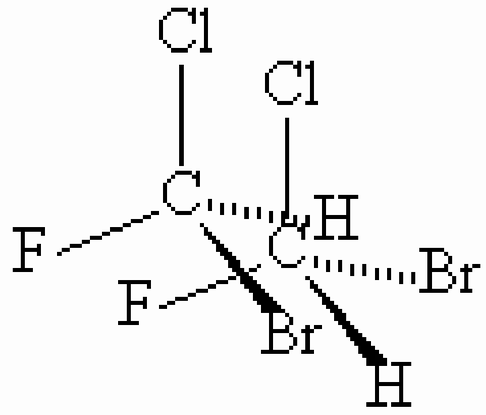
Differ at each and every chiral center





Stereoisomers – Enantiomers



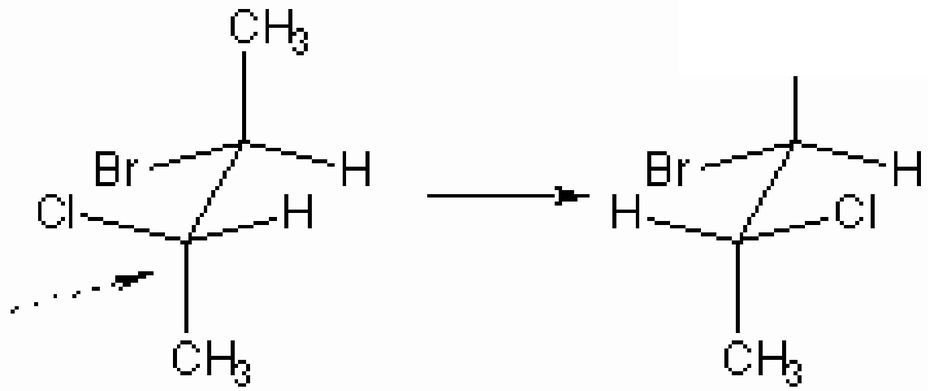


A molecule and its mirror image are not superposable when there is a stereogenic centre present

Stereoisomers – Diastereomers

NON-SUPERIMPOSABLE BUT NOT MIRROR IMAGES

Epimer = diastereomer that differs at **one and only one** chiral center



invert **only** **one** stereocenter

diastereomer

Not mirror images!

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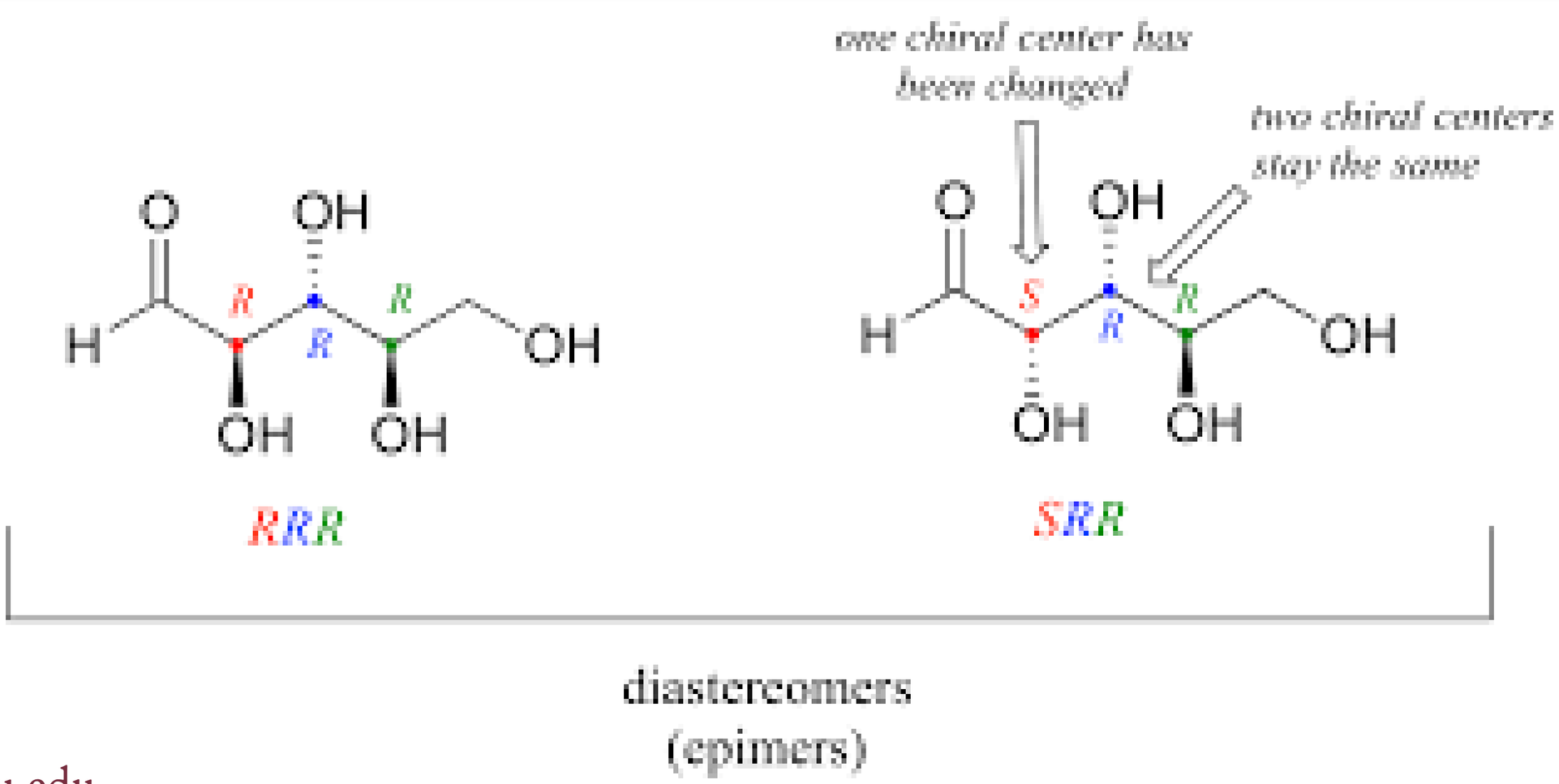
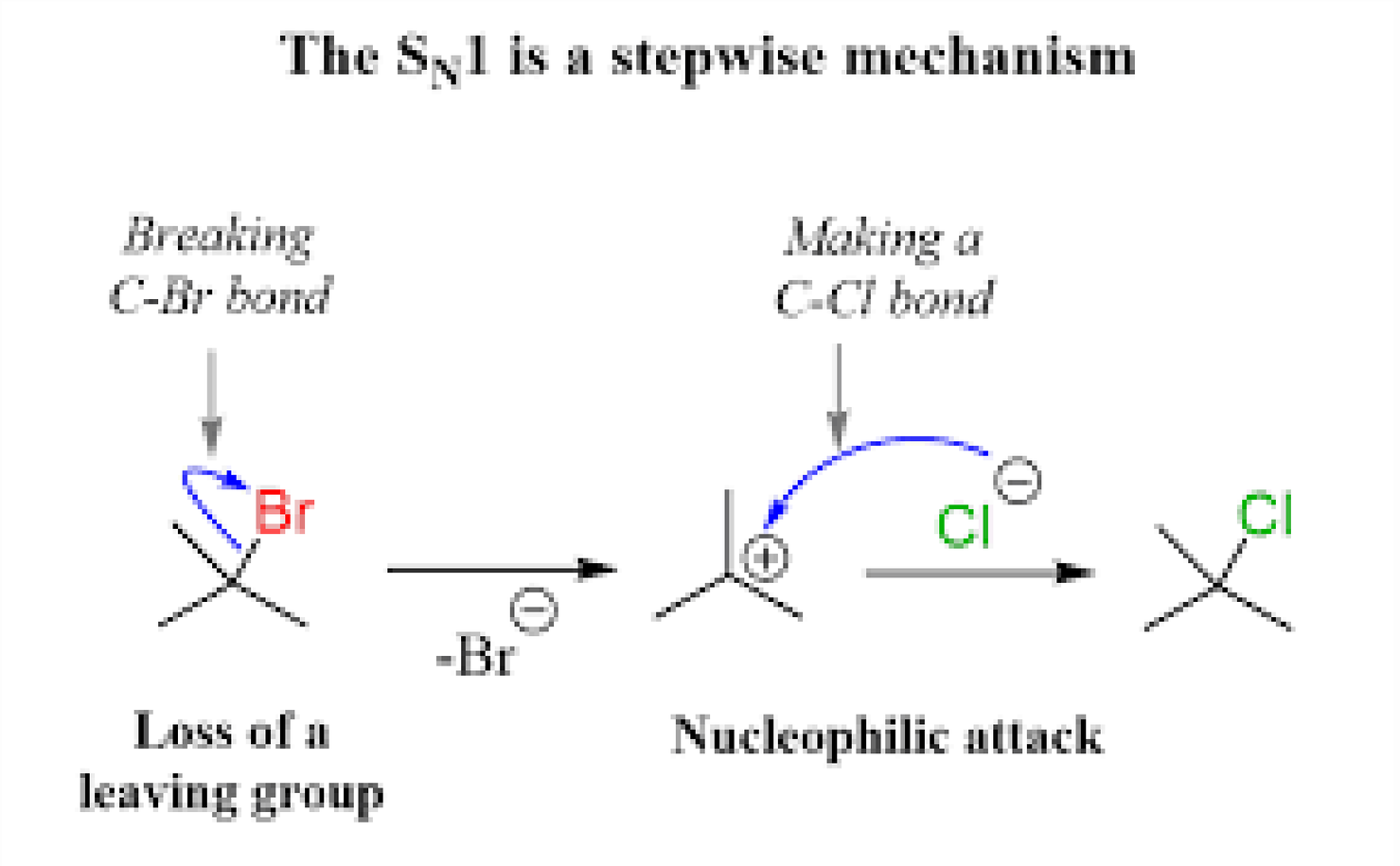
Stereoisomers – Diastereomers



Mechanisms – SN1

S= Substitution

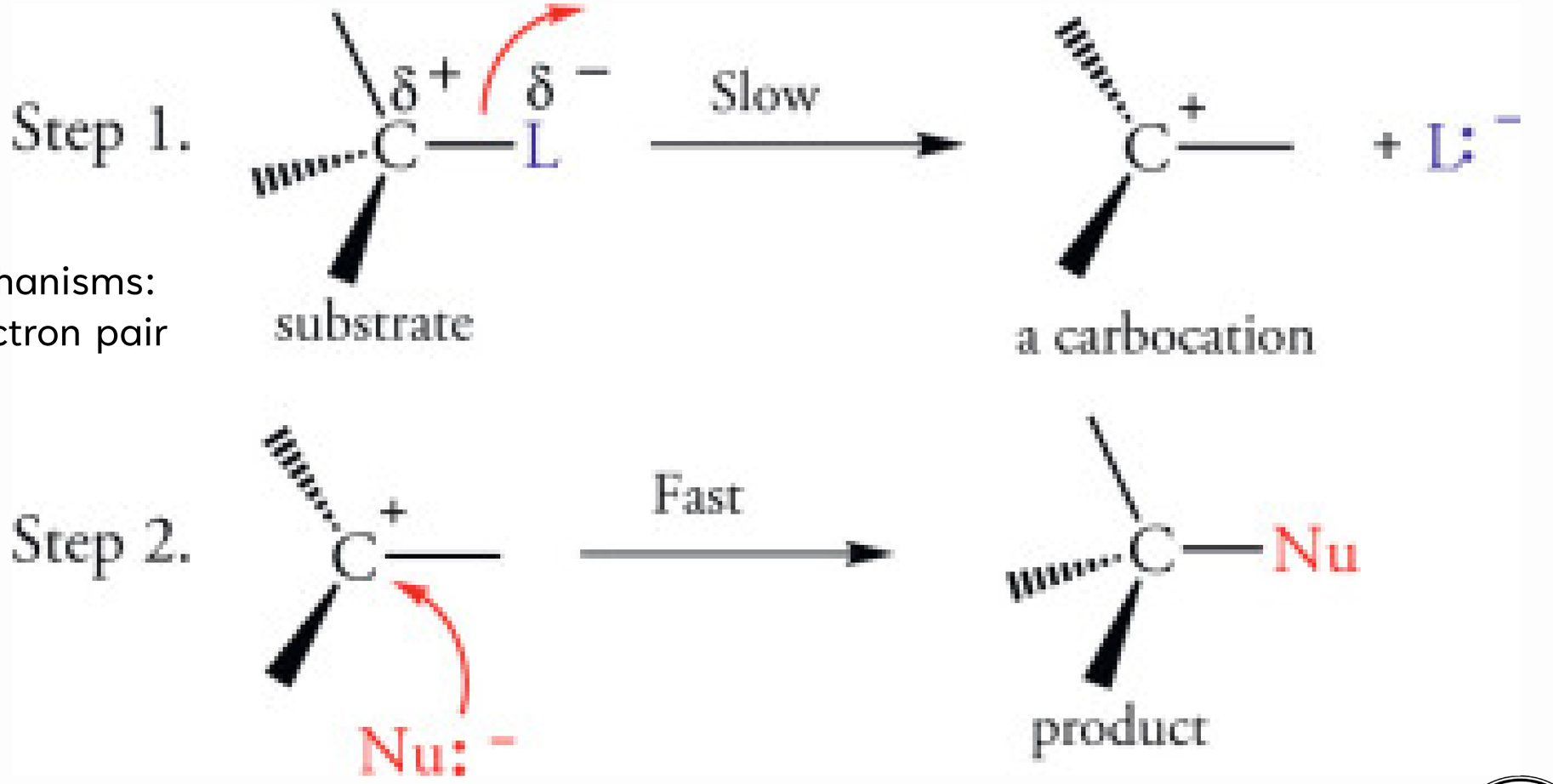
- SN = Nucleophilic substitution
- 1 = rate-determining step is unimolecular
- Always tertiary
- Sometimes secondary
- Never primary



Mechanisms – SN1

S= Substitution

When writing out mechanisms: Arrows start at an electron pair and move to an atom.

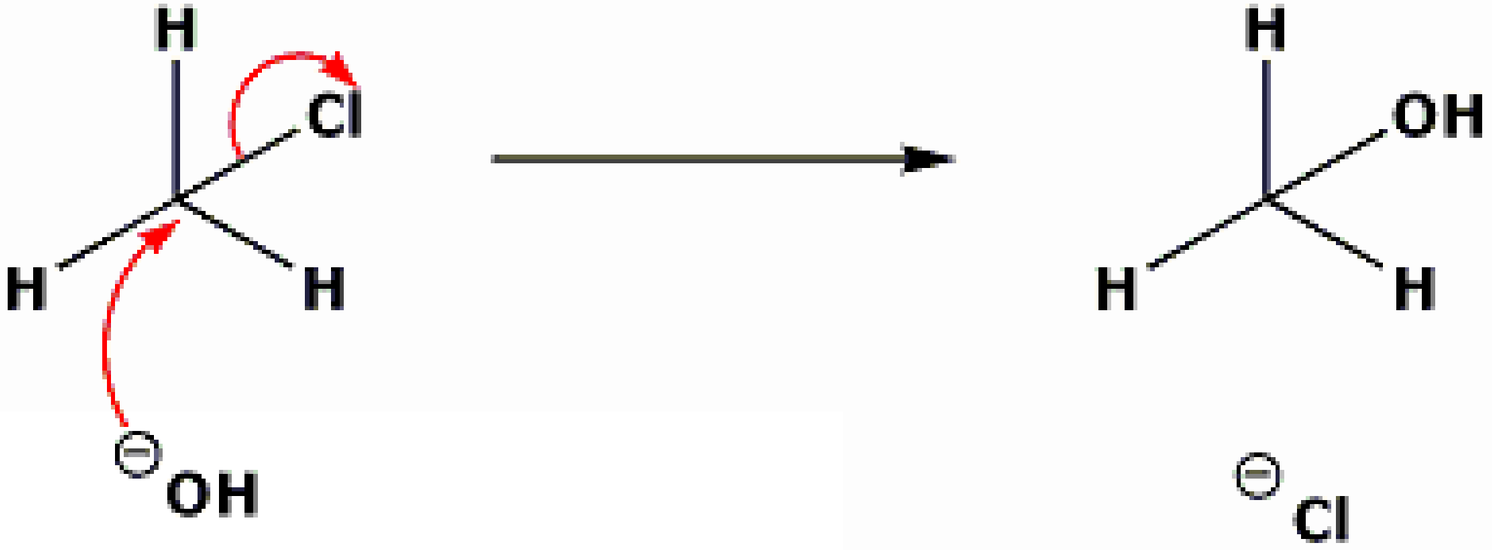


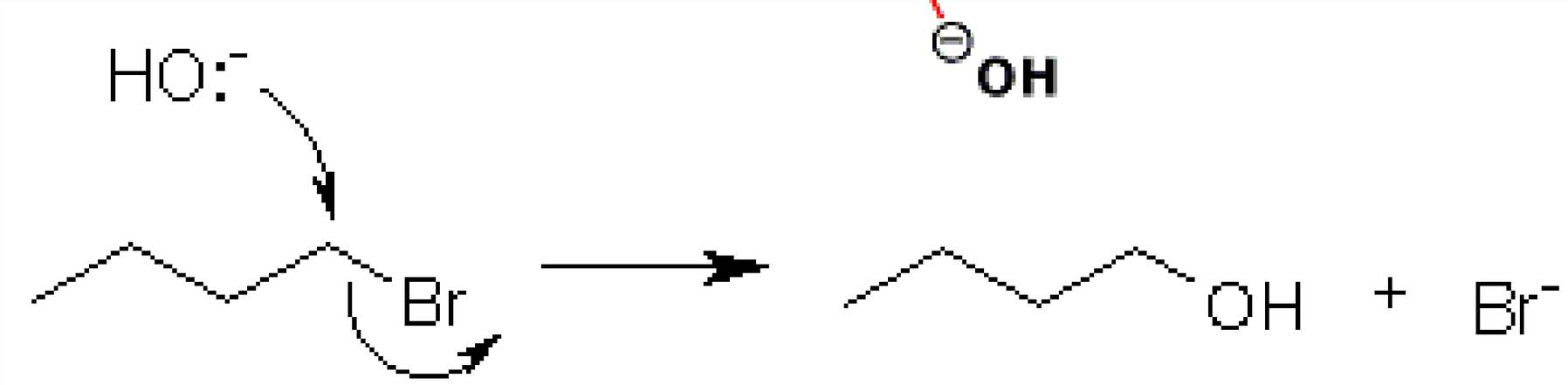
Mechanisms – SN_2

S= Substitution

- Always primary
- Sometimes secondary
- Never tertiary

Concerted mechanism - because you don't want to form a carbocation

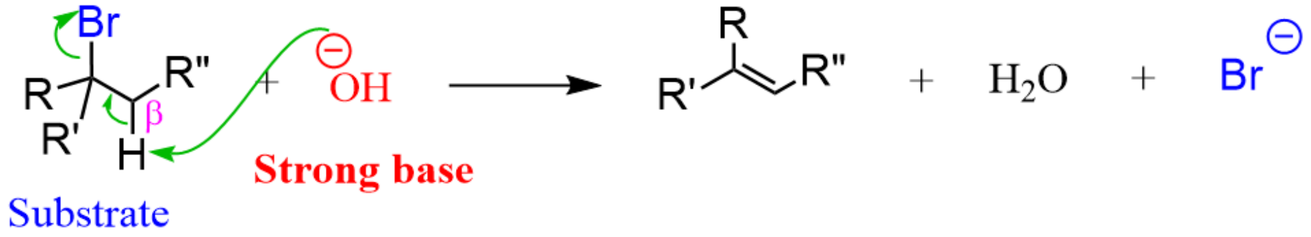




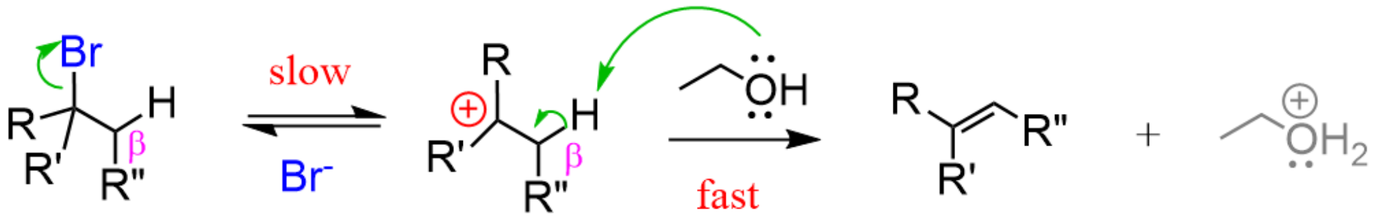
Mechanisms – E1 & E2

E = Elimination

The role of the base the E2 and E1 elimination mechanisms



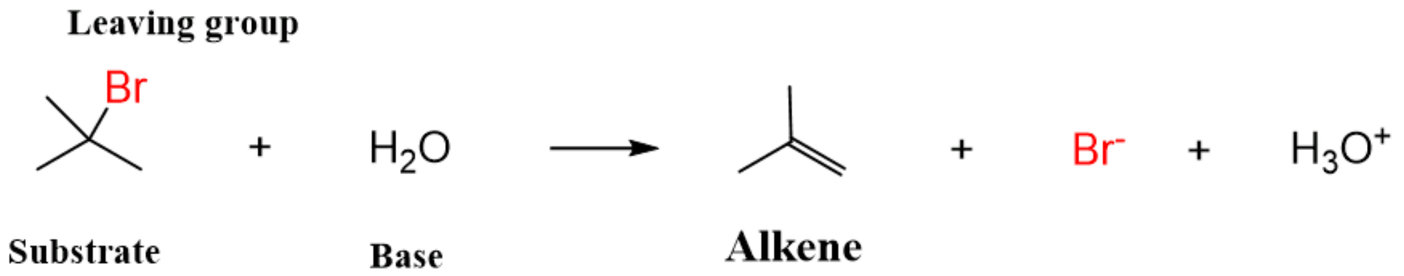
E2 reactions are favored by strong bases such as MeO^-, EtO^-, ^tBuOK, DBN and DBU



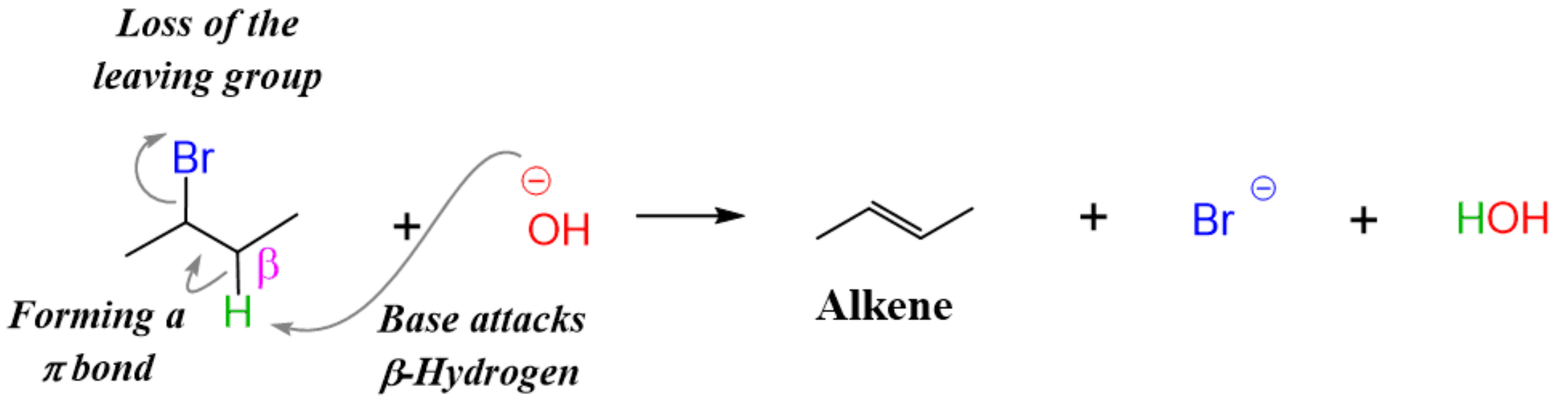
E1 reactions are favored by weak bases. Most common weak bases are **water and alcohols.**

Mechanisms – E1 & E2

E = Elimination



E1 - Elimination - Unimolecular



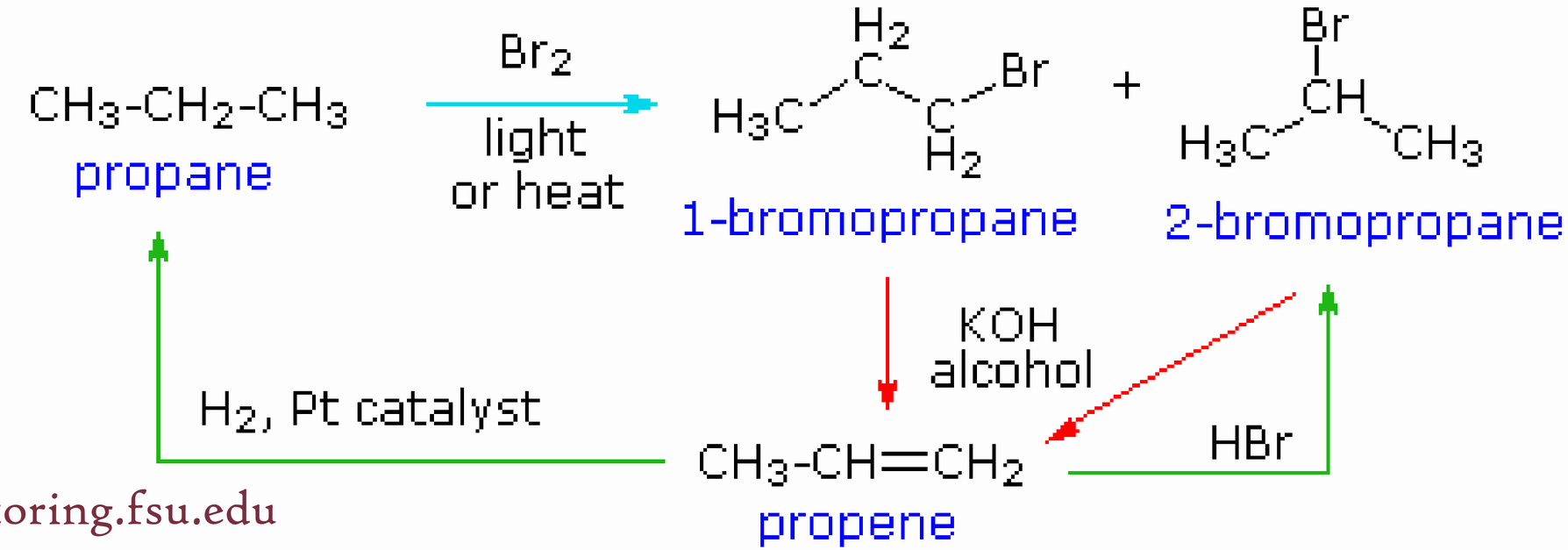
E2 Elimination - Binimolecular

Principles of Synthesis

Getting from starting compound to target compound / end product

Start with carbon framework
- Then add or remove functional groups
- Account for stereochemistry

Example:
- Start with propane and end with propene.
- Start with propane and end with 2-bromopropane



substitution →
elimination →
addition →

Other Concepts to Know

Alkene & Alkyne Reactions

- The basic ones will be used in synthesis problems, but you won't be tests on the mechanisms

Polarity

- Arises from a difference in electronegativity
- Dipole moments

Ionization constants

- Know the basic pKa's of compounds
  - Ex: pka of 1° alcohol = ~16
- Used to determine which way a reaction will proceed

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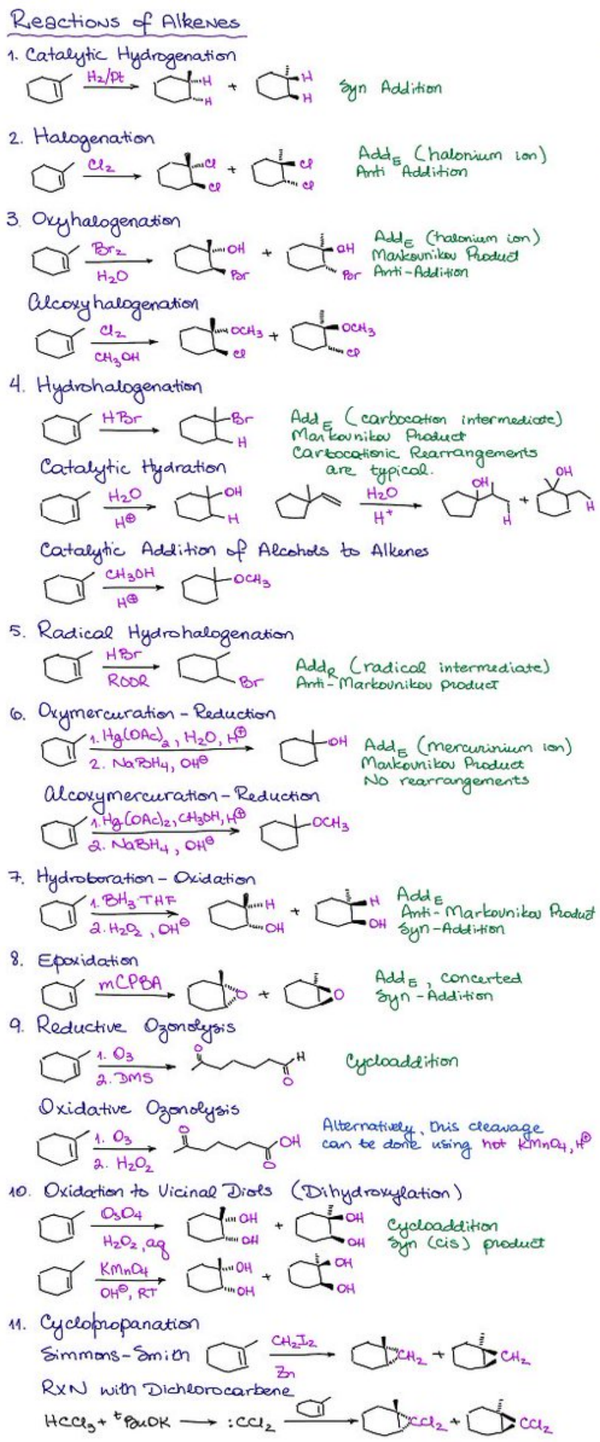

Chemistry Help Center

www.ChemistryHelpCenter.org

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References & Resources

Use these links for more information or come visit one of the FSU tutoring programs for one-on-one help!

- **ChemDraw** (chem.fsu.edu/computer-support/): This program is a drawing tool that allows users to draw chemical structures and reactions as well as biological objects, and it is available to FSU students. For instructions on how to access it, please visit the Chemistry department's computer support page.

- **ChemDoodle** (web.chemdoodle.com/): The ChemDoodle Web Components (CWC) library is a pure JavaScript chemical graphics and cheminformatics library derived from the ChemDoodle® application and produced by iChemLabs.

- **ChemSpider** (chemspider.com/StructureSearch.aspx): ChemSpider is a free chemical structure database providing fast access to over 100 million structures, properties, and associated information.

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- **Chemistry LibreTexts** (chem.libretexts.org/): This Living Library is a principal hub of the LibreTexts project, which is a multi-institutional collaborative venture to develop the next generation of open-access texts.

- **Lumen Learning Open Textbooks**: These full online textbooks are provided by universities for the enhancement of learning opportunities.
    - Introduction to Chemistry (courses.lumenlearning.com/introchem/)
    - Boundless Chemistry (courses.lumenlearning.com/boundless-chemistry/)
    - MCC Organic Chemistry (courses.lumenlearning.com/suny-mcc-organicchemistry/)
    - Organic Chemistry 1 (courses.lumenlearning.com/suny-potsdam-organicchemistry/)

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