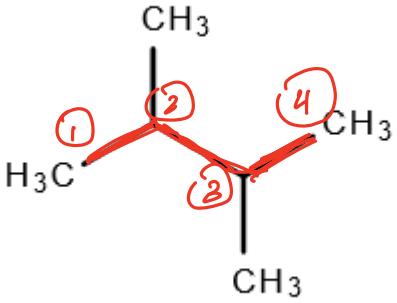
CHEM 223 (2024) SI Session #4

Learning Objectives: By the end of this session, students should be able to:

- Provide common and IUPAC names for some example compounds.
- Explain the differences between constitutional, conformational, and structural (constitutional) isomers.
- Draw Newman Projections of alkanes.
- Draw the chair-chair interconversions between cyclohexane.

Section 1: Common names, IUPAC names

1. In each of the problems, either draw the structure (if a name is given) or give the IUPAC name of the structure (include the common name if it's requested)



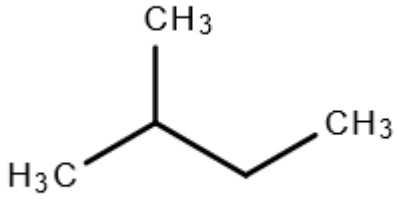
2,3 dimethyl butane

a.

b. Neopentane (include the common name)

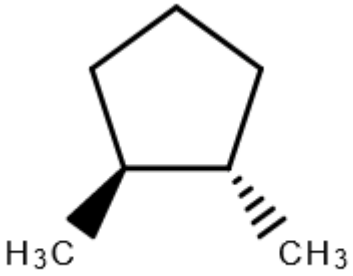
neopentane = 2,2 dimethyl propane

c. (Include the common name)



2-methylbutane

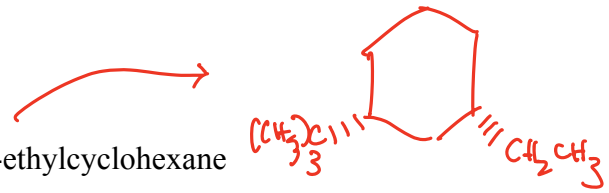
isopentane



trans-1,2-dimethylcyclohexane

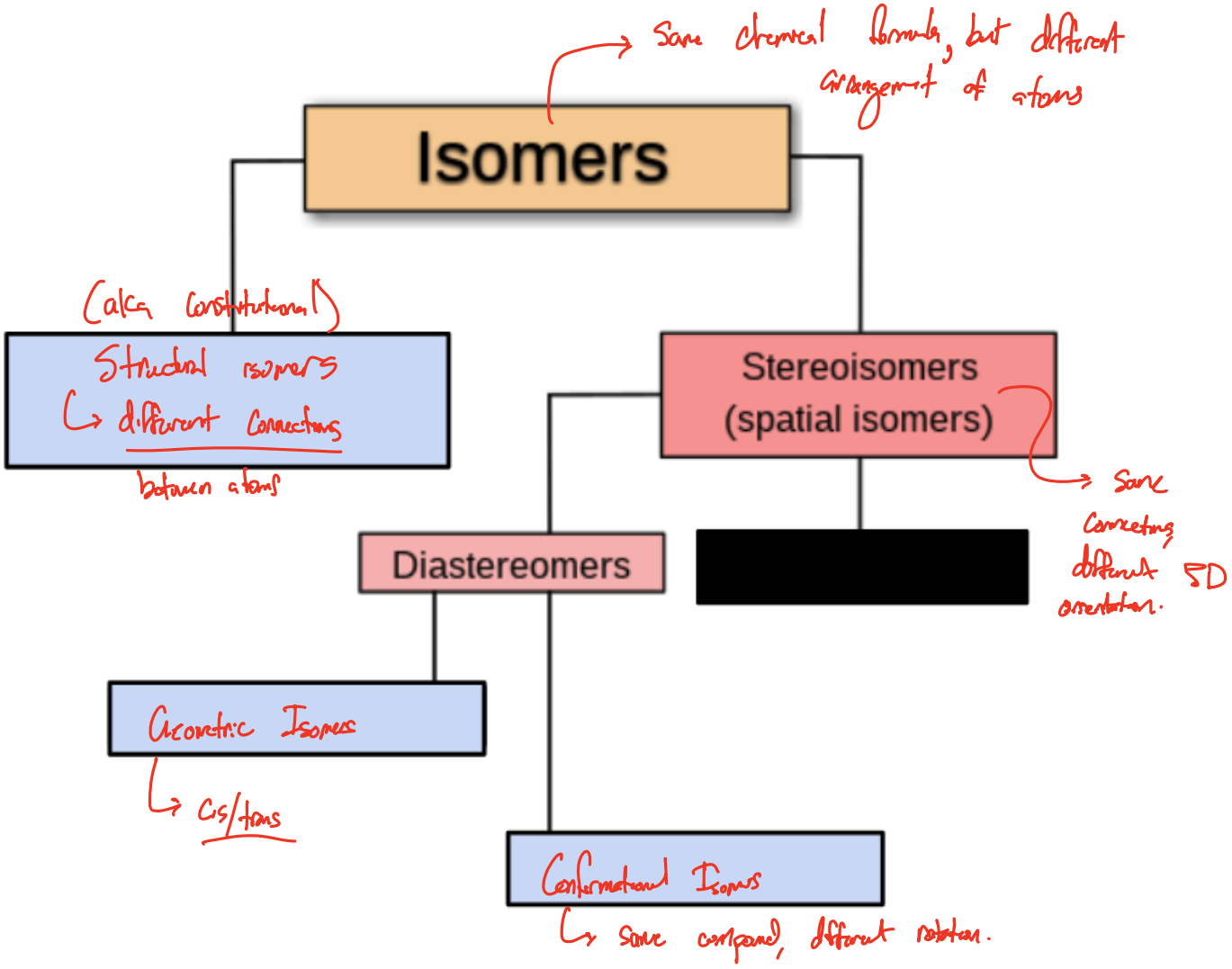
d.

e. Cis-1-(t-butyl)-3-ethylcyclohexane



Section 2: Isomerism Intro

2. Define "isomer." Fill in the tree of isomers. Provide definitions for each of the types of isomerism (except diastereomers). (Ignore the black boxes - I've purposefully removed these until Chapter 4)



3. Classify each of the following compounds as: "the same compound", "constitutional isomers", "geometric isomers", or "different compounds."

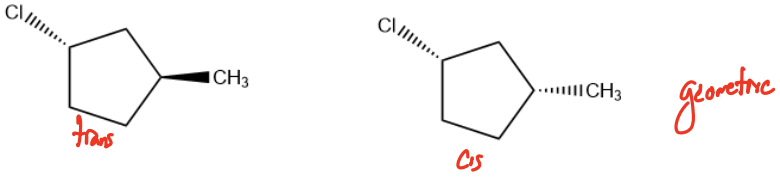
a.

Conformational; rotated 1 bond

b.  Structural / Constitutional

c.  structural / constitutional

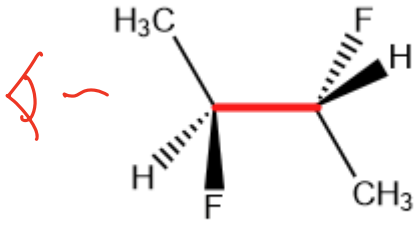
d.  C-C trans geometric

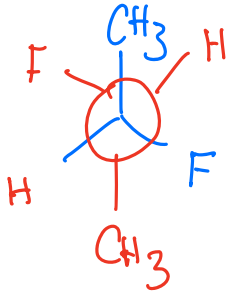
e.  trans cis geometric

f.  Structural

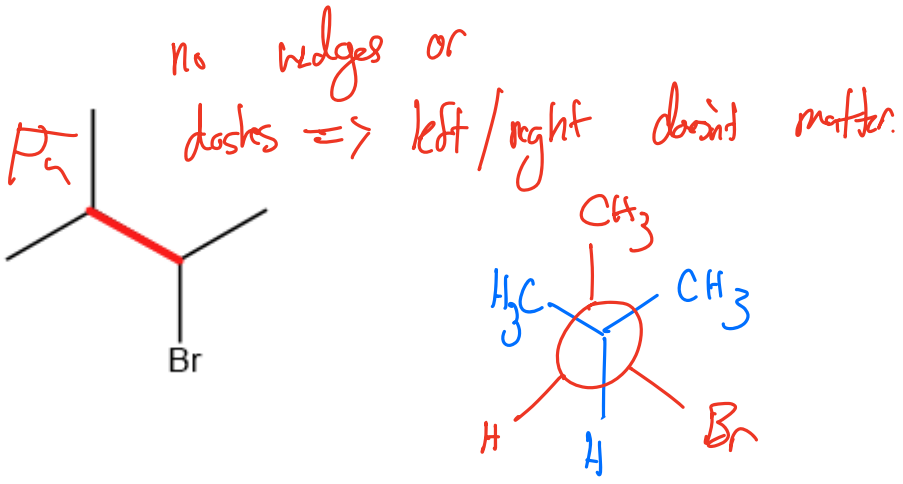
Section 3: Conformational Isomers & Newman Projections

4. Convert the following line-angle diagrams to Newman projections along the highlighted bond.

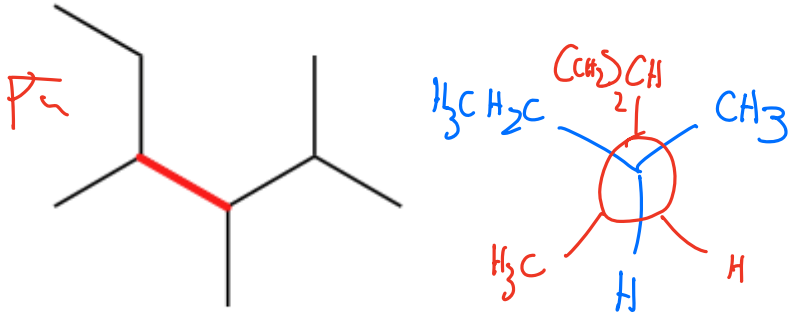
a.  front carbon back carbon



b.

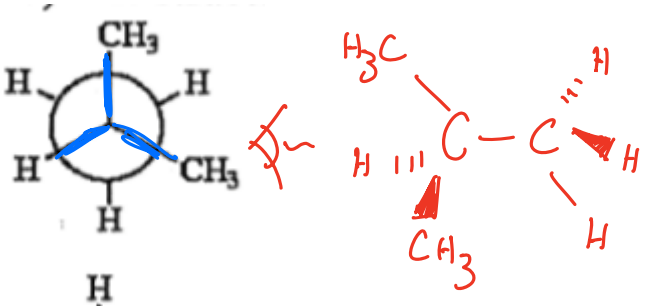


c.

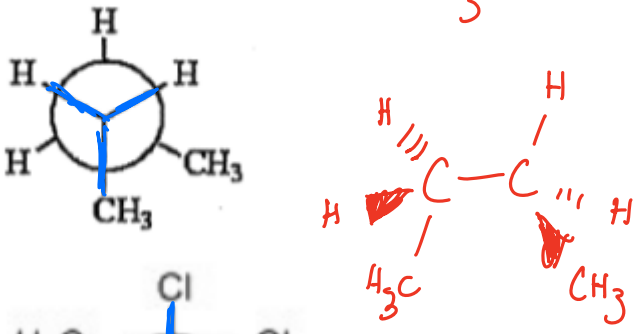


5. Convert each of the Newman projections into molecular structures. **Be sure to preserve the conformation**

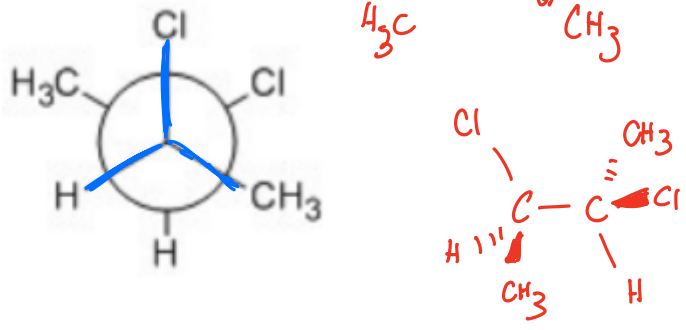
a.



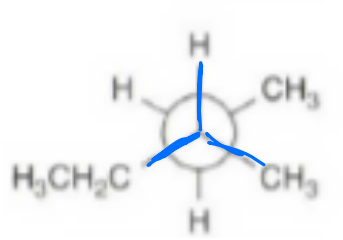
b.

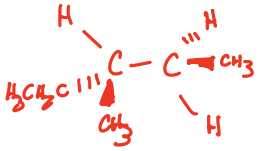


c.

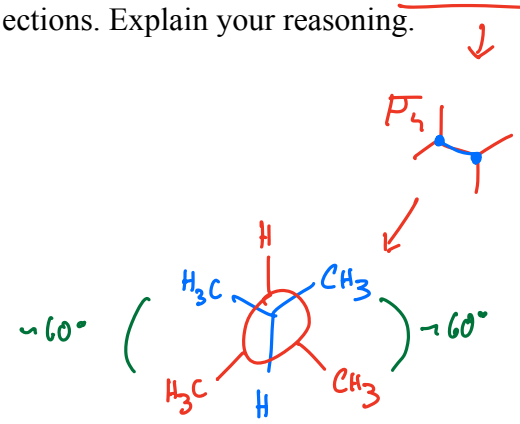


d.



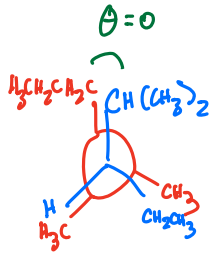


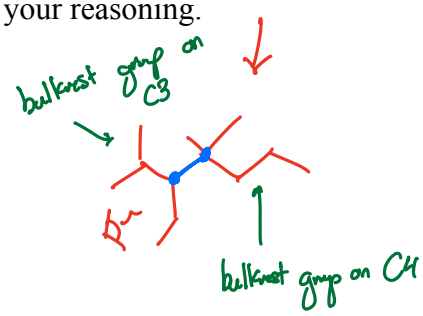
6. (From 2020's Exam 1) Looking down the C2-C3 bond of 2,3 dimethylbutane, draw the **most** stable Newman projections. Explain your reasoning.



This conformation has the bulky CH_3 s as far away from one another as possible, reducing steric strain.

7. (From 2023's Exam 1) Looking down the C3-C4 bond of 3-ethyl-2,4,4-trimethylheptane, draw the **least** stable Newman projection. Explain your reasoning.





In this conformation, the bulkiest groups on C3 (the isopropyl) and C4 (the propyl) are eclipsed with one another, leading to significant steric clash.

Session ended here

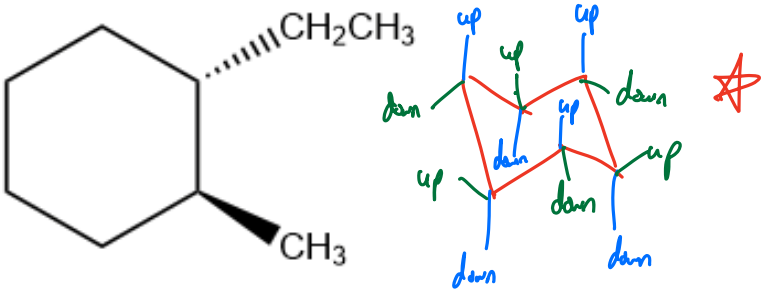
Section 4: Cycloalkanes

Section 4 will overflow onto next sheet

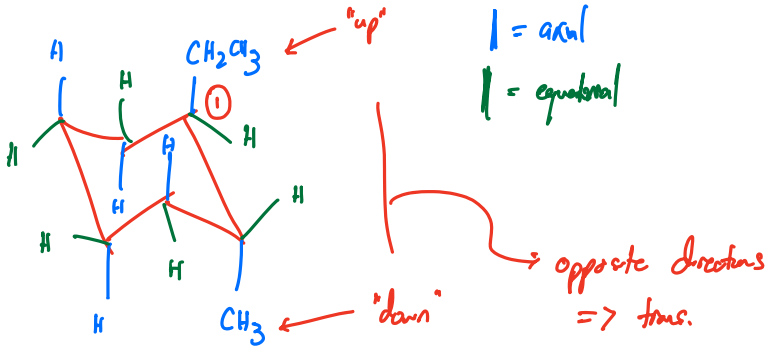
8. Which cycloalkane is the most stable? Explain.

Cyclohexane; it adopts a chair conformation, bringing the angles to ~109.5°. This reduces ring strain significantly.

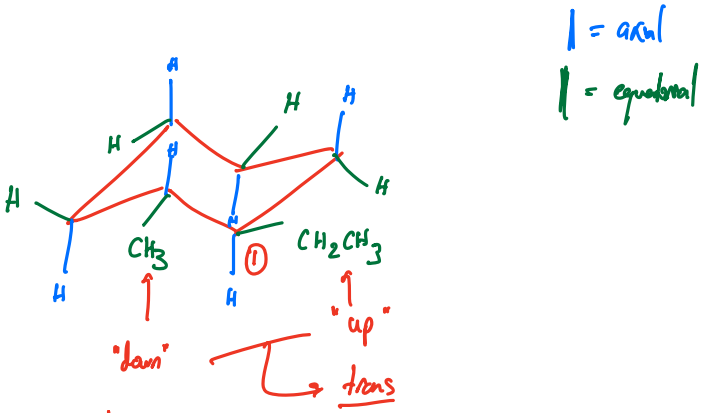
9. Use the following cyclohexane derivative to answer the questions below



a. Convert the structure into its chair conformation. Draw all hydrogens and label the axial and equatorial bonds.



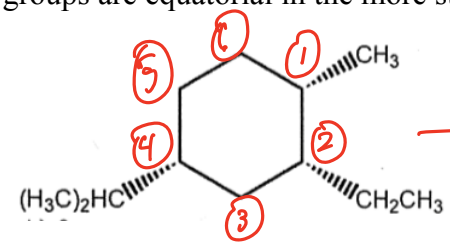
b. Convert the structure in (a) to its other chair conformation (chair-chair interconversion). Draw all hydrogens and label the axial and equatorial bonds.



c. Which structure (~~a~~ or b) is more stable? Explain your answer.

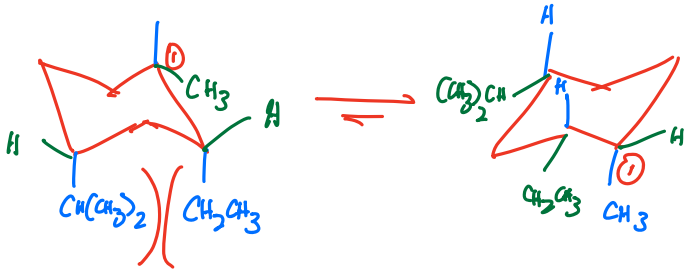
B is more stable; both groups are equatorial, which minimizes steric effects with the ring.

10. (From 2023's Exam 1) Draw the two chair conformers for the given cyclohexane derivative. How many groups are equatorial in the more stable conformer?



→ Number this way to minimize substituent numbers.

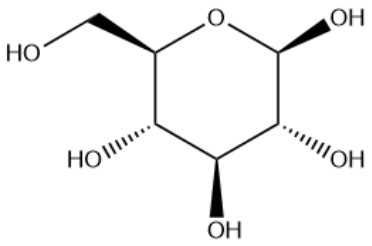
all groups down

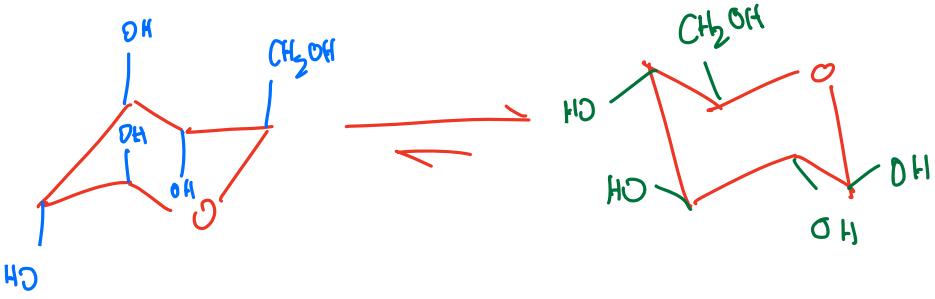


2,4 diaxial interaction

ethyl and isopropyl are equatorial in this conformer, reducing diaxial interactions and thus stabilizing the resulting structure.

11. (Challenge) Glucose is one of many sugar monomers that is crucial to most life on earth. The structure of one of its stereoisomers is given below. Convert the structure into the two chair conformers & select the more stable conformer.





all equatorial

(36%)

(α-glucose)

(64%)

(β-glucose)