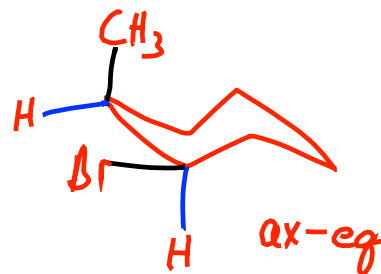
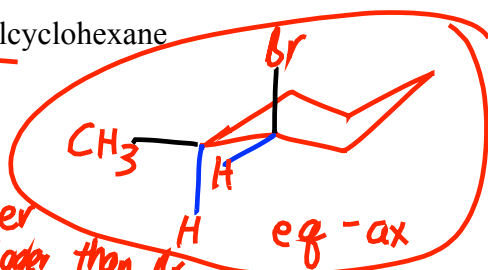


**A. Draw the two chair conformations for each of the following di-substituted cyclohexanes. Circle the more stable one.**

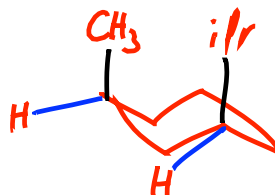
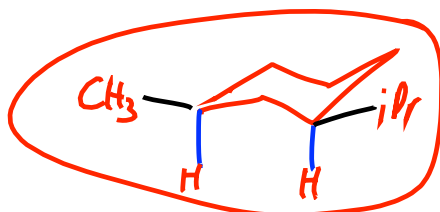
- For convenience, you may abbreviate the substituents (Me, Et, Pr, Bu, iPr, tBu, or the like rather than drawing out methyl, ethyl, propyl, butyl, isopropyl, t-butyl....)
- Assume that a halogen, OH, or NH<sub>2</sub> is smaller than a CH<sub>3</sub> or any other alkyl group.
- Remember to draw in the hydrogens on each of the “substituted” carbons

1. Cis-2-bromo-1-methylcyclohexane

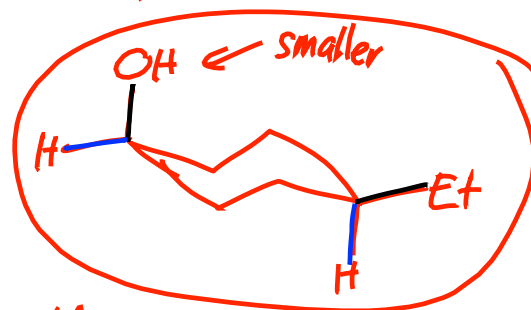
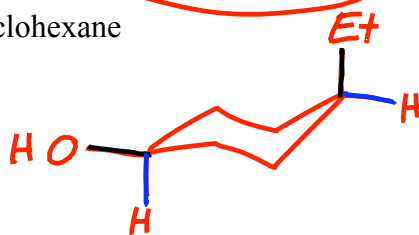
blue downer  
black upper



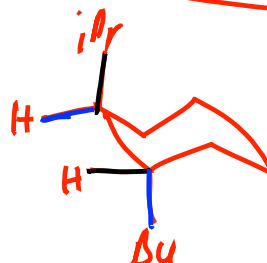
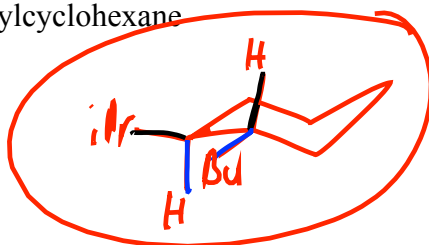
2. Cis-3-isopropyl-1-methylcyclohexane



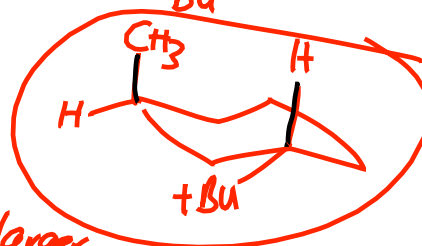
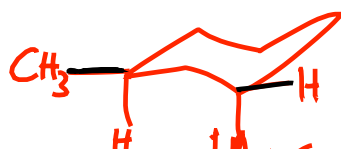
3. Cis-4-ethyl-1-hydroxycyclohexane



4. trans-2-butyl-1-isopropylcyclohexane

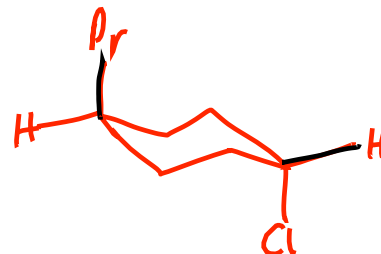
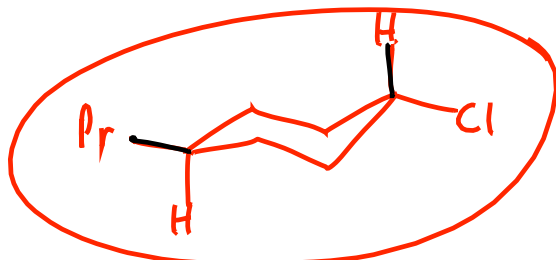


5. trans-3-t-butyl-1-methylcyclohexane



6. trans-4-chloro-1-propylcyclohexane

disaster



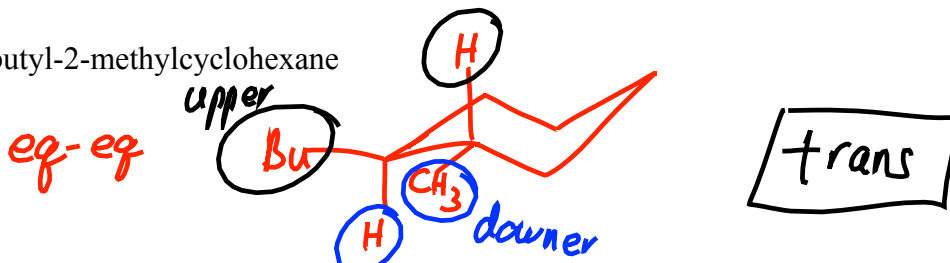
Cyclohexane Chair Practice

B. For each of the following, do two things:

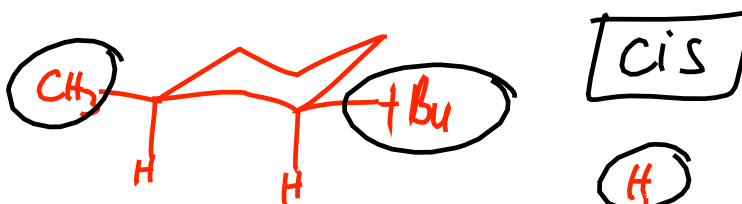
- A. draw the most stable chair form for the more stable stereoisomer for the molecule  
 B. identify whether the more stable stereoisomer is cis or trans.

*non-H's => equatorial*

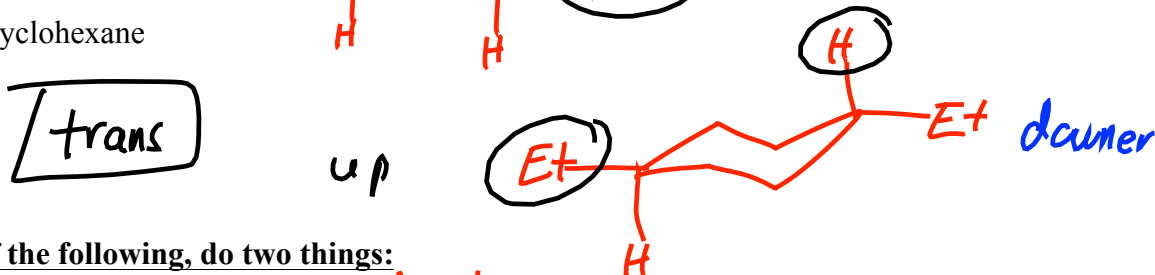
7. 1-butyl-2-methylcyclohexane



8. 3-t-butyl-1-methylcyclohexane



9. 1,4-diethylcyclohexane

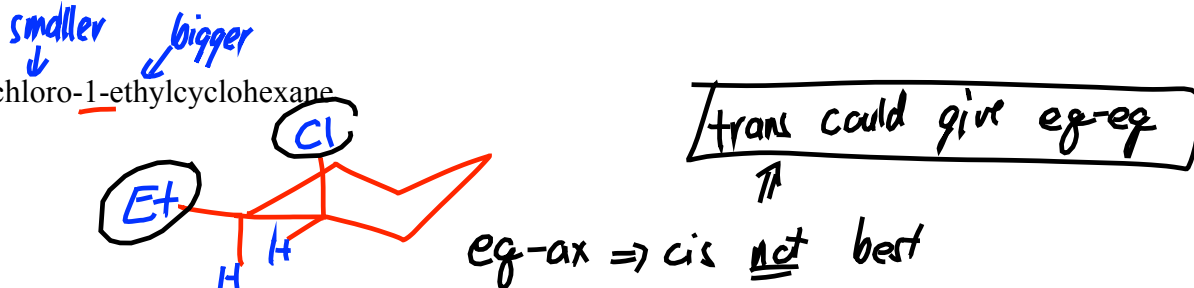


C. For each of the following, do two things:

- A. draw the most stable chair form  
 B. identify whether the more stable stereoisomer would be the cis or the trans stereoisomer

*put largest thing eq*

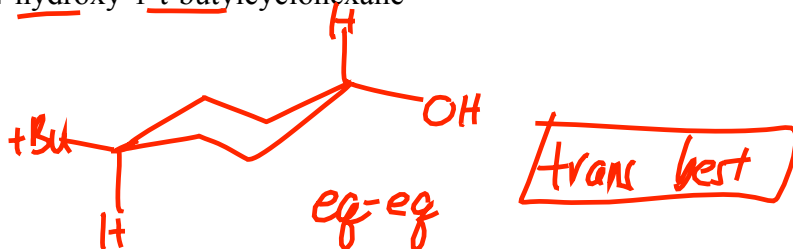
10. Cis-2-chloro-1-ethylcyclohexane



11. trans-3-butyl-1-isopropylcyclohexane



12. trans-4-hydroxy-1-t-butylcyclohexane



## Organic Chemistry I Jasperse Newman Projections and Cyclohexane Chairs. Steps.

### Steps for processing a di-substituted cyclohexane chair:

#### Summary: Draw chairs; install sticks; install substituents appropriately

1. Draw both "right-" and "left-handed" chairs
2. Draw in "axial" sticks on the relevant carbons; then draw in "equatorial" sticks on the relevant carbons
  - Use the left-most carbon for your first substituted carbon
3. On the left-most carbon, put your first substituent in on both chairs.
  - It should be equatorial in the "right-handed" chair, and axial in the other.
4. Use "upper/downer" logic to decide whether the second substituent belongs eq or ax on the first chair (then make it the opposite on the second chair)
  - • Draw in the H's on the relevant carbons
5. Are the two substituents eq/eq, eq/ax, or ax/ax? This will help recognize relative stability
6. If one subst. is forced axial, the preferred chair has the bigger subst. equatorial
7. The best cis vs trans isomer has both substituents equatorial.
8. **Note: To draw and identify the best cis versus trans, just draw a chair with both groups equatorial, and then identify whether that is cis or trans**

### Steps for Drawing the Best Newman projection

#### Summary: Draw staggered sticks; install substituents appropriately

1. Draw a staggered Newman projection, with three sticks on the "back" carbon and three on the "front". Have a stick up on the back carbon, and one down on the front.
2. Draw your biggest substituent on the back carbon on the "up" stick
3. Draw your biggest substituent on the front on the "down" "anti" stick
4. Fill in the other two back attachments on the other two back-carbon sticks.
5. Fill in the other two front attachments on the other two front-carbon sticks.

### Steps for Drawing the Worst Newman projection

#### Summary: Draw eclipsed sticks; install substituents appropriately

1. Draw an eclipsed Newman projection, with three sticks on the "back" carbon and three on the "front". Have a stick up on both the back and front carbons.
2. Draw your biggest substituent on the back carbon on the "up" stick
3. Draw your biggest substituent on the front on the "up" "totally eclipsed" stick
4. Fill in the other back and front attachments.

**Note: The more severe the eclipsing in the "worst" projection, the greater the rotation barrier**

### Tips for creating a Newman Projection Energy Diagram

1. Use the "worst" (totally eclipsed version) as  $0^\circ$  and  $360^\circ$ .
2.  $120^\circ$  and  $240^\circ$  will be the other "eclipsed" conformations => energy crests.
3.  $60^\circ$ ,  $180^\circ$ , and  $300^\circ$  will be the staggered conformations => energy valleys
4.  $60^\circ$  and  $300^\circ$  will be the other two staggered conformations (gauche) => energy valleys.
5. To compare the relative energies of the eclipsed crests, evaluate the sizes of the eclipsing substituents (when two non-hydrogens eclipse) and
6. To compare the relative energies of the staggered valleys, evaluate the number/severity of gauche interactions