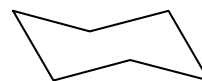


In-Class Solutions
Disubstituted Cyclohexane Conformers

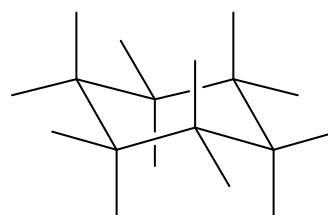
1. One important thing to understand about this sort of problem—a common one—is that the wedges and dashes on a wedge/dashed-bond drawing of cyclohexane have *nothing* to do with whether groups are axial or equatorial. To determine this, you *must* draw the chair form of the cyclohexane.

So how do I draw the chair form of a multisubstituted cyclohexane? I recommend you do it by this route:

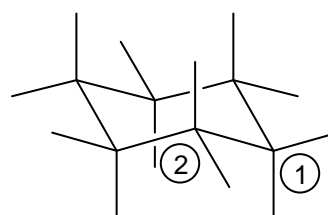
- a. Draw a blank chair cyclohexane first.



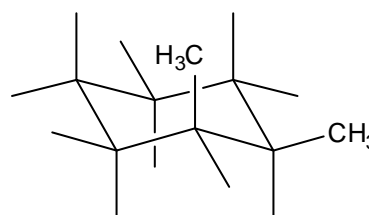
- b. Next, add axial and equatorial sticks to each carbon of the chair. Don't write atom labels on the sticks yet, just draw the sticks.



- c. Pick a carbon on the ring to be number 1, and then figure out which other carbons will also get substituents. In this problem, carbon 2 will also get one (from "cis-1,2-dimethyl"). I've assigned the "foot" of the chair to be carbon 1 arbitrarily—but you can choose any carbon you like.

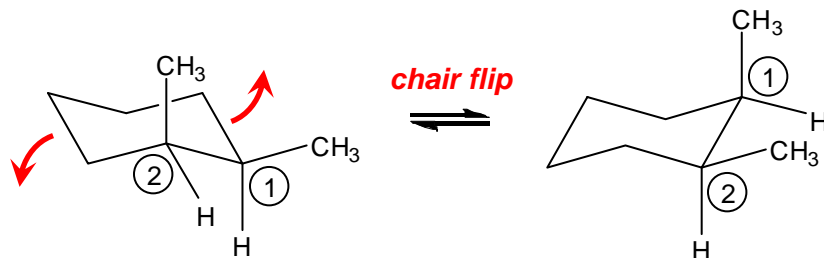


- d. Put substituents on the two carbons according to the wedges and dashes on the original wedge/dashed-bond drawing. Here, both methyls are on wedge bonds, and that means they both sit above the plane of the ring. (Dashed bonds would mean they sit below the plane of the ring.) Carbons 1 and 2 have two empty sticks, and the methyl groups occupy the upper ones.



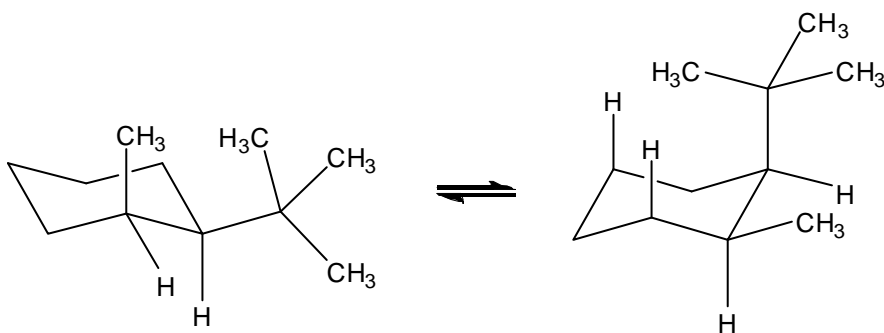
- e. Fill all the other sticks with hydrogens. (If you like.)

To make the other chair, flip the structure just like you would flip a lawn chair; the foot of the chair (my carbon 1) flips up to become the head, and the head flips down to become the new foot:



So where is the equilibrium—which chair is favored? Both conformers have one axial and one equatorial methyl group, so the conformers are equal in energy.

2. Carbon 1 gets a *tert*-butyl group in place of a methyl:



In this case, 1,3-diaxial repulsion between an axial *tert*-butyl group and its axial C-H neighbors (shown in the structure on the right) is much worse than 1,3-diaxial repulsion between the smaller axial methyl group and its axial C-H neighbors (shown on the left). So, the conformation of the left is more stable; it puts the larger, bulkier *tert*-butyl group in the equatorial position.