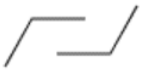
6.8: Diamond Lattice Drawings

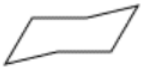
It will be helpful for you to be able to draw cyclohexane in the chair form because it is such a common structural element in natural compounds. Let's look at the way we would most easily draw cyclohexane: it's a six membered ring, a hexagon. Notice that the opposite sides of this ring are parallel. This feature is the key to drawing a chair.

Start by drawing two parallel lines of equal length, one slightly higher than the other and one slightly offset to the side. Most people find it easiest to make this first pair of lines horizontal.

A second pair of parallel lines will connect to these two at an angle, but at opposite ends of the original lines, and going in opposite directions: one upward, one downward.



At one end of the structure, we are beginning to draw the uplifted back of the chair, and at the other end is the downward footrest. Next, bridge the gaps at the two ends of the drawing with another pair of parallel lines.



That's the carbon skeleton of cyclohexane, but for careful conformational analysis we will also need to consider the positions of the hydrogens. Remember that there are three axial hydrogens above the ring and three below. Look at the ring you have drawn: three of the vertices are pointing downward and three are pointing upward. These vertices are pointing the way to the axial hydrogens. Extend these vertices with six parallel lines, three pointing up and three pointing down, from alternating corners.

You have just formed the axial C-H bonds.

Now, the useful thing to know about the drawing is that lines can only be drawn in four different directions. The remaining lines to the equatorial hydrogens will have to be chosen from among these directions. We already have lines in three directions on each carbon; we just need to add a fourth to each. To decide which direction is missing, skip one bond in either direction along the ring and you will find a parallel line.

Finally, remember that the equatorial hydrogens point outward, away from the ring, so keep these lines pointing away from the center of the chair.

This type of drawing is called a diamond lattice drawing, because the all-carbon structure of diamond can be constructed this way by extending the axial and equatorial lines into additional chairs. Diamond lattice drawings can also be used to depict staggered conformations of aliphatic hydrocarbons, but only if you are very careful. Taking a few minutes to practice these drawings now may be helpful before you proceed to the next section.

Exercise 6.8.1

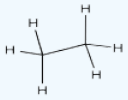
Using the cyclohexane chair as a template, draw diamond lattice representations of the following compounds in staggered conformations. If you have to, draw a whole chair and erase parts until you have only what you need.

a. ethane
b. propane
c. butane in a gauche conformation
d. butane in an anti conformation

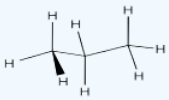
Answer

Template

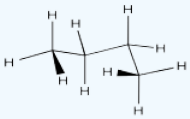
a) Ethane



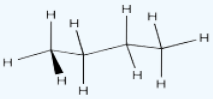
b) Propane



c) Butane in a gauche conformation



d) Butane in an anti conformation



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