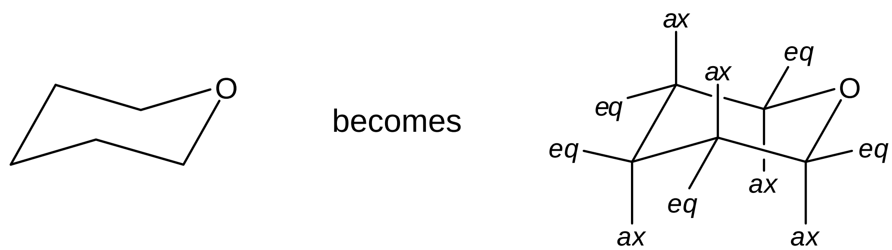
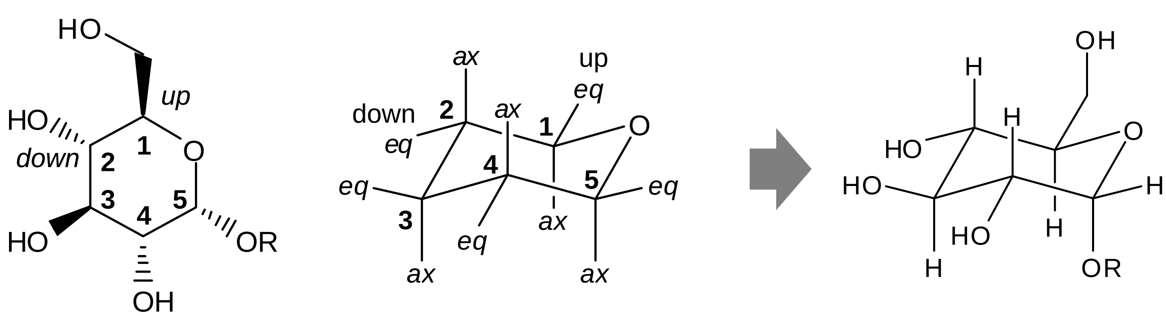
Chemistry 2331H Tuesday, October 1

Workshop 8 Solutions
Cyclohexane Conformers, and Sweetness

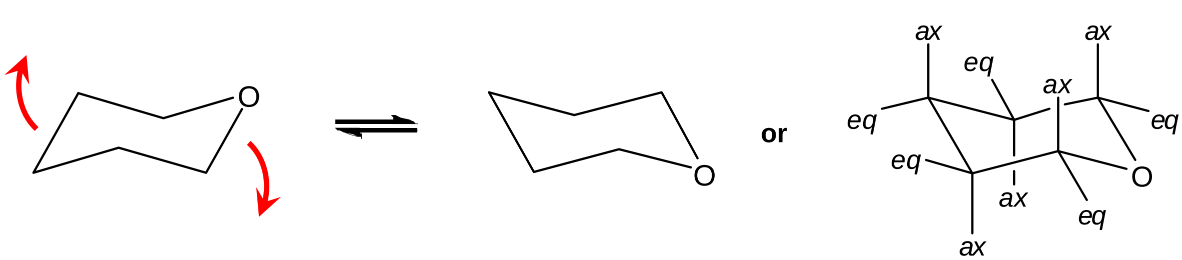
a) The first step in this problem is to draw equatorial and axial sticks on the cyclohexane chair, so we can then add substituents:



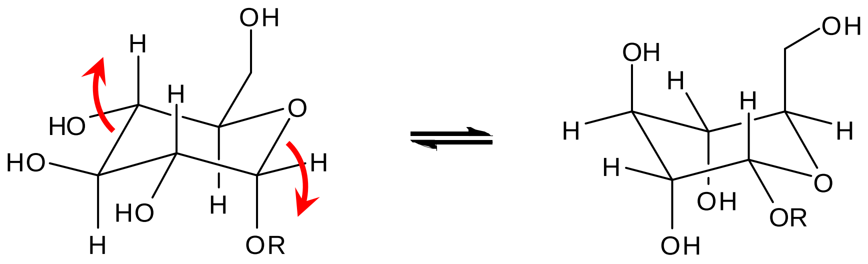
As you look around the ring, sometimes an equatorial stick is above an axial one, and sometimes an axial stick is above an equatorial one. We can map the two-dimensional drawing—with its "up" wedges and "down" dashes—onto this axial/equatorial system in 3-D.



Now, we can flip the chair by pushing the oxygen down and the opposite end up:



When we flip a cyclohexane chair, all axial susbtituents become equatorial, and all equatorial substituents become axial. So,

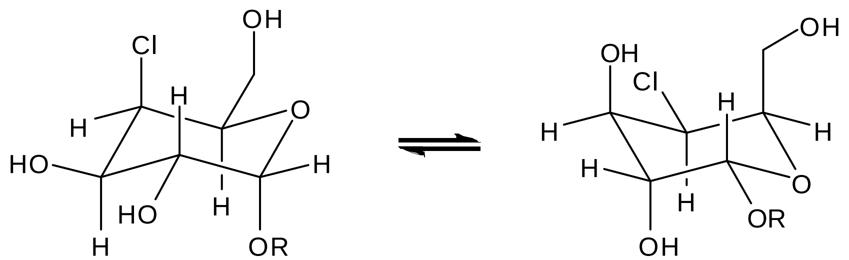


(our first chair)

Note that the "up"-"down" relationships don't change—substituents that were "up" are still "up", and those that were "down" are still "down".

b) Equatorial substituents are always more stable than axial ones. Looking at the two chairs above, the chair on the left has 4 equatorial and 1 axial substituent, while the chair on the right has 4 axial and 1 equatorial substituent. The chair with the fewest axial substituents—the one on the left—should be the most stable.

c)

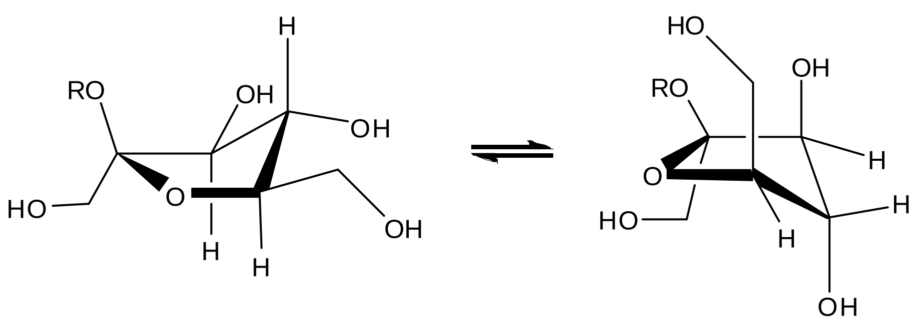


3 equatorial,
2 axial

2 equatorial,
3 axial

Again, I'd bet on the left conformer being more stable.

d)



The left envelope has three equatorial-like substituents on the flap, so it would be more stable.

So, you could put this all together to construct the absolute most stable conformers of the two molecules: