**CHE-2060 Modeling Alkane Conformations**

You’ll need a Molymod kit for this lab. Feel free to work in groups.

***Conformations of Ethane***

Make a staggered model of ethane.

1. Does the model have any planes of symmetry?

(a) How many? Yes, three

1. Where? Three – one connecting each of three H – C – C – H sets

Rotate one carbon atom 60° so that the model becomes eclipsed.

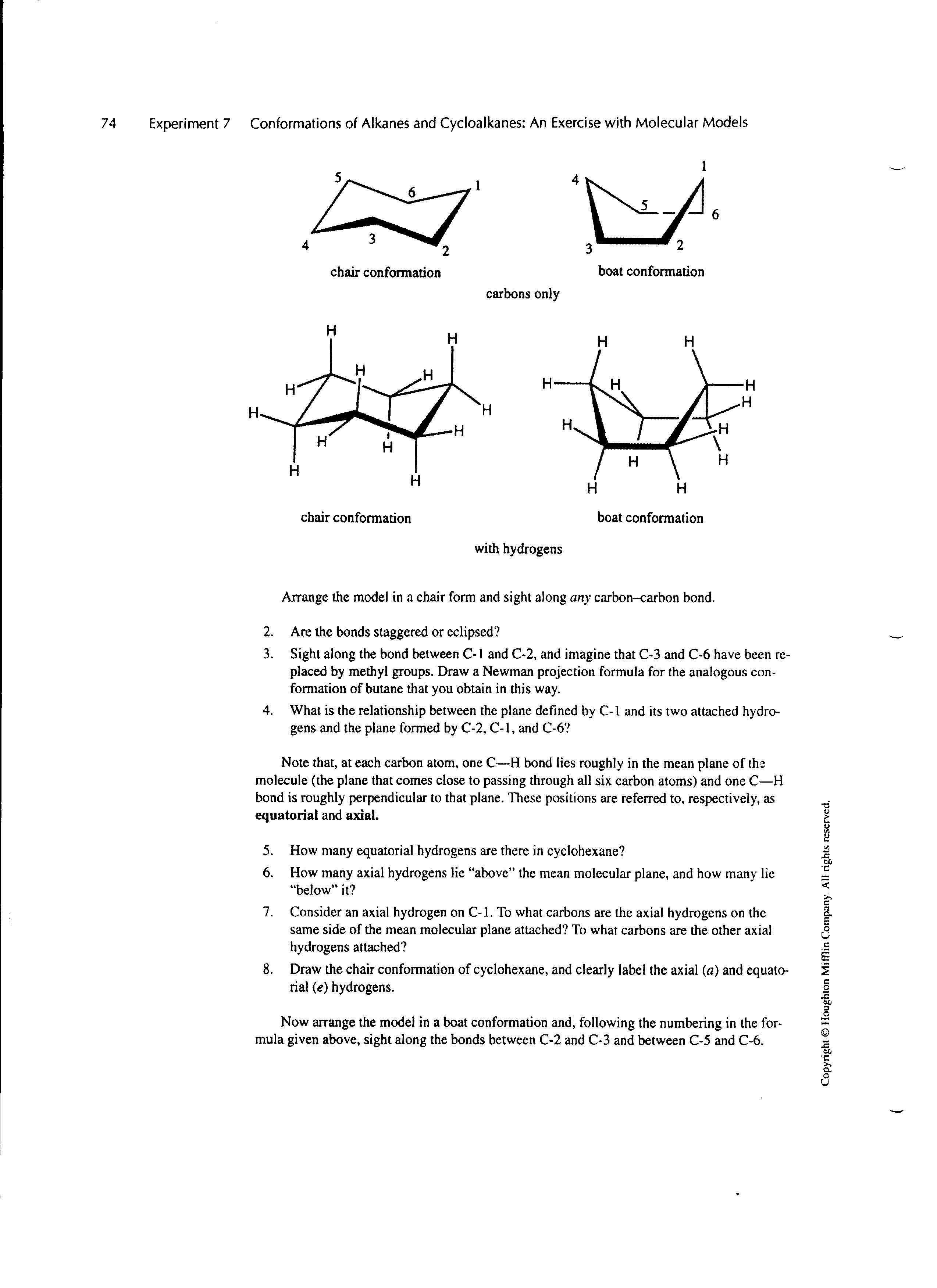
1. Does this model have any planes of symmetry?
2. How many planes of symmetry are present now? Four
3. Where? 1. Between the two carbons; perpendicular to the C-C bond.

2. Between the two hydrogens pointing straight up (0°).

3. Between the two hydrogens at 120°.

4. Between the two hydrogens at 240°.

***Conformations of Cyclohexane***Make a model of cyclohexane and represent hydrogens with bonds or atoms.



Flex the model in to a ***chair*** form.

1. Sight along any C-C bond. Are these two carbons staggered or eclipsed? Staggered

4. How many hydrogens are in equatorial positions? Six – one on each carbon.

1. How many hydrogens are axial? Six – one on each carbon
2. Which are axial and above the ring? Three: carbons 1, 3, 5

(b) Which are axial and below the ring? Three: carbons 2, 4, 6

1. Holding the axial hydrogen on carbon 1, make a list of the carbons whose axial hydrogens are on the same side. Carbons 1, 3, 5
2. List the carbons whose axial hydrogen atoms are located on the other side of the ring.

Carbons 2, 4, 6

Flex the cyclohexane model into the boat form.

1. Sight along the bonds between C2 and C3, and then between C5 and C6
   1. Are C2 and C3 staggered or eclipsed? eclipsed
   2. Are C5 and C6 staggered or eclipsed? eclipsed
2. Which conformation is more stable, chair or boat? Explain why.

The chair conformation is more stable for at least two reasons:  
1) The substitutuents on carbons 1 & 4 are well out of each other’s space; lower steric hindrance.

2) Adjacent carbons of chair are staggered; in boat they are eclipsed.

***Conformations of Substituted Cyclohexanes***

Flex cyclohexane into the chair conformation. Replace one equatorial hydrogen with a chlorine (green).

1. “Flip” the C1 (carbon with the chlorine attached) to make a boat conformer with C1 & C4 as the bow & stern. Is the chlorine now equatorial or axial? equatorial
2. Flex back into the chair conformer and place two chlorines in the equatorial positions on two adjacent carbons, making 1,2-dichlorocyclohexane. Are the chlorines *cis-* or *trans-* to each other? *trans*
3. ‘Flip’ the model into the “other” chair conformer. Are the two chlorines now axial or equatorial? *axial*
4. Are the two chlorines on the same side, or opposite sides, of the mean ring plane?

Opposite sides

1. Are the two chlorines *cis-* or *trans-* to each other? *Trans*
2. Which chair conformer is more stable? Explain why.  
   The chlorines prefer to be in the equatorial positions because this gives them more space (less steric hindrace) than axial positions.
3. Now change the model so that the chlorine at C1 is equatorial and the C2 chlorine is axial. Are the chlorines *cis-* or *trans-* to each other? *cis*
4. ‘Flip’ the model into the other chair conformation. Which chlorine is axial? Which is equatorial? Now the C1 chorine is axial & the C2 chlorine is equatorial.
5. Are the chlorines *cis-* or *trans-* to each other? *cis*
6. Which chair conformation is more stable? Explain why. *Equally stable*
7. Which is more stable, *cis*- or *trans-*1,2-dichlorocylcohexane? Explain why.  
   *Trans where both chlorines are equatorial.*
8. Now change the model so that it is 1,3,5-trichlorocyclohexane. Are the chlorines *cis*- or *trans-* to each other?  
   Cis if all axial or all equatorial.
9. ‘Flip’ the model into the other chair conformation. Is the chlorine at C1 axial or equatorial now? What about the chlorine at C2?   
   If they were axial before, they are all equatorial now, and this (all equatorial) is the more stable conformation.