Chemistry 235
Experiment 7 – Stereochemistry Exercises

Name:	**Lab Room:**	**Desk #:**

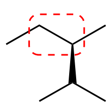
Complete the stereochemistry exercises below. Not all questions require a written answer.

Conformations of Acyclic Alkanes

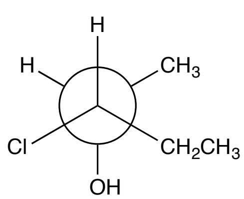
1. Build a molecular model of pentane. Viewing along the C2-C3 bond, rotate your bonds in order to make the following conformations. Draw each of these conformations below
   a. Staggered, anti   b. Staggered, gauche   c. eclipsed

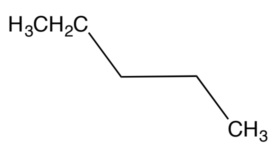
   Of the three conformations above, which is the most stable? Least Stable?

2. Build a molecular model of the compound shown below. Viewing along the indicated bond, rotate the bonds in the molecule to make the most stable conformation. Draw the Newman projection for this most stable conformation.



3. Build a molecular model of the compound shown below. Look at the molecule from multiple directions in order to see the perspective of the Newman projection and the perspective for a typical 3D representation. Complete the bond-line structure below showing 3-dimensionality.





Conformations of Cycloalkanes

4. Build molecular models of cyclobutane and cyclopentane.
   a. What are the approximate bond angles in each?

   b. See if you can find the torsional strain that is present in cyclobutane.
   c. Take your model of cyclopentane and twist the atoms so that you make an envelope shape. Can you see how this envelope shape helps relieve torsional strain?

5. Build a molecular model of methylcyclohexane.
   a. Look at the molecule from the side and see if you can identify the chair structure. You may need to twist the atoms and bonds a bit to get a correct chair. Draw the chair structure below.

   b. In this structure is your methyl group axial or equatorial?

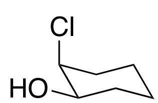
   c. Move the atoms in the model to make the boat conformation. Can you see why the boat conformation is higher in energy than the chair?
   d. Move the atoms again to convert the boat to the other chair conformation. Is the methyl in this conformation axial or equatorial? Draw this chair structure below.

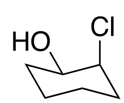
   e. In the conformation that has the methyl axial, try to identify the 1,3-diaxial interactions.

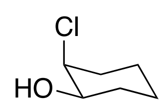
6. Build models of *cis*-3-methylcyclohexanol and *trans*-3-methylcyclohexanol. Look at both chair conformation of each. Draw these chair conformations below.

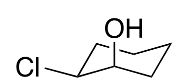
   a. Which conformation for each molecule is the most stable?
   b. Which isomer of 3-methylcyclohexane do you think is overall more stable?

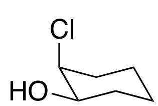
7. Build models of each pair of chair cyclohexanes below. Compare the two models in each set and determine whether they are identical or stereoisomers. You are allowed to do a ring-flip to see if you can get the molecules to match.

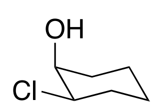
(a) 

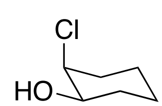
and 

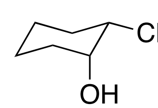
(c) 

and 

(b) 

and 

(d) 

and 

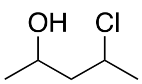
8. Build models of *cis*-1,2-dichlorocyclopentane and *trans*-1,2-dichlorocyclopentane.
   a. Identify the chiral centers in each.
   b. Classify each molecule as chiral or achiral. If you have trouble deciding, build models of the mirror images and see if they are superimposable.

Enantiomers and Diastereomers

9. Build a model of CH_2BrCl. Next, build a model of the mirror image of your first molecule. How are these models related?

10. Build a model of CHBrClF. Next, build of model of the mirror image of your first molecule. How are these molecules related?

11. Consider the molecule shown below.

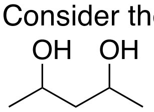


a. How many stereoisomers are possible? *Recall: the maximum number of stereoisomers is equal to 2^n, where n = number of stereogenic centers.*

   b. Draw each of the possible stereoisomers.

   c. Identify pairs of enantiomers and pairs of diastereomers.
   d. Build a model of the stereoisomer that has both the OH group and the Cl pointing out. Also, build a model of the mirror image of this molecule.
   e. Do your two molecules represent enantiomers? Are they chiral?

12. Consider the molecule shown below.



a. How many stereoisomers are possible?

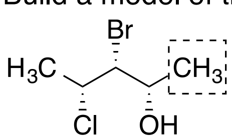
   b. Draw each of these stereoisomers.

   c. Identify pairs of enantiomers and pairs of diastereomers.
   d. Build a model of the stereoisomer that has both OH groups pointing out. Also, build a model of the mirror image of the molecule.
   e. Do your two molecules represent enantiomers? Are they chiral?

Fischer Projections

13. Build a model of 1-bromo-1-chloroethane.
   a. Draw a 3D representation of this molecule.
   b. Assign an R/S configuration to your molecule.
   c. Draw four different, but correct Fischer projections for this molecule.
   d. Build a model of the other enantiomer and draw a Fischer projection of this molecule.

14. Build a model of the molecule shown below.



   a. Rotate the bonds of your molecule so that five-carbon chain of the molecule is curved away from the viewer. This will make up the vertical backbone of your Fischer projection.
   b. Placing the boxed CH_3 at the top, try to visualize flattening out your molecule to form a Fischer projection.
   c. Draw the Fischer projection and the enantiomer.
   d. Assign R/S configurations to each chiral center.

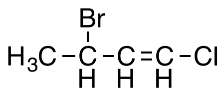
Alkenes and Stereoisomerism

15. Build and draw two different models of 2-butene. This is a four-carbon chain with a double bond between carbons 2 and 3.

    a. These two models are stereoisomers. What is their relationship? Enantiomers, diastereomers, something else?

    b. Classify the two models as cis- and trans-

16. Build a model of the compound shown below.



    a. Draw the 3D representation that you built.

    b. Draw the enantiomer of this molecule.

    c. Draw a diastereomers of this molecule.

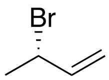
    d. How many stereoisomers are possible for this molecule.

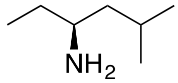
    e. How many chiral (asymmetric) centers are present?

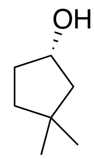
    f. How many stereogenic centers are present?

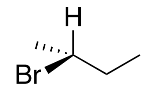
Assigning R and S Configuration

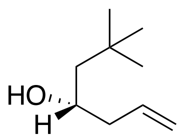
17. Assign the R/S configuration to each chiral center below. If you have difficulty, try building a molecule.

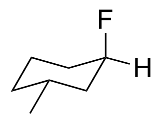


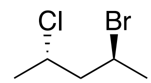












Symmetry and Chirality

18. Identify all chiral centers in each molecule below. Determine whether each molecule is chiral or achiral. If the achiral molecules are meso, classify them as such.