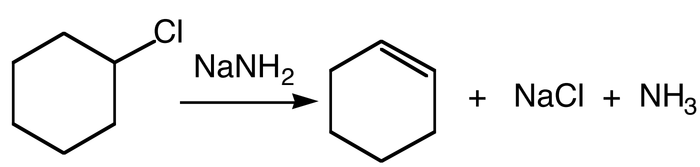
Homework problems –Chapter 5

1. In your textbook (Organic Chemistry by Maitland Jones, Jr): 5.35-5.41, 5.45 and 5.48.

2. Assume that you have a variety of cyclohexanes substituted in the positions indicated. Identify the substituents as either axial or equatorial. For example, a 1,2-*cis* relationship means that one substituent must be axial and one equatorial, whereas a 1,2- *trans* relationship means that both substituents are axial or both are equatorial.
   (a) 1,3-trans disubstituted
   (b) 1,4-cis disubstituted
   (c) 1,5–trans disubstituted
   (d) 1,3-cis disubstituted
   (e) 1,5-cis disubstituted
   (f) 1,6-trans disubstituted

3. Draw the two chair conformations of 1,1,3-trimethylcyclohexane and estimate the amount of strain energy in each. Which conformation is favored?
4. We will see later that alkyl halides undergo an elimination reaction to yield alkenes on treatment with strong base. For example, chlorocyclohexane gives cyclohexene on reaction with $NaNH_2$.



   If axial chlorocyclohexanes are generally more reactive than their equatorial isomers, which do you think will react faster, *cis*-1-*tert*-butyl-2-chlorocyclohexane or *trans*-1-*tert*-butyl-2-chlorocyclohexane? Explain why!
5. One of the two chair structures of cis-1-chloro-3-methylcyclohexane is more stable than the other by 3.7 kcal/mol. Which is it? What is the energy cost of a 1,3-diaxial interaction between a chloride and a methyl group?
6. Draw *trans*-1,4-dimethylcyclohexane in its two chair conformations, and determine whether the two chairs are identical, conformational enantiomers, or conformational diastereomers. Then do the same for the *cis* isomer.
7. Given that one 1,3-diaxial interaction of isopropyl and hydrogen costs 1.1 kcal/mol in energy, calculate the ratio of axial to equatorial isopropylcyclohexane that is present at room temperature.