Week 2 Worksheet

Objectives:

Chapter 7

➢ Draw mechanisms for, and differentiate between, $S_n1$ and $S_n2$ reactions
➢ Explain trends in nucleophilicity, basicity, carbocation stability, reactivity of alkyl halide reagents, and either polar protic or polar aprotic solvent choices
➢ Utilize alkyl halides and various other organic reagents for organic synthesis of novel compounds

Problem Set:

1. Rank the species in each group in order of increasing nucleophilicity.
   a. $\cdot$OH, F$^-$, Cl$^-$ in acetone
   b. HS$^-$, F$^-$, Cl$^-$ in CH$_3$OH
   c. CH$_3$CH$_2$S$^-$, CH$_3$CH$_2$O$^-$, CH$_3$CO$_2$- in CH$_3$OH

2. Rank the carbocations in each group in order of increasing stability.
   a. 
   b.
3. Draw the products of each $S_N1$ reaction and indicate the stereochemistry when necessary.

a. 

\[ \text{alkyl} : \text{Br} : \quad \text{OH} \]

b. 

\[ \text{cyclohexyl} : \text{Br} : \quad \text{H}_2\text{O} \]

4. Draw the mechanism of nucleophilic substitution of each reaction and draw the products, including stereochemistry.

a. 

\[ \text{alkyl} : \quad \text{alkyl} \quad \text{OH} \]

b. 

\[ \text{cyclopentyl} : \text{Br} : \quad \text{alkoxide} \]
5. Consider the following SN2 reaction:

\[ \text{alkyl halide} + \text{CN}^- \rightarrow \text{alkyl cyanide} + \text{halide}^- \]

a. Draw the mechanism using curved arrows.
b. Draw the structure of the transitioned state.
c. What is the rate equation?
d. What happens to the reaction rate in each of the following instances? [1] The leaving group is changed from Br\(^-\) to I\(^-\); [2] The solvent is changed from acetone to CH\(_3\)CH\(_2\)OH; [3] The alkyl halide is changed from CH\(_3\)(CH\(_2\))\(_4\)Br to CH\(_3\)CH\(_2\)CH\(_2\)CH(Br)CH\(_3\); [4] The concentration of – CN is increased by a factor of five; and [5] The concentrations of both the alkyl halide and – CN are increased by a factor of five.