Problem Set 6

1. Read Chapter 6 Section 7: You are responsible for understanding the difference between nucleophilic substitution and elimination reactions. What are the products of nucleophilic substitution and elimination? How do you recognize when substitution or elimination of an alkyl halide has occurred?

   Work the following problems found in Section 7 of Chapter 6: **Problems 11 and 12.**

2. Read Chapter 6 Section 8: You should be familiar with the S_N2 reaction (2^{nd}-order nucleophilic substitution), the general reaction mechanism, why S_N2 reactions lead to inversion of configuration in products that have a stereocenter, what the transition state for S_N2 reactions looks like, the energy profile for S_N2 (concerted) reactions, the rate equation for S_N2 reactions and why the rate of S_N2 reactions depends on the concentration of both the substrate (alkyl halide) and nucleophile. Study Figure 6-5 and Key Mechanism 6-2 for the S_N2 reaction.

   Work the following problem found in Section 8 of Chapter 6: **Problem 13.**

3. Read Chapter 6 Section 9: You are responsible for knowing that S_N2 reactions are ubiquitous and can be used to generate products featuring a wide range of functional groups based on the nucleophile that is used. Examine the Summary of S_N2 reactions of alkyl halides.

   Work the following problems found in Section 9 of Chapter 6: **Problems 14 and 15.**

4. Read Chapter 6 Section 10: You should be familiar with the factors that affect the strength of nucleophiles—namely, whether the nucleophile is negatively charged or neutral, whether the nucleophile contains bulky substituents that cause it to be sterically hindered, and the influence of solvent in solvating or not solvating the nucleophile (i.e., polar protic vs. polar aprotic). You should be familiar with the term nucleophilicity and know the trends in nucleophilicity. Study Table 6-3 and the Summary of trends in nucleophilicity.

   Work the following problem found in Section 10 of Chapter 6: **Problem 16.**

5. Read Chapter 6 Section 11: You should be familiar with factors that affect the reactivity of the substrate (alkyl halide)—namely, the leaving group and the degree of substitution on the carbon bearing the halide (steric effects). What makes a good leaving group? What makes a poor leaving group? Keep in mind that good leaving groups are atoms or groups that are the conjugate bases of strong acids that are able to stabilize negative charge. Why are 1° alkyl halides more reactive toward nucleophiles compared to 2° and 3° alkyl halides?

   Work the following problems found in Section 11 of Chapter 6: **Problems 17-19.**

6. Read Chapter 6 Section 12: You are responsible for knowing why S_N2 substitution on 2° alkyl halides with two different alkyl groups leads to inversion of configuration at the stereocenter of the resulting chiral product. Why are concerted S_N2 reactions on 2° alkyl halides stereospecific, leading to a single chiral product? In contrast, later on we will examine two-step S_N1 reactions involving a carbocation intermediate that results in formation of racemic products where the stereochemistry is scrambled.

   Work the following problems found in Section 12 of Chapter 6: **Problems 20 and 21.**

   Work the following problems found at the back of Chapter 6: **Problems 33, 35-37, 39, 44a, 45-47, 49 and 55.**