Week 3 Worksheet

1. For the following SN 2 reaction

\[
\begin{array}{c}
\text{H} \\
\text{D} \\
\text{Et} \\
\text{Br} \\
\end{array} + 
\begin{array}{c}
\text{I}^- \\
\end{array}
\]

a) Label the alkyl halide and the nucleophile in this reaction.

b) Draw the correct mechanism clearly with curvy arrow notation.

c) Draw out the organic products indicating correct stereochemistry of products.

d) What type of alkyl halide is depicted in the reactant?

e) Is there any beta-branching in this molecule?

f) Write the rate law of the reaction. Is this reaction bimolecular or unimolecular?

\[
\text{g) Draw the energy diagram for this SN2 reaction, labeling Ea, } \Delta \text{H.}
\]
2. Circle the solvent that would lead to the slowest SN2 reaction.

   DMSO, acetone, methanol

3. Rank the molecules by increasing alkene stability with 4 being the most stable.

4. (From previous midterm) Identify whether each substrate favors SN1, SN2, or both.

5. (From previous midterm) Answer the following set of questions based on the given table.

<table>
<thead>
<tr>
<th>Nucleophile</th>
<th>Relative Rate of SN2 Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₂O</td>
<td>1</td>
</tr>
<tr>
<td>Cl⁻</td>
<td>23,500</td>
</tr>
<tr>
<td>NH₃</td>
<td>316,000</td>
</tr>
<tr>
<td>N₃⁻</td>
<td>630,000</td>
</tr>
<tr>
<td>HO⁻</td>
<td>3,163,000</td>
</tr>
<tr>
<td>I⁻</td>
<td>25,100,000</td>
</tr>
</tbody>
</table>
a. List two nucleophiles from the table that are good nucleophiles and weak bases. __________
b. List one nucleophile from the table that is a good nucleophile and a strong base. __________
c. Which compound from the table is the best leaving group? __________
d. Which compound from the table is the worst nucleophile in an $S_n^2$ reaction? __________
e. If the solvent was changed to DMSO (polar aprotic), which halide ion from the table would be the strongest nucleophile? __________

6. (From previous midterm) Rank the following in order of decreasing carbocation stability (1 = most stable carbocation)

7. (From previous midterm) For the following substitution reaction:

a. Is this reaction SN1 or SN2? __________
b. Use curvy arrows to show the mechanism for this reaction. Include all lone pairs and charges.

8. (From previous midterm) For the following substitution reaction:
a. Draw the reaction using curvy arrows. Don’t forget to draw lone pairs. (Hint: pay attention to the alkyl halide and the solvent)

b. Draw the correct product of the reaction. Pay attention to stereochemistry if necessary!

c. Draw the structure of the transition state for this reaction. Include any partial charges.

d. Is this a reversible reaction? 

9. Propose appropriate reagents and an appropriate solvent to obtain the following product:

10. (From Previous Midterm) Propose an alkoxide and alkyl halide of the for the synthesis of the following compound: