Midterm 1 Review Worksheet

Topics Covered:
- Sn2, E2, Sn1, and E1 reaction properties and trends
- Nucleophilicity trends
- Reaction rates for Sn2, Sn1, E2, and E1
- Fill in the starting material, reagents, or products of the four reaction types
- Arrow pushing mechanisms
- Predict Reaction Equilibrium
- Synthesis

Chapter 7

Multiple Choice

1. Which of the following molecules would react the FASTEST with KCN?

   a) \( \text{Br} \)  
   b) \( \text{Br} \)  
   c) \( \text{Br} \)  
   d) \( \text{F} \)

2. Which of the following is a polar, aprotic solvent?

   A) \( \text{OH} \)  
   B) \( \text{NH}_2 \)  
   C) \( \)  
   D) \( \text{SO} \)
3. Rank the following reactions from the slowest to the fastest:

\[
\begin{align*}
\text{I} & \quad \text{CH}_3\text{Cl} + \text{NaF} \xrightarrow{\text{H}_2\text{O}} \quad \text{III} & \quad \text{CH}_3\text{Cl} + \text{NaI} \xrightarrow{\text{H}_2\text{O}} \\
\text{II} & \quad \text{CH}_3\text{Cl} + \text{H}_2\text{O} \xrightarrow{} \quad \text{IV} & \quad \text{CH}_3\text{Cl} + \text{NaOH} \xrightarrow{\text{DMSO}}
\end{align*}
\]

A. I < IV < III < II    B. IV < III < II < I    C. II < I < III < IV    D. I < II < III < IV

**Mechanisms**

1. Predict the substitution products and draw the curved-arrow mechanisms for the reactions below.

a)

\[
\begin{align*}
\text{H} \quad \text{D} & \quad \text{Na}^+ & \quad \text{O} \\
\text{Br} & \quad & \text{Cyclohexane}
\end{align*}
\]
Chapter 8

Multiple Choice

1. Which is the major product of the following reaction?

\[
\begin{align*}
\text{Br} & \quad \text{H}_2\text{O} \\
& \quad \text{heat} \\
\end{align*}
\]

\[\text{Cl}\]

\[
\begin{align*}
\text{NaOEt} & \\
\end{align*}
\]

\[
\begin{align*}
a) & \quad b) & \quad c) & \quad d) \\
\end{align*}
\]
2. Which of the following is NOT a possible product of the following reaction?

![Chemical structure](image)

- a) ![Structure a](image)
- b) ![Structure b](image)
- c) ![Structure c](image)
- d) ![Structure d](image)

3. Rank the following alkenes by decreasing stability.

- ![Alkene I](image)
- ![Alkene II](image)
- ![Alkene III](image)
- ![Alkene IV](image)

- A. I > II > III > IV
- B. II > III > I > IV
- C. IV > II > I > III
- D. II > I > III > IV
Mechanisms

4. Draw a curved-arrow mechanism that shows the formation of the major product. Draw any additional minor products.

![Mechanism 4](image)

5. Draw a curved-arrow mechanism that shows the formation of the major alkene product. Draw any additional minor products.

![Mechanism 5](image)
When is it SN2/SN1/E1/E2?

<table>
<thead>
<tr>
<th>Substrate</th>
<th>Solvents</th>
<th>Base (Nucleophilic)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Protic</td>
<td>Aprotic</td>
</tr>
<tr>
<td>CH₃-X</td>
<td></td>
<td>Strong</td>
</tr>
<tr>
<td>1° Alkyl Halide</td>
<td></td>
<td>Bulky</td>
</tr>
<tr>
<td>2° Alkyl Halide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3° Alkyl Halide</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Multiple Choice

1. Select the favored mechanism(s) of the following reaction.

A. E2
B. SN2
C. E1 and SN1
D. E2 and SN2
2. Which of the following reactions is the LEAST LIKELY to occur?

a) \[
\text{Cl} \quad \xrightarrow{\text{NaOH}} \quad \text{OH}
\]

b) \[
\text{Br} \quad \xrightarrow{\text{MeOH}} \quad \text{O}
\]

c) \[
\text{I} \quad \xrightarrow{\text{NaOEt}} \quad \text{O}
\]

d) \[
\text{Br} \quad \xrightarrow{\text{KN_3}} \quad \text{N}_3
\]

3. Select the correct rate law for the following reaction.

\[
\text{Br} \quad \xrightarrow{\text{NaOCH}_3, \text{CH}_3\text{OH}}
\]

A. rate = \( k [\text{Br} \text{Br} ] \)

B. rate = \( k [\text{NaOCH}_3][\text{Br} \text{Br} ] \)

C. rate = \( k [\text{CH}_3\text{OH}][\text{Br} \text{Br} ] \)

D. rate = \( k [\text{NaOCH}_3][\text{CH}_3\text{OH}] \)
Fill in the Blank

Fill in the box with the appropriate starting material, reagent, or major product.

\[
\text{Cl} \quad \text{KOTBu} \quad \text{Blank}
\]

\[
\text{CH}_3\text{Br} \quad \text{Blank} \quad \text{Blank}
\]

\[
\text{Blank} \quad \text{CH}_3\text{OH} \quad \text{Blank}
\]

\[
\text{Blank} \quad \text{NaH} \quad \text{Blank}
\]
Equilibrium

\[
\text{CH}_3\text{CH}_2\text{CH}_2\text{Br} + I^- \rightleftharpoons \text{CH}_3\text{CH}_2\text{CH}_2\text{I} + Br^- 
\]

For the reaction above, predict the side favored by equilibrium in the following solvents:

a. Water

b. THF

Mechanism

Draw a step-wise mechanism for the following reaction.

\[
\text{OCH}_2\text{CH}_2\text{I} + \text{NaOH} \rightarrow \text{C}_3\text{H}_6\text{O}
\]
Synthesis

Compose a multi-step synthesis using any necessary reagents to go from starting material to product.