1. (2 pts) Circle the least reactive compound in an SN2 reaction. Indicate the reason as steric, inductive and/or resonance.

Reason: **Steric, 2° carbon**

2. (2 pts) Circle the least reactive compound in an SN1 reaction. Indicate the reason as steric, inductive and/or resonance.

Reason: **Inductive, F⁻ bad LG**

3. Consider the reaction below to answer the following questions:

![Chemical reaction diagram]

A. (2 pts) Compound B is the: (circle correct answer)
   a. SN2 product
   **b. SN1 product**
   c. E2 product
   d. E1 product

B. (2 pts) Compound C is the: (circle correct answer)
   a. SN2 product
   b. SN1 product
   c. E2 product
   **d. E1 product**
4. Consider this reaction for the following question:

\[ \begin{align*}
\text{Br} & \quad \text{OH} \\
\text{or} & \\
\text{Br} & \quad \text{CH}_3
\end{align*} \rightarrow \text{E2 product} \]

(10 pts) Draw the saw-horse projection leading to product. Put the number 1 carbon "in front" and number 2 carbon "in back". Draw the product as well.

5. (4 pts each) Draw the structure(s) of the major organic product(s) for each of the following reactions. If a product is made by SN1, SN2, E1 or E2 indicate. Also indicate the stereochemistry for each reaction when appropriate.

a. \[ \begin{align*}
\text{OCH}_3 & \quad \text{E1} \\
\text{most minor} & \\
\text{major} & \\
\text{minor}
\end{align*} \]

b. \[ \begin{align*}
\text{SN1} & \\
\text{racemic}
\end{align*} \]

c. \[ \begin{align*}
\text{SN2} & \\
\text{inversion}
\end{align*} \]
d. 

\[ \text{KOH-DMS} \rightarrow \text{isopropanol} \]

\[ \text{Bulky} \]

\[ \text{E2} \text{ and E1 as well} \]

Chair where 1,2-diaxial can happen

\[ \text{TsOH} \]

\[ \text{pyridine} \]

f. 

\[ 1. \text{O}_2, \text{CH}_2\text{Cl}_2 \]

\[ 2. \text{Zn, HOAc} \]

ODeuctive

\[ \text{Mark product.} \]

g. 

\[ 1. \text{Hg(OAc)}_2/\text{H}_2\text{O} \]

\[ 2. \text{NaBH}_4 \]

\[ \text{Mark product.} \]

h. 

\[ 1. \text{BH}_3-\text{THF} \]

\[ 2. \text{H}_2\text{O}_{2}, \text{NaOH, H}_2\text{O} \]

\[ \text{Anti Mark product.} \]
6. (10 pts) Provide curved arrows AND charges for the following reaction:

Indicate the stereochemistry of the middle structure and the product below by adding a hydrogen and a methyl to the left structure. Add a hydrogen and OH to the right structure.
7. (20 pts) Use the templates provided to control the stereochemistry. Populate with hydrogens, carbons and charges as needed. Assign R/S to each product in the saw-horse structures. Assign the stereo-chemical relationships between products.

\[
\begin{align*}
\text{Br}_2 & \quad \text{MeOH} \\
\text{attack at } 2 & \\
\text{attack at } 3 & \\
\text{attack at } 3 & \\
\end{align*}
\]
8. (10 pts) Using any reactions you know make the following product through a multi step synthesis. Indicate reagents and conditions but not mechanisms.

\[ \text{PROBLEM IMAGE} \]

- Anti \textit{Markovnikov} addition
- \[ \text{BH}_3 \cdot \text{THF} \]
- \[ \text{H}_2\text{O}_2 / \text{OH}^- \cdot \text{H}_2\text{O} \]
- \[ \text{NaI acetone (SN2)} \]