1. (4 pts) Which of the following reactions involve inversion of configuration?

- R-2-bromohexane $\rightarrow$ S-2-iodobutane
- R-3-bromo-3-methylhexane $\rightarrow$ R-2-bromohexane

a) I, II  b) III, IV  c) II, III  d) I, IV  e) I, II, III

2. (10 pts, 5 each) A) Give the structure of the major organic product in each of the following substitution reactions, and B) predict whether the mechanism will be predominantly 1st order (S_N1) or second order (S_N2). Be sure to show the correct stereochemistry of the product when necessary. If the product is a racemic mixture, draw both enantiomers.

   a) $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\Delta} \text{Cyclic product}$

   b) $\text{CH}_3\text{CH}_2\text{CH}_2\text{I} \xrightarrow{\text{NaCN, DMSO}} \text{Linear product}$

3. (10 pts, 5 each) A) Give the structure of the major organic product in each of the following elimination reactions, and B) predict whether the mechanism will be predominantly first order (E1) or second order (E2). BE SURE TO SHOW THE CORRECT STEREOCHEMISTRY OF THE PRODUCT WHEN NECESSARY.
4. (10 pts) Write the complete mechanism for the following substitution reaction that explains the formation of the products given.

5. (8 pts) a) Explain WHY the syn addition product is the only product obtained when 1-methylcyclohexene undergoes hydroboration by 9-BBN. (Please show the mechanism of this hydroboration to aid in your explanation).

b) Please explain the regioselectivity of the 9-BBN addition.

The addition of 9-BBN is a concerted reaction. The B-H adds only to one face of the alkene to give the syn addition product.

b) The bulky 9-BBN adds to the less-hindered side of the alkene (regioselectivity) because it is so bulky. Also, the hydride adds to more substituted carbon (3°, more stable) because of the steric hindrance.
6. (2 pts) The IUPAC name of the following compound is 1-chloroethene.

Another way to name this compound (the common name) is vinyl chloride.

7. (3 pts) Which of the following is the optimum set of conditions for an E1 reaction of t-butyl bromide?

<table>
<thead>
<tr>
<th>nucleophile/solvent</th>
<th>temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) CH₃OH</td>
<td>25°C</td>
</tr>
<tr>
<td>(b) CH₂OH</td>
<td>80°C</td>
</tr>
<tr>
<td>(c) CH₃O⁻, CH₃OH</td>
<td>25°C</td>
</tr>
<tr>
<td>(d) CH₃CH₂O⁻, DMSO</td>
<td>25°C</td>
</tr>
<tr>
<td>(e) CH₃CH₂O⁻, DMSO</td>
<td>80°C</td>
</tr>
</tbody>
</table>

8. (4 pts) Give the major product of the following reaction:

\[
\text{Butyl halide} \xrightarrow{\text{strong base}} \text{alkene}
\]

9. (3 pts) One of the isomers of 1-chloro-2-methylcyclohexane gives a single E2 elimination product upon reaction with potassium tert-butoxide. What is the reactive conformation of this isomer?

10. (5 pts) Explain WHY, in the acid-catalyzed addition of water to 2-methyl-1-propene, the major product is 2-methyl-2-propanol and not 2-methyl-1-propanol.
11. (6 pts, 3 each) Which compound in each of the following pairs will react faster in an S$_{N}$2 reaction with OH$^-$? (Circle answer) Briefly explain why you chose your answer.

- CH$_3$CH$_2$I in ethanol or CH$_3$CH$_2$I in dimethyl sulfoxide

- H$_2$C=CHBr or H$_2$C=CHCH$_2$Br

12. (4 pts) The name (E)-1-isopropyl-1-butene is incorrect. Explain why it is incorrect and give the correct IUPAC name.

- Correct name: (E)-2-methyl-3-hexene

13. (28 pts, 4 each) Give the structure of the major organic product of each of the following reactions. Clearly indicate stereochemistry where appropriate. If the major product is a pair of enantiomers, only draw one of the two structures.

- a) Acid-catalyzed hydration

- b) Anti-Addition

- c) Raney Nickel
14. (3 pts) Draw the bromonium ion intermediate formed when Br₂ reacts with 2-methyl-1-propene.