1. Identify the reagents a-c in the following scheme: (8%)

![Chemical structure](image)

2. Assign R or S configurations to the chirality centers in the following molecules: (6%)

(a) ![Chemical structure](image)
(b) ![Chemical structure](image)
(c) ![Chemical structure](image)

3. Order each of the following sets of compounds with respect to $S_{N}2$ reactivity. (4%)

(a) CH₃CH₂CH₂OCH₃, CH₃CH₂CH₂OTos, CH₃CH₂CH₂Br
(b) (CH₃)₂CHCH₂Br, (CH₃)₂CCH₂Br, CH₃CH₂CH₂Br

4. Predict the products of the following reactions (the aromatic ring is unreactive in all cases). Indicate regiochemistry when relevant. (10%)

(a) ![Chemical reaction](image)
(b) ![Chemical reaction](image)
(c) ![Chemical reaction](image)
(d) ![Chemical reaction](image)
(e) ![Chemical reaction](image)

5. Predict the product(s) of the following reactions: (8%)

(a) ![Chemical reaction](image)
(b) ![Chemical reaction](image)
(c) ![Chemical reaction](image)
(d) ![Chemical reaction](image)
1. Predict the products for the reaction (HNO₃, H₂SO₄) of the following compounds (10%):

\[ 
\text{Br-} + \text{Cl}_2 \xrightarrow{\text{HNO}_3, \text{H}_2\text{SO}_4} \text{Cl}_2 + \text{Br} \quad \text{(q)}
\]

2. Write the detailed steps (mechanism) for the following reactions (8%):

\[ 
\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4\text{OH} \quad \text{(a)}
\]

10. Which reaction in each of the following pairs is more nucleophilic (6%):

\[ 
\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4\text{OH} \quad \text{(a)}
\]

8. What products would you expect from the reaction of 1-bromopropane with each of the following reagents (12%):

\[ 
\text{p} \text{. The Sn2 displacement by HCl} \quad \text{q} \text{. The Sn2 displacement by HNO}_3 \text{. H}_2\text{SO}_4 \quad \text{r} \text{. The Sn2 displacement by a proton} \quad \text{s} \text{. The Sn2 displacement by HCl} \quad \text{t} \text{. The Sn2 displacement by HNO}_3 \text{. H}_2\text{SO}_4 \]

6. Which reaction in each of the following pairs would you expect to be faster (8%):

\[ 
\text{p} \text{. The Sn2 displacement by HCl} \quad \text{q} \text{. The Sn2 displacement by HNO}_3 \text{. H}_2\text{SO}_4} \quad \text{r} \text{. The Sn2 displacement by HCl} \quad \text{s} \text{. The Sn2 displacement by HNO}_3 \text{. H}_2\text{SO}_4} \]

7. Predict the products from reaction of 1-heptene with the following reagents (12%):

\[ 
\text{p} \text{. The Sn2 displacement by HCl} \quad \text{q} \text{. The Sn2 displacement by HNO}_3 \text{. H}_2\text{SO}_4} \quad \text{r} \text{. The Sn2 displacement by HCl} \quad \text{s} \text{. The Sn2 displacement by HNO}_3 \text{. H}_2\text{SO}_4} \]

6. Assign E or Z configuration to each of the following alkene: (8%)

\[ 
\text{E} \quad \text{Z}
\]