Consider the following compounds.

1. Which of the three compounds is the most acidic?
2. Which of the three compounds is the least acidic?

Consider the following compounds

3. Which of the three compounds is the most basic?
4. Which of the three compounds is the least basic?

Consider the following compounds.

5. Which of the three compounds is the most reactive with respect to $\Theta$OH in water.
6. Which of the three compounds is the least reactive with respect to $\Theta$OH in water.

Consider the following compounds.

7. Predict the product of the following reaction sequence.

8. Predict the product of the following reaction sequence.
Consider the following compounds.

9. Predict the product of the following reaction sequence.

\[
\text{HO-CH₂-CH₂-CH₂-OH} \xrightarrow{\text{H}^+} \text{carboxylic acid}
\]

10. Predict the product of the following reaction sequence.

\[
\text{NaOEt} \xrightarrow{\text{NaOH}} \xrightarrow{\text{HCl}} \text{ester}
\]

Consider the following compounds.

11. Predict the product of the following reaction sequence.

\[
\text{H}_2\text{SO}_4/\text{HNO}_3 \xrightarrow{1. \text{Fe/HCl}} \text{NO}_2/\text{HCl} \xrightarrow{\text{Cu}_2\text{O}, \text{Cu}^{+2}, \text{H}_2\text{O}} \text{Br}_2
\]

12. Predict the product of the following reaction sequence.

\[
\text{H}_2\text{SO}_4/\text{HNO}_3 \xrightarrow{\text{Br}_2/\text{FeBr}_3} \xrightarrow{1. \text{Fe/HCl}} \text{NO}_2/\text{HCl} \xrightarrow{\text{Cu}_2\text{O}, \text{Cu}^{+2}, \text{H}_2\text{O}} \text{Br}_2
\]
Suppose you had a mixture of the three compounds shown on the left below and carried out the indicated separation scheme.

13. Which flask contains the cyclohexanol?
14. Which flask contains the cyclohexylcarboxylic acid?
15. Which flask contains the cyclohexylamine?

16. Predict the product of the following reaction sequence.
17. A student was asked to draw a curved arrow mechanism for formation of an ester from an acid chloride and an alcohol in the presence of pyridine. Which of the following is the most accurate representation of the first intermediate?

\[ \text{acid chloride} \xrightarrow{\text{OH, pyridine}} \text{ester} + \text{pyridine} \]

\[ \begin{align*}
\text{Cl} & \quad \text{O} \\
\text{N} & \quad \text{O} \\
\text{Cl} & \quad \text{OH} \\
\end{align*} \]

a. \[ \begin{align*}
\text{Cl} & \quad \text{O} \\
\text{N} & \quad \text{O} \\
\text{Cl} & \quad \text{OH} \\
\end{align*} \]

b. \[ \begin{align*}
\text{Cl} & \quad \text{O} \\
\text{N} & \quad \text{O} \\
\text{Cl} & \quad \text{OH} \\
\end{align*} \]

c. \[ \begin{align*}
\text{Cl} & \quad \text{O} \\
\text{N} & \quad \text{O} \\
\text{Cl} & \quad \text{OH} \\
\end{align*} \]

d. \[ \begin{align*}
\text{Cl} & \quad \text{O} \\
\text{N} & \quad \text{O} \\
\text{Cl} & \quad \text{OH} \\
\end{align*} \]

e. \[ \begin{align*}
\text{Cl} & \quad \text{O} \\
\text{N} & \quad \text{O} \\
\text{Cl} & \quad \text{OH} \\
\end{align*} \]

18. The following reaction gives two main products. Identify the products.

\[ \text{phenyl bromide} + \text{NaNH}_2 \xrightarrow{\text{NaNH}_2, \text{NH}_3} \text{products} \]

a. \[ \begin{align*}
\text{CH}_3 & \quad \text{NH}_2 \\
\text{NH}_2 & \quad \text{NH}_2 \\
\end{align*} \]

b. \[ \begin{align*}
\text{CH}_3 & \quad \text{NH}_2 \\
\text{NH}_2 & \quad \text{NH}_2 \\
\end{align*} \]

c. \[ \begin{align*}
\text{CH}_3 & \quad \text{NH}_2 \\
\text{NH}_2 & \quad \text{NH}_2 \\
\end{align*} \]

d. \[ \begin{align*}
\text{CH}_3 & \quad \text{NH}_2 \\
\text{NH}_2 & \quad \text{NH}_2 \\
\end{align*} \]

e. \[ \begin{align*}
\text{CH}_3 & \quad \text{NH}_2 \\
\text{NH}_2 & \quad \text{NH}_2 \\
\end{align*} \]
The following problems require short answers. Points are given as indicated.

19. Predict the product of the reaction sequence. (5 pts)

\[
\text{OH} \quad \text{Br} \quad \text{K}_2\text{CO}_3 \quad \text{heat} \quad \text{product}
\]

20. Predict the product of the following reaction. (5 pts)

\[
\text{O} \quad + \quad \text{H} \quad \text{H} \quad + \quad \text{H}_2\text{N} \quad \text{catalytic H}^+ \quad \text{product}
\]

21. A student attempted to form an alkene by performing a Hofmann elimination with the compound ephedrine. No alkene was obtained. Instead a single enantiomer of an unknown chiral compound was obtained. Identify the unknown compound and show the exact expected stereochemistry. (6 pts)

\[
\text{OH} \quad \text{2 CH}_3\text{I} \quad \text{Ag}_2\text{O} \quad \text{C}_9\text{H}_{10}\text{O} \quad \text{ephrdeine}
\]

chiral compound 
not an alkene
22. Step 2 of the following scheme involves a pericyclic reaction similar to the Cope rearrangement. Give the structures of compounds A, B and C. (8 pts)

\[
\begin{align*}
\text{N} & \quad \text{Cl} \quad \text{O} \\
\text{CH}_3 & \quad \text{O} \\
\text{C} & \quad \text{A} \\
\text{LDA} & \quad \text{B} \\
\text{heat} & \quad \text{C} \\
\text{step 1} & \quad \text{step 2} \quad \text{step 3}
\end{align*}
\]

LDA = \[ \text{Li}^+ \]

23. Give a curved arrow mechanism for the following reaction. (8 pts)

\[
\begin{align*}
\text{H}_3\text{C} & \quad \text{O} \quad \text{O} \quad \text{H} \\
\text{H}_2\text{O} & \quad \text{O} \\
\text{heated} & \quad \text{H}_3\text{C} \quad \text{CH}_3 \\
\text{step 1} & \quad \text{step 2}
\end{align*}
\]

24. Benzphetamine is sold as an appetite suppressant drug. Propose a synthesis starting with benzene and any other carbon containing compounds of three carbons or less. (8 pts)

\[
\begin{align*}
\text{C} & \quad \text{N} \quad \text{CH}_3 \\
\text{CH}_3 & \quad \text{NH}
\end{align*}
\]