I. Nomenclature

1. Polymeric formaldehyde is known as:____________________________ (2 points)

2. Provide a systematic name for each of the following structures (9 points)

3. Draw the oxime of 1-phenyl-2-propanone. (3 points)

4. What is the common name for the following structure? (2 points)

II. Theory

1. If a base has a $pK_b$ value of 16, then its conjugate acid has a $pK_a$ value of ______. (2 points)

2. Is the structure below optically active? Justify your answer. (4 points)
3. Circle all statements that are true of sulfa drugs. (3 points)
   a) They were first discovered by Traugott Sandmeyer.
   b) They inhibit bacterial growth.
   c) Bacteria incorporate them into “folic acid” in place of PABA.
   d) Iron uptake into bacteria is prevented by sulfa drugs.
   e) They all contain a sulfoxide functional group.

4. Provide a scheme showing how benzyl amine can be separated from naphthalene by way of extraction. (4 points)

5. Which sequence ranks the following carbonyl compounds in order of increasing Lewis basicity? (3 points)

   \[
   \begin{align*}
   &\text{1} &\text{2} &\text{3} \\
   &\text{H}_3\text{C} - \text{NH}_2 &\text{H}_3\text{C} - \text{H} &\text{H}_3\text{C} - \text{CH}_3 \\
   \end{align*}
   \]

   a) 1<2<3     b) 2<3<1     c) 3<1<2     d) 3<2<1     e) 2<1<3     f) 1<3<2

III. Reactions

1. Citronellol is used as a fragrance in soaps and perfumes. It is also used as an insect repellant. Show what reagents are necessary to convert citronellol to citronellal. Provide an IUPAC name for citronellal. (5 points)

   \[
   \begin{align*}
   &\text{CH}_3\text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{CH}_2 \text{OH} &\rightarrow &\text{CH}_3\text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{CH} = \text{C} - \text{H} \\
   \end{align*}
   \]

   IUPAC:
2. Fill in the missing products for the two reactions shown below. (6 points)

\[
\begin{align*}
\text{NH}_2 \quad & \quad \text{NaNO}_2 / \text{HCl} \quad & \quad \text{H}_3\text{PO}_2 \\
\text{Ph} \quad & \quad \text{Ph} \\
\end{align*}
\]

3. Using a 1,3-dithiane intermediate, show how benzaldehyde can be converted to acetophenone. (7 points)

4. Shown below is an intermediate in the synthesis of the core structure of the lituarines, a group of natural products having cytotoxic and antifungal activity (\textit{Org. Lett.} \textbf{2005}, \textit{7}, \textit{5007}). Show what products would form when this intermediate is hydrolyzed in an acid aqueous solution. (6 points)

\[
\begin{align*}
\text{H}_3\text{C} \quad & \quad \text{CH}_3 \quad & \quad \text{O} \quad & \quad \text{O} \quad & \quad \text{CH}_3 \\
\text{H}_3\text{C} \quad & \quad \text{CH}_3 \\
\end{align*}
\]

5. Predict the outcome of the reaction below. (3 points)

\[
\begin{align*}
\text{Ph} \quad & \quad \text{Er}_2, \text{FeBr}_3 \\
\end{align*}
\]
6. Cinnamaldehyde is the active component of cinnamon. Complete each unknown in the sequence of reactions shown below. (8 points)

\[
\begin{align*}
&\text{PPPh}_3 \quad \xrightarrow{1)} \quad \begin{array}{c}
\text{Ph}_3\text{P} \equiv \equiv \\
\end{array} \\
&\text{cinnamaldehyde} \\
\end{align*}
\]

7. Show how vanillin could be converted to 2-methoxy-4-methylphenol. (3 points)

\[
\begin{align*}
&\text{CHO} \\
&\text{H}_3\text{CO} \quad \xrightarrow{\text{?}} \quad \text{CH}_3 \\
&\text{OH} \\
\end{align*}
\]

8. The structure shown below was an intermediate in the synthesis of a galanthamine derivative, which enhances cognitive ability of Alzheimer’s disease. (J. Am. Chem. Soc. 2005, 14785). Complete the transformation below by filling in the necessary reagents. (4 points)

\[
\begin{align*}
&\text{OH} \quad \xrightarrow{\text{?}} \quad \text{NH} \\
&\text{HO} \quad \xrightarrow{\text{?}} \quad \text{H}_3\text{C} \quad \text{N} \\
&\text{OH} \\
\end{align*}
\]
IV. **Mechanisms**

1. Draw all possible products resulting from the following sequence of reactions. (6 points)

   ![Reaction Sequence](image)

2. Provide both resonance forms of the nitrosonium ion. (4 points)

3. Use an arrow-pushing mechanism to show how the following aldehyde is converted to the cyanohydrin. Include all intermediates and formal charges. (6 points)

   ![Conversion](image)

V. **Synthesis:**

1. Fill in the necessary reagents to accomplish the following synthesis. (6 points)

   ![Synthesis](image)
2. Darifenacin is an alkaloid that is used in the treatment of overactive bladder syndrome (*J. Med. Chem.* **2005**, 6597). Show how darifenacin could be made from the intermediate shown below. (4 points)

![Intermediate structure](image)

**Darifenacin**

**VI. Extra Credit** (5 points possible)

1. Show 5 different methods of synthesis for the following amine.

![Amine structure](image)

You received __________ points out of 100 points possible. To check your overall grade in lecture go to [http://vista.weber.edu](http://vista.weber.edu)