CHEMISTRY 332

EXAM 1

(Prof. Levi Stanley)

Friday, September 18, 2015

I. (22 points) 

II. (30 points) 

III. (24 points) 

IV. (24 points) 

Extra Credit. (5 points) 

TOTAL (100 points) 

(Please CLEARLY PRINT your name)
I.A. Provide a complete and correct name or structure in the box for each of the following compounds. (12 points)

- **Diethyl sulfide**
- **Trans-3-ethylcyclohexanol**
- **Butyl phenyl ether**
- **Butyrophenone**
- **4-Fluorophenol**
- **p-Fluorophenol**

I.B. For the two functional groups listed below, draw a specific molecule that contains the functional group. No R groups or similar generalizations are allowed. Attempts to litter a molecule with multiple related functional groups will be frowned upon. (4 points)

- **Thiol**
- **Epoxide**

I.C. For each pair of molecules, circle the most acidic compound. (6 points)

- **Cyclohexanol**
- **Cyclohexane**
- **Benzoic acid (NO₂)**
- **Benzoic acid (OMe)**
II. Draw the missing starting material, reagents, or major organic product for **10 out of the following 11 reactions**. Clearly cross out the problem you do not want graded. If the product is missing, "no reaction" is a possible answer. (30 points).

A.  
\[ \text{Cl} \quad \text{NO}_2 \rightarrow \text{HNO}_3, \text{H}_2\text{SO}_4 \rightarrow \text{Cl} \quad \text{N}_2 \quad \text{O}_2 \]

B.  
\[ \text{OCH}_3 \quad \text{CH}_2\text{Cl} \rightarrow \text{AlCl}_3 \rightarrow \text{OCH}_3 \quad \text{O} \]

C.  
\[ \text{O} \rightarrow \text{LiAlH}_4 \rightarrow \text{OH} \rightarrow \text{H}_2\text{O}^+ \rightarrow \text{OH} \]

D.  
\[ \text{D}\text{OH} \rightarrow \text{Dess-Martin periodinane} \rightarrow \text{C} \quad \text{H} \quad \text{H} \quad \text{O} \]

E.  
\[ \text{OH} \rightarrow \text{POCl}_3, \text{pyridine} \rightarrow \text{Ph} \quad \text{Ph} \]

F.  
\[ \text{C} \quad \text{C} \rightarrow \text{m CPBA} \rightarrow \text{C} \quad \text{C} \quad \text{O} \]
G. 
\[ \text{Ph} - \text{Ph} \rightarrow \text{Ph} - \text{Ph} \]

H. 
\[ \text{O} - \text{H} \rightarrow \text{O} - \text{Cl} \]

I. 
\[ \begin{align*}
\text{Br} & \rightarrow \text{Br} \\
1) \text{Mg}^0 & \\
2) \text{MgOCH}_3 & \\
3) \text{H}_3\text{O}^+ &
\end{align*} \]

J. 
\[ \begin{align*}
\text{Hg(O}_2\text{CCF}_3)_2, \text{CH}_3\text{CH}_2\text{OH} & \\
\text{NaBH}_4 & \rightarrow 
\end{align*} \]

K. 
\[ \begin{align*}
\text{Br} & \rightarrow \text{S} \\
1) \text{H}_2\text{N} - \text{NH}_2 & \\
2) \text{H}_2\text{O, NaOH} & \rightarrow 
\end{align*} \]
III. Write stepwise reaction mechanisms for the following reactions. You do not need to draw all of the resonance structures for each intermediate. (24 points)

A.

\[
\begin{align*}
\text{Cl-phenyl} & \xrightarrow{\text{SO}_3, \text{H}_2\text{SO}_4} \text{Cl-phenyl-SO}_3\text{H} \\
\text{Cl} + \text{SO}_3 & \xrightarrow{\text{H-}\text{HSO}_4} \text{Cl-SO}_3\text{H} \\
\text{Cl} + \text{SO}_3 & \xrightarrow{\text{H-}\text{HSO}_4} \text{Cl-SO}_3\text{H} \\
\end{align*}
\]

B.

\[
\begin{align*}
\text{OH} & \xrightarrow{\text{PBr}_3} \text{Br} \\
\text{Br} & \xrightarrow{\text{H}^+} \text{Br} \\
\text{Br} & \xrightarrow{\text{H}^+} \text{Br} \\
\text{Br} & \xrightarrow{\text{H}^+} \text{Br} \\
\end{align*}
\]
IV. Complete 2 of the following 3 multistep synthesis problems using the given starting material and any reagent containing no more than five carbon atoms. Clearly cross out the problem you do not want graded. Reaction mechanisms are not required (24 points).

A.

B.
Extra Credit (5 points). Do not attempt this problem until you have completed the rest of the exam.

An amino group (NH₂) is a strongly electron-donating (activating) group. However, the nitration of aniline occurs to form meta-nitroaniline as the major product. Explain why this reaction selectively forms the meta-substitution product.