Solve the following problems in the space provided. You have 120 minutes to complete this closed book, closed notes exam. You must turn in the exam at the end of this time. Please take the exam in a quiet, controlled area such as a classroom. When you are in doubt, rely on your logic rather than vague memories. Budget your time according to the point value of the problem. It is better to do most of an exam well than all of it poorly.

It is very important that you keep your time and you do not consult any other sources. If you have a question about the exam, it is your responsibility to contact Dr. Nerz (6108884530), but it is important to realize that Dr. Nerz is not available 24/7. Otherwise, you have to try to do your best and Dr. Nerz will do her best to treat you fairly in the event of any confusion. This is the nature of self-scheduled exams.

1. Consider the following proposed reactions. Critique four and only four, of the following five reactions. Please keep your comments brief or use structures to explain. Write an equation to describe the more likely route or routes. If there is no reaction write no reaction and give a brief explanation. (18 points)

\[ \text{Nitration} \]
\[ \text{HNO}_3/\text{H}_2\text{SO}_4 \]

![Image of chemical structures]

2. The base is incompatible with solvents.

\[ 2 \text{ bases} \]
\[ \text{NaOCH}_2\text{CH}_3 + \text{HO}^+ \rightarrow \text{HO}^- + \]

For NaOCH}_2\text{CH}_3 and NaOH reactions must exclude ortho and para to leaving group.
2. Write major products for seven (7) of the following nine (9) reactions. You do not want to include mechanism here. If you do not believe a reaction is possible, write "no reaction". Be sure to include stereochemistry where it is relevant. (56 points)

a. 

\[
\begin{array}{ccc}
\text{SO}_3 & \xrightarrow{\text{H}_2\text{SO}_4} & \text{SO}_3^+ \\
\end{array}
\]

b. 

\[
\begin{array}{ccc}
\text{H}_3\text{O}^+ & \xrightarrow{} & \text{H}_2\text{O}^+ \\
\end{array}
\]

c. 

\[
\begin{array}{ccc}
\text{NaNH}_2\text{NH}_2 & \xrightarrow{} & \text{NH}_2 \\
\end{array}
\]

d. 

\[
\begin{array}{ccc}
1. \text{CH}_3\text{Br} / \text{AlCl}_3 & \xrightarrow{} & \text{NO}_2 \\
2. \text{HNO}_3/\text{H}_2\text{SO}_4 \text{ INXS} \text{ increasing temperature} & \xrightarrow{} & \text{NO}_2 \\
\end{array}
\]
e. 

\[ \text{H}_2\text{CrO}_4 \rightarrow \text{[Chemical Reaction]} \] 

g. 

\[ \text{[Chemical Reaction]} \rightarrow \text{[Chemical Structure]} \] 

h. 

1. 2 Li/hexanes 

2. 1-pentanol
3. Consider the following compounds. Circle the compounds that meet the criteria for aromaticity. (10 points).
4. Write a complete mechanism (arrow formalism) leading to major products of the following reactions. Be sure to include resonance forms and stereochemistry. If a reaction has multiple major routes, show all products, but only show the complete mechanism once. (48 points)

a.

b.

c. $\text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr}$

Et$_2$O

d. $\text{D}_2\text{O}^+$
5. Outline a reasonable synthesis (mechanisms not needed here) for one (1) of the following target molecules from the given starting materials. You must construct the carbon skeleton from the given molecules.

a. (16 points)
b. (16 points)

\[ \text{from} \]

\[ \text{+ HBr} \rightarrow \]

\[ \text{Br} \]

\[ \text{Br}_2 \text{FeBr}_3 \]

\[ \text{1.} \text{2Li/Hexane} \]

\[ \text{2.} \text{H}_3\text{O} \]

\[ \text{10. NaOH} \]

\[ \text{2. P}_4\text{O}_5 \]

\[ \text{1.5 SO}_3 \]
6. Write all the resonance forms for the following compound. (10 points)

7. In which compound would the ortho and para hydrogens absorb at a higher ppm in an nmr spectrum? (6 points)