1. Predict the major product(s) for each of the following reactions and any significant minor products. (44 points)
   - Include any byproduct that is formed also (eg. H₂O, NaBr).
   - If no reaction is expected, briefly explain why.
   - You may neglect stereochemistry.

A) 
\[
\begin{array}{c}
\text{CH}_2=\text{CH} - \text{CH}_3 \\
\text{CH}_3
\end{array}
\] 
\[
\text{OH}^- \rightarrow
\begin{array}{c}
\text{CH}_2=\text{CH} - \text{CH}_3 \\
\text{CH}_3
\end{array}
\]

B) 
\[
\begin{array}{c}
\text{CH}_3
\end{array}
\] 
\[
\text{NaOCH}_2\text{CH}_2\text{CH}_3 \rightarrow
\begin{array}{c}
\text{CH}_3
\end{array}
\]

C) Indicate the intermediate and final products of the following scheme:
\[
\begin{array}{c}
\text{CH}_2=\text{CH}-\text{N} \end{array}
\] 
\[
\text{Ph}^{\text{MgBr}} \rightarrow
\begin{array}{c}
\text{CH}_2=\text{CH}-\text{N} \end{array}
\] 
\[
\text{H}_2\text{O}^+ \rightarrow
\begin{array}{c}
\text{CH}_2=\text{CH}-\text{N} \end{array}
\]

D) 
\[
\text{Br} \rightarrow \text{NaCN, acetone} \rightarrow \text{OH}^- \rightarrow \text{H}_2\text{O}
\]

E) 
\[
\text{O} \rightarrow \text{Li}^+ \rightarrow \text{N}^+ \rightarrow \text{H}_2\text{O}^+ \text{heat}
\]

F) 
\[
\text{Cl} \rightarrow \text{NaOEt, EtOH}
\]
2. (16 points) Consider the reaction below:

A) Predict the major product(s) of the reaction.

B) Give a complete arrow-pushing mechanism for the formation of the major product.
3. (16 points) Provide a complete arrow-pushing mechanism for the following series of reactions.

- Clearly show important resonance structures for the stability of any ions formed.
- Also show any byproducts produced in the various steps.

\[
\begin{align*}
2 \text{ } & \xrightarrow{\text{MeOH / NaOMe}} & \text{MeOH / NaOMe} & \xrightarrow{\text{OH}^-} & \text{OH}^- & \xrightarrow{\text{H}_2\text{O}^+ \text{ / heat}} & \text{H}_2\text{O}^+ \text{ / heat} \\
\end{align*}
\]
4. (12 points) Suggest reasonable reaction scheme to carry out the following transformation.

\[
\text{HOOCCH}_2\text{COOH} \quad \rightarrow \quad \text{HOOCCH}_2\text{NCH}_3
\]

5. (12 points) Outline a synthetic scheme for the formation of the following compound, using carboxylic acids as your only source of carbon atoms. You may use any other reagents or solvents as needed. Mechanisms are NOT required.

\[
\text{O} \quad \text{O} \quad \text{O}
\]

\[
\text{O} \quad \text{O} \quad \text{H}
\]