1. (6 pts, 3 each) Give the IUPAC name of the following compounds.

a) \[
\text{6-methyl-1,3-dimethoxy-cyclohexane}
\]

2. (12 pts, 4 each) Give the structure of the major product, starting material or the reagents needed for the following transformations. Be sure to show stereoisomerism where appropriate. Write “No RXN” if there is no reaction.

a) \[
\begin{align*}
\text{H}_2\text{C} & \quad \text{HCl} \\
\text{OH} & \quad \uparrow \quad \text{CH}_3\text{Cl}
\end{align*}
\]

b) \[
\begin{align*}
\text{H}_2\text{C} & \quad \text{CH}_3\text{CH}_2\text{OH} \\
\text{CH}_3\text{CH}_2\text{O} & \quad \text{Na}^+ \\
\text{H}_2\text{C} & \quad \text{CH}_3\text{CH}_2\text{OH}
\end{align*}
\]

c) \[
\begin{align*}
\text{HO} & \quad \text{Swein} \\
\text{H}_2\text{C} & \quad \text{C} \quad \text{O}
\end{align*}
\]

d) \[
\begin{align*}
\text{HO} & \quad \text{H} \\
\text{H} & \quad \text{pyridine}
\end{align*}
\]

e) \[
\begin{align*}
1) & \quad \text{H}_2\text{C} \quad \text{CH}_2\text{Cl} \quad \text{CH}_3\text{CO} \\
2) & \quad (\text{CH}_3\text{CH}_2)_2\text{N} \quad -60^\circ\text{C}
\end{align*}
\]

Gottfried, two nitriles, two nitriles, two nitriles, two nitriles, two nitriles.
7. (14 pts) The following is a listing of the ¹H-NMR spectral data of a compound with a molecular formula of C₉H₁₈O.

δ 1.2, 3H, triplet; δ 1.5, 3H, doublet; δ 3.5, 2H, quartet; δ 4.0, 1H, quartet; δ 7.2, 5H, broad multiplet

a) How many units of unsaturation are in this compound?

\[ \frac{2C + 2 + N - H - X}{2} = \text{units of unsat.} \]

b) Propose a structure for this compound and place your final answer in the box. Be sure to show any partial structures you determine below and correlate those structures to their chemical shifts in order to receive partial credit.
10. (6 pts) Draw a branching diagram to show the expected splitting pattern that would be observed for the H₆ hydrogens in the following compound. Note the coupling constants given below for J₆₆ and J₆₇.

\[
\text{H}_{6} \quad \text{only new this for full order}
\]

\[J_{66} = 1.5 \text{ Hz}; J_{67} = 10 \text{ Hz}\]

11. (12 pts) Show how the following multistep transformation can be accomplished. You may use any reagents you deem necessary for your synthesis. Be sure to show the structures of intermediate compounds along the pathway to the final product.