1. Nomenclature. Provide the structure or the name for the following. If stereochemistry is a factor, do not neglect it. (6 pt)

- (E)-6-hydroxyhept-4-en-2-one
- trans-6-hydroxy-4-hepten-2-one
- 3-isopropylbenzaldehyde
- (S)-3-phenylbutanal

2. Rank the following, with 1 being highest, or most. (6 pt)

- Equilibrium concentration of enol
- Reactivity toward MeMgBr
- Acidity
3. Draw the products for the following reactions (3 pt each)

- \( \text{CH}_3\text{C} = \text{C} - \text{H} \quad \text{Hg}^{2+}, \text{H}_2\text{O}, \text{H}_2\text{SO}_4 \rightarrow \text{thiocarbonyl} \)

- \( \text{KCN, HCN} \rightarrow \text{hydroxycyanide} \)

- \( \text{MeOH, H}^+ \rightarrow \text{oxime} \)

- \( \text{NaOMe, MeOH} \rightarrow \text{acetaldehyde} \)

- \( \text{Cyclohexene + Benzaldehyde} \quad \text{NaOEt, EtOH, heat} \rightarrow \text{diene} \)

- \( \text{NaOMe, MeOH} \rightarrow \text{ester} \)
4. Draw the products for the following multistep reactions. (3 pt each)

\[
\text{Product 1:} \quad \text{MeO-CH-Ph} \quad \text{Protection Chemistry}
\]

\[
\text{Product 2:} \quad \text{MeO-CH-Ph}
\]

\[
\text{Product 3:} \quad \text{MeO-CH-Ph}
\]

\[
\text{Product 4:} \quad \text{MeO-CH-Ph}
\]
5. For the following chemicals, describe the extent to which each would be deprotonated by LDA (LiN-iPr₂) or by NaOH at equilibrium. Fill in all 6 boxes. Options are complete deprotonation (A), a little deprotonation (B), and no deprotonation (C). (6 pt)

Options:
A = completely
(-100%)
B = a little, but not much
(<10% but not 0%)
C = none at all
(0%)

6. Suggest a plausible structure consistent with the following information. (5 pt)
a. It reacts positively with 2,4-dinitrophenylhydrazine.
b. It reacts positively with NaOH/I₂, the iodoform test
c. It does not react with Tollen's reagent [Ag(NH₃)₂⁺OH⁻].
d. It does not react with Br₂ in dichloromethane solvent.
e. Chemical formula is C₇H₁₂O
f. Its ¹³C spectrum shows 5 carbons (1 singlet, 1 doublet, 2 triplets, and 1 quartet)

7. Which of the following would not undergo decarboxylation (loss of CO₂) upon heating? (2 pt)
8. Put in the starting materials from which the following would be made. (3 each)

\[ \text{NaOMe, MeOH} \]

\[ \text{NaOMe, MeOH} \]

\[ \text{NaOMe, MeOH, heat} \]

\[ \text{cat. H}^+ \]

9. Draw the mechanisms for the following reactions. (4 pt each)
(Note: this one counts as 2 problems, 8 points total)

All steps are actually in equilibrium, but I only want you to show the forward direction.
10. Provide reagents for the following transformations. (4 pt each)

\[
\text{MeOH, H}^+ \quad \text{(protect)} \\
\text{NaBH₄, MeOH or LiAlH₄} \\
\text{H₂C, H}^+ \quad \text{(deprotect)}
\]

11. Design a synthesis for the following alkene **FROM ALCOHOLS WITH NO MORE THAN 5 CARBONS.** (6 pt)

\[
\text{Use } \text{CWIg} \\
\text{H₂CrO₄} \\
\text{br} \\
\text{H₂O, H}^+ \\
\text{H₃PO₃} \\
\text{PCC}
\]