1. Give the IUPAC name for each of the following compounds.

- phenyl 6-hydroxybenzoate
- oct-(2E, 5Z)-dieneyl chloride
- (3R)-3-ethoxybutan-4-one pentanoic anhydride
- (4S)-dimethylamino hexaenitrile
- N-methyl-N,N-diphenylacetamide
- 5-hydroxyhex-2-enoic acid lactone

2. Capsaicin is the compound isolated from peppers that is used as a topical treatment for arthritis. Capsaicin’s IUPAC name is N-(3-hydroxy-4-methoxybenzyl)-8-methylnon-(6E)-enamide.

a. Draw the structure of capsaicin.

b. If capsaicin underwent hydrolysis, what would the products be:

   Under acidic conditions

   Under basic conditions
3. Which has the higher boiling point, acetic acid or acetamide? Explain your answer.

Acetamide has the higher b.p. The \( \text{CONH}_2 \) group has a partial negative charge that contributes significantly to the hybridization and allows for very strong \( \text{H}^+ \) bonding.

\[
\text{R-C=NH}_2 \quad \leftrightarrow \quad \text{R-CONH}_2
\]

4. Rank the following acid derivatives in order of increasing reactivity in nucleophilic substitution reactions (1= least reactive, 4=most reactive) and explain your reasoning.

Reactivity is based on leaving group, the better the L.G., the more reactive the derivative is.

5. Rank the following protons in order of decreasing acidity (1=most acidic, 4=least acidic) and explain your reasoning.

The carboxylic acid's \( \text{H}^+ \) is most acidic—attached to \( \text{CO}_2 \).

\( \text{H}_c - \text{H}^+ \) on \( \alpha \) \( \text{C} \) between \( 2 \text{C}=\text{O} \) so carbocation formed when \( \text{H}^+ \) is removed is stabilized by both \( \text{C}=\text{O} \).

\( \text{H}_b - \text{H}^+ \) on \( \alpha \) \( \text{C} \) of \( \text{O} \) before so only \( 1 \text{C}=\text{O} \) to stabilize.

\( \text{H}_4 \)-least acidic since after \( \text{C}=\text{O} \) is least polar due to resonance with second \( \text{O} \).
6. Give step-by-step mechanisms for three of the following four reactions.

a) \( \ce{CH3OH} \) (excess)

b) \( \ce{H3O+} \)

c) \( \ce{CH3OH} \)

d) \( \ce{LDA, H} \) followed by \( \ce{H+, Δ} \)
7. Complete the following reactions by providing either the products or the necessary reagents.

- **A**: Base, then acid catalyst
- **B**: LDA, then acid catalyst
- **C**: Acid catalyst
- **D**: Excess CH₃MgBr, then acid catalyst
- **E**: (C₈H₁₆O₂)
- **F**: Acid catalyst
- **G**: NaBH₄, EtOH
- **H**: Acid catalyst
- **I**: PBr₃
- **J**: NaCN
- **K**: Acid catalyst
- **L**: (C₇H₁₂O₃)
- **M**: Compound F, with heat
- **N**: H₂/Pt, with heat
- **O**: (C₇H₁₃NO)
8. The Wieland-Miescher ketone is a valuable starting compound used in the synthesis of steroid hormones. It can be synthesized starting with malonic ester and going thru the intermediates shown below. Complete the synthesis showing the necessary steps between each intermediate.
1. The following compound undergoes two successive intramolecular Michael additions in the presence of LDA. Show the product.

2. The following compound undergoes an intramolecular Michael addition followed by an intramolecular aldol condensation in the presence of LDA. Show the product.