1. **Isomers (12 pts)** Include all hydrogens in all structures. Stereochemistry or geometry differences must be recognizable using standard conventions when used to differentiate between structures.

   a) **Draw** the structures of **four** different **aldehydes** with the molecular formula, \( \text{C}_4\text{H}_6\text{O} \), which do not contain rings.

   ![Structure 1]

   ![Structure 2]

   ![Structure 3]

   ![Structure 4]

   b) **Draw** the structures of **four** different **acid chlorides** with the molecular formula, \( \text{C}_8\text{H}_7\text{ClO} \), which also contain benzene rings.

   ![Structure 5]

   ![Structure 6]

   ![Structure 7]

   ![Structure 8]

   c) **Draw** the structures of **two secondary amides** with the molecular formula, \( \text{C}_3\text{H}_7\text{NO} \).

   ![Structure 9]

   ![Structure 10]

   d) For each of the following structures, give the **total number of chiral carbons** below the structure.

   ![Structure 11]

   ![Structure 12]

   ![Structure 13]

   ![Structure 14]

   **CONTINUED ON BACK**
1. Isomers ( \( \_\_\_\_\_ \) pts) Include all hydrogens in all structures. Stereochemistry or geometry differences must be recognizable using standard conventions when used to differentiate between structures.
   (a) Draw the structures of \textbf{four} different ketones with the molecular formula, \( \text{C}_4\text{H}_5\text{BrO} \), which do not contain rings.

   \[
   \begin{align*}
   \text{C}_4\text{H}_5\text{BrO} & \quad \text{C}_4\text{H}_5\text{BrO} \\
   \begin{array}{c}
   \text{O} \\
   \text{H} \\
   \end{array} & \quad \begin{array}{c}
   \text{O} \\
   \text{H} \\
   \end{array} \\
   \begin{array}{c}
   \text{C} \quad \text{H} \\
   \end{array} & \quad \begin{array}{c}
   \text{C} \quad \text{H} \\
   \end{array} \\
   \end{align*}
   \]

   (b) Draw the structures of \textbf{five} different carboxylic acid anhydrides with the molecular formula, \( \text{C}_9\text{H}_8\text{O}_3 \), which also contain benzene rings.

   \[
   \begin{align*}
   \text{C}_9\text{H}_8\text{O}_3 & \quad \text{C}_9\text{H}_8\text{O}_3 \\
   \begin{array}{c}
   \text{O} \\
   \text{O} \\
   \end{array} & \quad \begin{array}{c}
   \text{O} \\
   \text{O} \\
   \end{array} \\
   \begin{array}{c}
   \text{H} \\
   \end{array} & \quad \begin{array}{c}
   \text{H} \\
   \end{array} \\
   \end{align*}
   \]

   (c) Draw the structures of \textbf{two} tertiary amides with the molecular formula, \( \text{C}_4\text{H}_5\text{NO} \).

   \[
   \begin{align*}
   \text{C}_4\text{H}_5\text{NO} & \quad \text{C}_4\text{H}_5\text{NO} \\
   \begin{array}{c}
   \text{O} \\
   \end{array} & \quad \begin{array}{c}
   \text{O} \\
   \end{array} \\
   \begin{array}{c}
   \text{H} \\
   \end{array} & \quad \begin{array}{c}
   \text{H} \\
   \end{array} \\
   \end{align*}
   \]

   (d) For each of the following structures, give the total number of chiral carbons below the structure.

   \[
   \begin{align*}
   \text{Chiral carbons} & \quad \text{Chiral carbons} \\
   \begin{array}{c}
   \text{4} \\
   \end{array} & \quad \begin{array}{c}
   \text{3} \\
   \end{array} \\
   \end{align*}
   \]

\textbf{CONTINUED ON BACK}
2A. (pts) Give the complete IUPAC names of each of the following compounds.

a) Isopropyl 3-methoxybenzoate

b) E-4-Chlorohept-3-en-2-one
   (or part E after 3)
   or E-4-Chloro-3-hepten-2-one
   (give geometry)

2B. (pts) Draw the correct structures for each of the following compounds. Include all hydrogens including those attached to rings. Include all carbons except those which are part of rings. When needed, stereochemistry and geometry must be recognizable following standard conventions.

c) p-Vinylbenzoyl chloride

d) Z-4-Amino-2-hexenal

e) trans-2-hydroxycyclopropyl formate

f) N-butylpropanamide

g) Allyl m-fluorophenyl ketone

h) Acetic anhydride

i) Acetone
2A. (pts) Give the complete IUPAC names of each of the following compounds.

a) \[ \text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2\cdot \text{C}=-\text{Cl} \]
   \( \text{E} \)
   (give geometry)
   \( \text{E}-3\text{-Bromohex-2-enoyl chloride} \)
   (can write \( \text{E} \)E)
   \( \text{a} \ E-3\text{-Bromo-2-hexenoyl chloride} \)

b) \[ \text{CH}_3-\text{CH}_2-\text{CH} (\text{C}=\text{O})-\text{CH}_2-\text{CH}_3 \]
   (give stereochemistry)
   \( \text{trans-2-Phenyl-4-ethylcyclopentanone} \)
   or \( \text{trans-4-Ethyl-2-phenylcyclopentanone} \)

2B. (pts) Draw the correct structures for each of the following compounds. Include all hydrogens including those attached to rings. Include all carbons except those which are part of rings. When needed, stereochemistry and geometry must be recognizable following standard conventions.

c) Isobutyl p-aminobenzoate

\[ \text{H}_2\text{N}-\text{C}\cdot \text{O} \quad \text{C} \cdot \text{O} \cdot \text{CH}_2-\text{CH}_2-\text{CH}_3 \]

\( \text{f) Allyl benzyl ketone} \)

\[ \text{CH}_2=\text{CH} \cdot \text{CH}_2-\text{CH}_2-\text{C} \cdot \text{H} \cdot \text{H} \]

\[ \text{g) Urea} \]

\[ \text{H}_2\text{N}-\text{C} \cdot \text{N} \cdot \text{H}_2 \]

\( \text{h) Formaldehyde} \)

\[ \text{H} \cdot \text{C} \cdot \text{H} \]