Before you begin this exam: First: You are allowed to have a simple model set at your seat. Please put away all other materials. Second: Place your student identification on your desk. A proctor will come around to check everyone’s ID. Third: Read through the entire exam. Your goal, as always, is to score as many points as possible. Do not waste time on problems that you can’t do if there are others that look easy. Fourth: It is critically important that your answers be written in a clear, unambiguous manner. Answers in which your intentions are unclear will not receive credit. Fifth: READ THE INSTRUCTIONS FOR EACH PROBLEM. You have until 9:50 to complete this exam. There will be no extensions, so budget your time carefully.

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Total 100
1. (6 points) Calculate the molecular formula of each of the following compounds.

\[ \text{C}_{12}\text{H}_{24}\text{O} \quad \text{C}_{11}\text{H}_{24} \]

2. (8 points) Draw four different skeletal isomers of \( \text{C}_7\text{H}_{12} \). Note: There are more than four acceptable answers here – just draw any four. If you draw more than 4, we will grade the first 4.

Here are a few to get you started......
3. (6 points) Provide a viable IUPAC name for the compound below. Be sure to specify the stereochemistry.

\[
\begin{align*}
&\text{H} \\
&\text{F} \\
&\text{Z-3-fluoro-3-hexene}
\end{align*}
\]

4. (10 points) Identify the hybridization of the indicated atoms.

Lysergic acid, diethyl amide

This nitrogen is \( \text{sp}^2 \) hybridized

This nitrogen is \( \text{sp}^3 \) hybridized

This carbon is \( \text{sp}^2 \) hybridized

This carbon is \( \text{sp}^3 \) hybridized

This carbon is \( \text{sp} \) hybridized
5. (10 points) Classify each of the following pairs of compounds as either resonance forms, conformational isomers, structural isomers, or stereoisomers.

Conformational Isomers

Structural Isomers

6. (15 points) Draw the Lewis dot structure (show DOTS!) and assign partial charges for both carbons and for the nitrogen in this resonance form of methyl isocyanide (below).

CH₃—N≡C

(5 points) Draw one additional resonance form for methyl isocyanide. Show the proper use of arrows: arrows for the motion of electrons and arrows to denote resonance forms.
7.  a) (5 points) Draw a Newman projection of propane in a staggered conformation.

\[
\begin{array}{c}
\text{H} \\
\text{CH}_3 \\
\text{H} \\
\text{H} \\
\text{H} \\
\end{array}
\]

b) (10 points) Draw the rotational energy diagram for propane. On your diagram clearly indicate the position of staggered conformations and eclipsed conformations. Your diagram should include rotation through any 2 staggered and any 2 eclipsed conformations.

\[
\begin{array}{c}
\text{E} \\
\text{staggered} \\
\text{eclipsed} \\
\text{staggered} \\
\text{eclipsed} \\
\end{array}
\]

8.  (9 points) How many \( \Box \) molecular orbitals (bonding plus antibonding) are present in each of the following:

\[
\begin{array}{c}
\text{3} \\
\text{2} \\
\text{3} \\
\end{array}
\]
9. (10 points) Nitrogen is more electronegative than carbon. Explain why 4-cyanoaniline (below) has nitrogens as both the positive and the negative end of the dipole. Note: a picture is worth a thousand words. DO NOT exceed the space provided.

![Dipole Diagram]

10. (6 points) The lone pair on nitrogen in the compound below is NOT stabilized by resonance, despite the adjacent π bond. Explain why this is. Note: a picture is worth a thousand words. DO NOT exceed the space provided.

![Compound Diagram]

Lone pair on nitrogen is in an orbital that is perpendicular to the C=O π system. No overlap is possible.

END OF EXAM