1. **(ORANGE EXAM)** Deduce the structure that corresponds to the spectral data on pages 2-4. Write your final answer in the box. A correct answer is worth full credit. If the answer is incorrect, your analysis of the spectra can be worth significant partial credit, so show your work clearly in the space below each set of data only. **Answers outside of these places will be ignored.**

**Final Structure Box**

**Mass spectrum:** m/z = 149 (M; 100%), m/z = 150 (11.6%), and m/z = 151 (0.8%). The molecule does not contain fluorine or iodine.

**IR**

**$^1$H-NMR:** 7.32 – 7.14 ppm (multiplet; integral = 5), 2.88 ppm (doublet; integral = 2), 2.76 ppm (sextet; integral = 1), 2.42 ppm (singlet; integral = 3), 1.17 ppm (singlet; integral = 1), and 1.05 ppm (doublet, integral = 3).
2. A series of carbonyl functional group interconversions is outlined below. Fill in the missing reagents and products. Your reagents may contain as many carbons as you like. Many side products are formed along the way, but only the methanol one is shown in order to help you determine one of the necessary reagents along the way.

**orange exam**

![Diagram of carbonyl functional group interconversions]

The route shown above is a VERY inefficient way to convert an acid chloride into an amide. In the space provided below, write out the SHORTEST possible way to accomplish this transformation.

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![Diagram of carbonyl functional group interconversions]

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3. Propose a reasonable mechanism that accounts for the transformation shown below.
4. Predict the products of the following reactions.

\[
\begin{align*}
\text{Br}_2 & \quad \text{NaOH} & \quad \text{Br}_2 & \quad \text{NaOH} \\
\text{CH}_2=\text{C}(\text{CN}) & \quad \text{NaOH} & \quad \text{Br}_2 & \quad \text{NaOH} \\
\text{NH}_2 & \quad \text{H}_2\text{O} & \quad \text{NH}_2 & \quad \text{H}_2\text{O} \\
\end{align*}
\]
5. Propose a synthesis from (E)-4-propyl-5-propyldienenonane starting with ethylacetoacetate and propyl bromide as your only sources of carbon. You may use as many equivalents of propyl bromide as you need. You may also use any other reagents, as necessary, as long as the carbons in the final product originate from ethylacetoacetate and propyl bromide.

![Synthesis Diagram]

6. The following transformations require the number of steps indicated. In the box provided over the arrow, fill in the missing reagents. The reagents may contain carbon atoms.

![Reactions Diagram]