1. $^1$H, $^{13}$C, and HSQC spectra of 5-hexen-2-ol are (CH$_2$=CHCH$_2$CH$_2$CHOHCH$_3$) shown on the accompanying pages. Make as many assignments as you can on all the spectra, including measuring J values.

2. Drawing a COSY spectrum like you would expect for this compound. Briefly explain why the different cross peaks would appear where they do.

3. a. Write a stepwise mechanism for the following ester forming reaction. Include several curved arrows to show the direction of electron flow.

\[
\text{HO}^- + \text{CH} = \text{CHCH}_2\text{CH}_2\text{CHOHCH}_3 \xrightarrow{\text{H}^+} \text{HO}_2\text{CCH} = \text{CCH}_2\text{CHOHCH}_3
\]

b. The reaction is not balanced as written. What is missing?

c. This type of reaction establishes an equilibrium between reactants and products. How would one drive this reaction to completion? How is this reaction different from the ester synthesis carried out in lab (in terms of what technique you would use to drive it to completion)?

4. Once the above reaction was done, what steps would you take to separate the product ester from unreacted starting material and acid catalyst, and prepare the sample for analysis by IR or NMR?

5. Draw three isomers with the formula C$_6$H$_{12}$O and tell how you would distinguish them using infrared spectroscopy.

6. What are three important, potential hazards in the organic lab? How do we protect ourselves from these hazards?