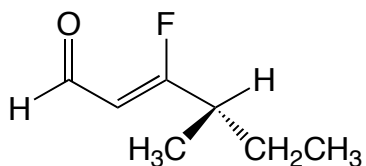
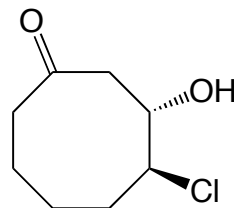


1. Provide an unambiguous name (IUPAC or common) for each of the following molecules. Be sure to indicate stereochemistry where appropriate. (10 points)

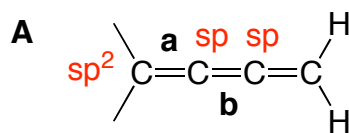


**(S,Z)-3-fluoro-4-methylhex-2-enal**



**(3S,4S)-4-chloro-3-hydroxycyclooctanone**

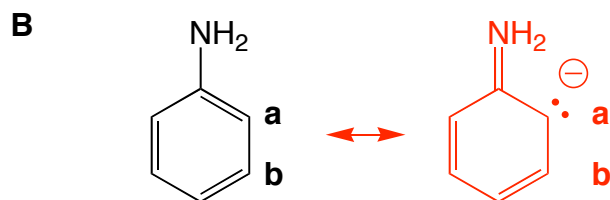
2. For each problem below, assign **a** and **b** to the spectroscopic data shown at the right. Then using pictures and/or words (whichever best illustrates your explanation), provide a rationale for your assignments. (12 points)



**a** 1900 cm<sup>-1</sup>

**b** 2100 cm<sup>-1</sup>

One of the carbons making up bond **a** is sp hybridized while the other is sp<sup>2</sup> hybridized. The two carbons making up bond **b** are both sp hybridized. Since sp hybridized carbons form shorter bonds than sp<sup>2</sup> orbitals, the double bond with TWO sp hybridized carbons would be shorter than the double bond with the sp<sup>2</sup> and sp hybridized carbons. The shorter the bond, the faster the vibration. The faster the vibration, the higher the wavenumber of the vibrational stretch.

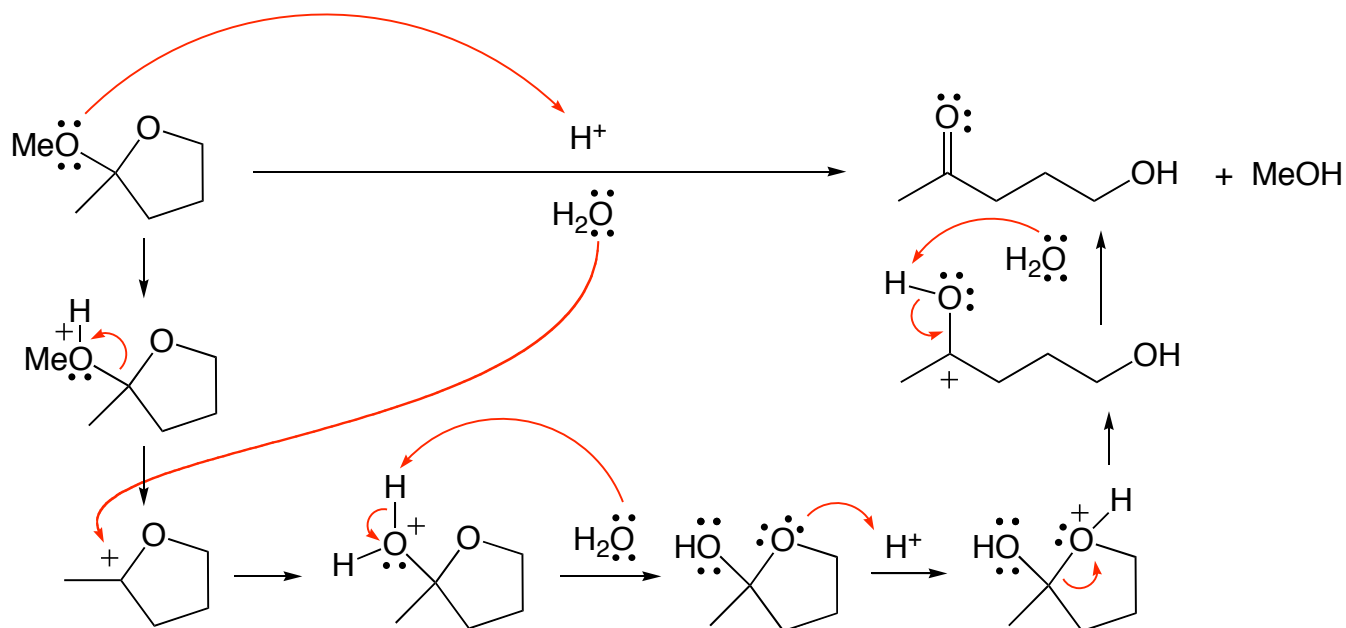


**a** 116 ppm

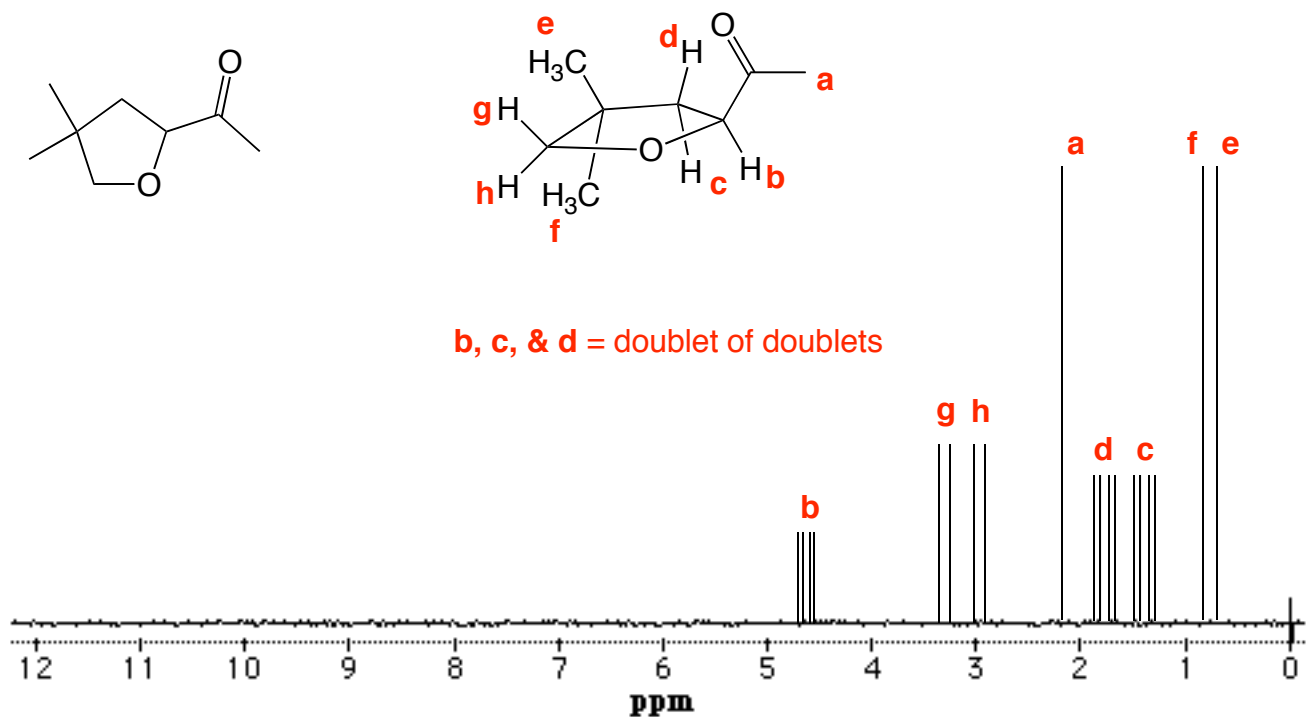
**b** 129 ppm

Although **a** is closer to the inductively withdrawing amino group than **b**, the resonance structure shown indicates that the negatively charged **a** actually has more electron density around it than does **b**. Therefore, **a** is more shielded than **b** and will have the more upfield chemical shift.

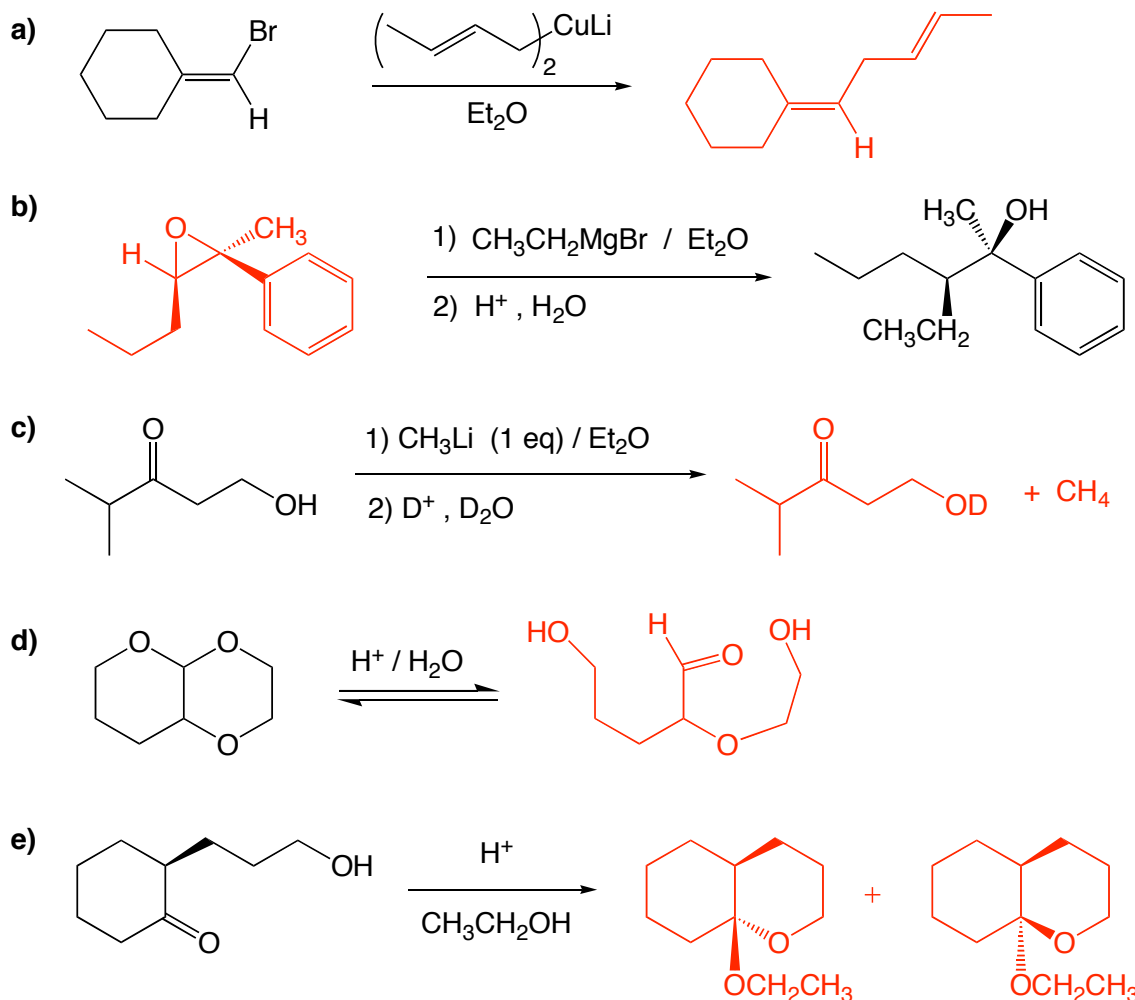
3. Provide a mechanism for the following reaction. Be sure to show all charges and lone pairs of electrons in your structures. Also provide the structures of all intermediates. (12 points)



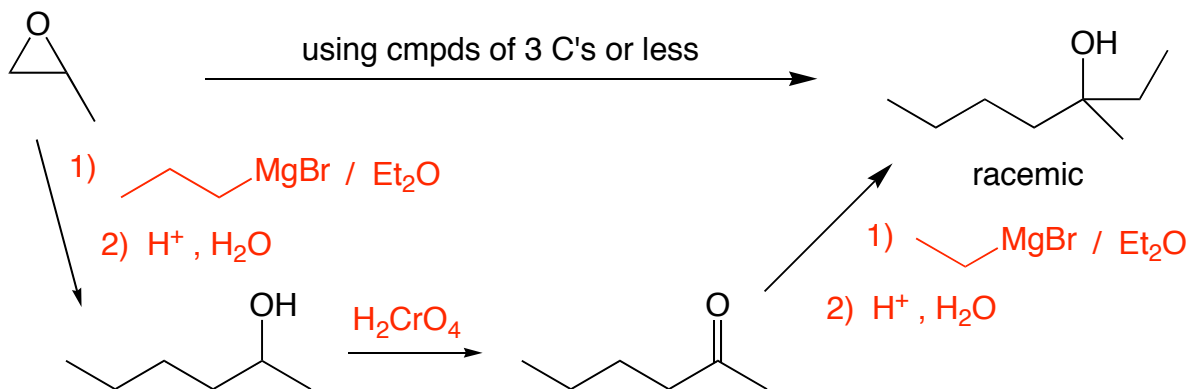
4. Predict the proton NMR of the following molecule. For full credit, you must assign your peaks *and* consider the relative heights in all peaks that show splitting. (12 points)



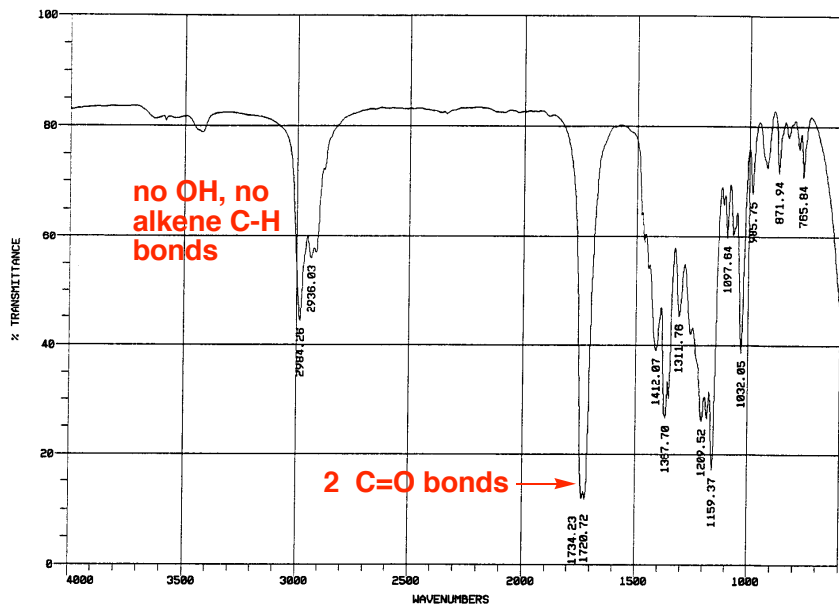
5. Complete the following reactions by providing either the starting materials or products. If you provide more than one product, circle the major product(s). (30 points)



6. Provide a synthesis for the following transformation. For full credit, be sure to draw all intermediary products along the way. (12 points)

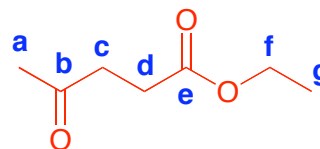
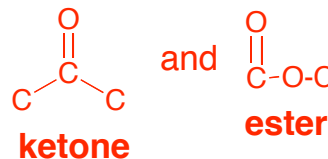


7. A compound with the molecular formula  $C_7H_{12}O_3$  gives the following spectra. Provide a structure and assign peaks in each spectrum for full credit. *Circle your answer.* (12 points)



**DU = 2**

**Based on the spectra,  
the 2 DUs must be...**



**no COOH or aldehyde**

**no alkene**

