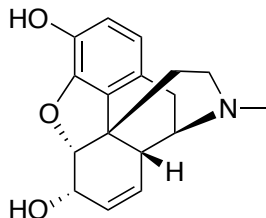# Chemistry 235
Experiment 13 – Report Sheet

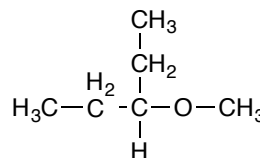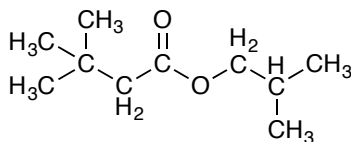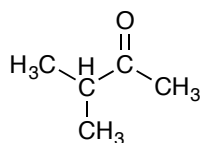| Name:	Lab Room:	Desk #:

Pre-Lab Questions (Complete Prior to Lab)

1. The structure of morphine is shown below. How many chemically distinct types of hydrogen are present in this molecule?


2. Predict the expected multiplicity (singlet, doublet, etc.) for every distinct set of hydrogen in each molecule below.

3. Consider the NMR spectrum shown below. The integration values are not normalized. Normalize every integration by dividing each integration value by the lowest integration value. Do your values add up for the correct number of hydrogen? If not, multiply each value by a common number to get the correct total number of hydrogen represented.
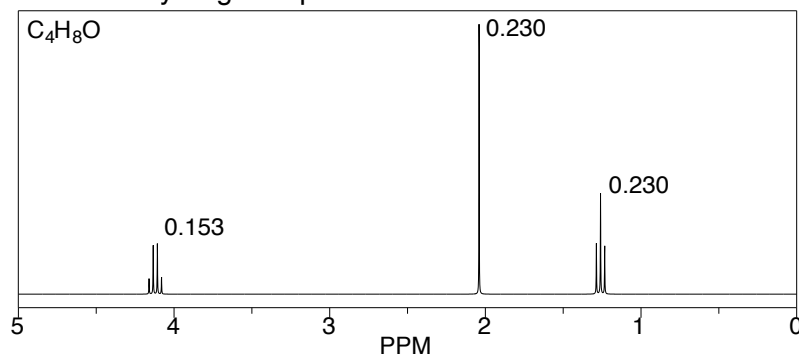
4. Calculate the coupling constant *(J)* for the NMR signal at δ 6.4 ppm shown below. A 500 MHz instrument was used to record the spectrum. You will find that this is a typical coupling constant for *trans*-alkenes.
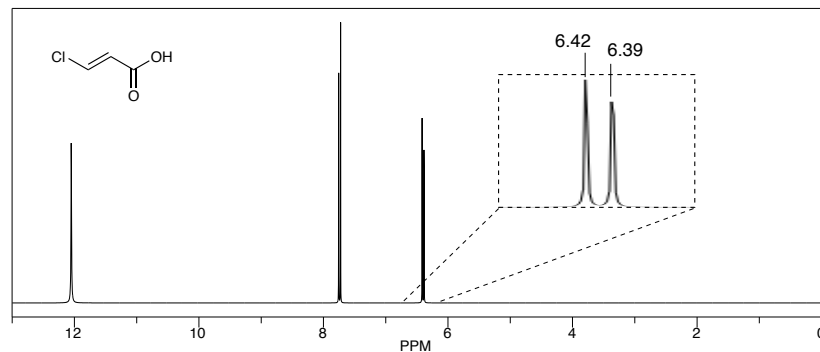
Experimental Data (Complete During Lab)

For each unknown, you will have an IR and NMR spectrum to analyze. List the key IR absorptions in the table below along with the structural/functional group assignment for each absorption. Then, list your NMR signals, giving each one a group assignment. Using this data, you can deduce the structure of your unknown. The unknown will be one of the compounds from the IR/NMR Potential Unknowns that is posted online.

Unknown Number:	
Key IR Absorptions	**Assignment**
NMR Signals	**Group Assignment**
i.e. 2.2 ppm, t, 2H	-CH$_2$-
Identification:	**Additional Notes:**

Unknown Number:	
Key IR Absorptions	**Assignment**
NMR Signals	**Group Assignment**
i.e. 2.2 ppm, t, 2H	-CH$_2$-
Identification:	**Additional Notes:**

Post-Lab Questions (Complete Following Lab)

1. A careless student mistakenly dissolved his sample in non-deuterated chloroform (CHCl$_3$). What do you think resulted in the corresponding NMR spectrum that he recorded?

2. For each compound shown below, predict the expected IR and NMR data. Record the NMR data in the form (chemical shift, multiplicity, integration). You chemical shift values and IR absorption values only need to be a rough approximation. The first molecule is already assigned to provide an example.

4.0 ppm, q, 2H   1.4 ppm, t, 2H

0.9 ppm, s, 9H

1.2 ppm, t, 3H   2.3 ppm, t, 2H
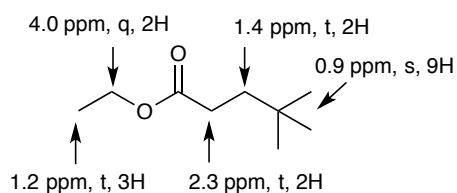
IR Data: C=O, 1740 cm^{-1}
Csp^3-H, 2930-2990 cm^{-1}
Csp^2-O, 1250 cm^{-1}
Csp^3-O, 1050 cm^{-1}