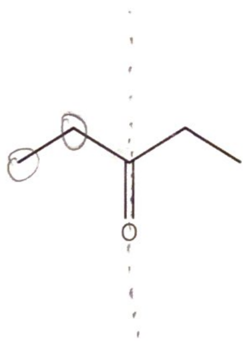
NMR #1: Nailing Down Terminology and Solving Problems with It

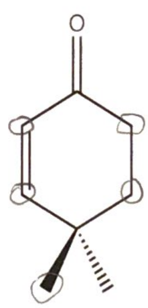
Hey, gang! Now to be honest, when I was first introduced to NMR when I was taking Organic Chemistry in college, I remember **hating** this topic (and by now, you all know that I love Ochem and can't get enough of this stuff). However, it was because I wasn't fluid with the terminology, and anytime I tried to solve a problem, I wasn't organizing the information given to me and then making an attempt to solve the problem.

SO, having said that, this worksheet won't have any problems where we will have to draw structures from scratch given an NMR spectra (but don't worry, they are coming in the next few ☺). This worksheet will have problems designed to get the NMR juices flowing and reinforcing the terminology so that when we do get some spectra and have to deduce structures, we are ready to handle those problems with ease. But enough of my textual blabber—let's get to it.

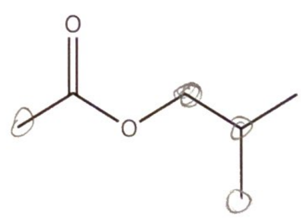
1.) Okay, so I'm going to have a list of structures below, and all I want you to do is determine how many **unique** positions are in the structure. Said another way, I want to know **how many signals will be seen in that particular structure's HNMR spectrum**. The # of unique positions in the structure will directly translate to be the # of signals in an HNMR spectrum (that's why this is a good exercise to do).



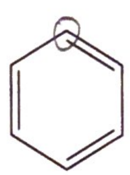
2 positions



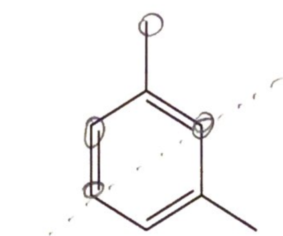
5 positions



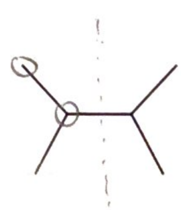
4 positions



1 position



4 positions

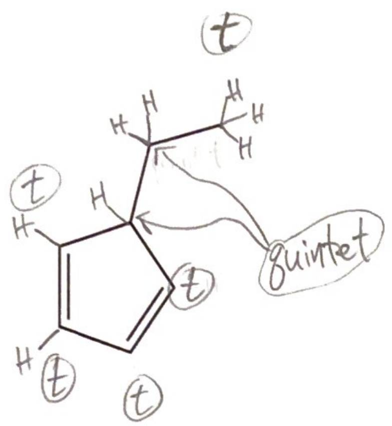


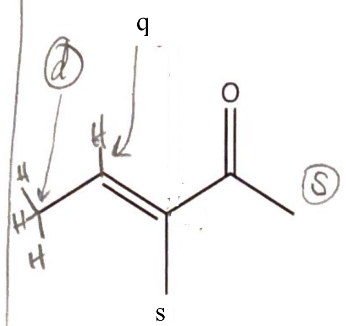
2 positions

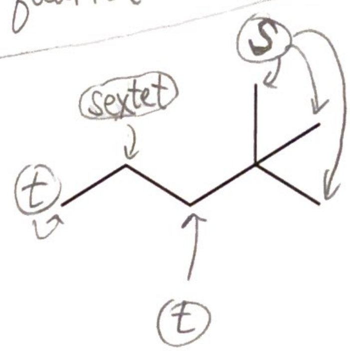
2.) Okay, so let's keep chugging along. Now, I want to talk about splitting patterns. Given the molecules pictured below, I want you to identify all of the splitting patterns for the protons at each position, where appropriate (whether the protons have a singlet, doublet, triplet, quartet, quintet, sextet, septet).

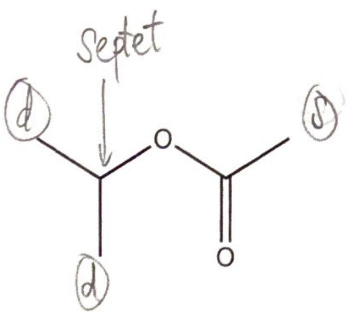
*Remember—the **n+1** rule is your friend here ☺

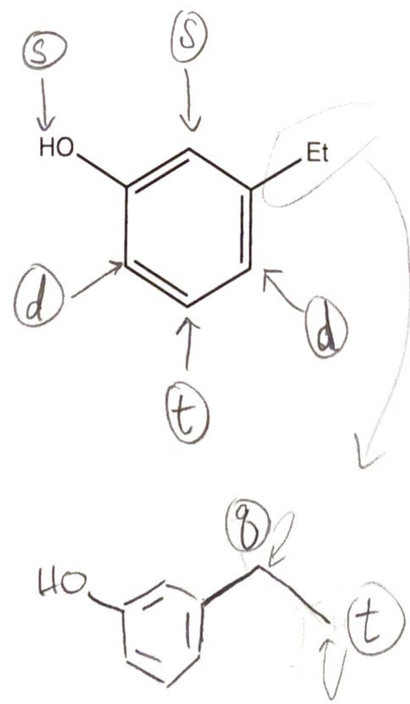
S - singlet
d - doublet
t - triplet
q - quartet

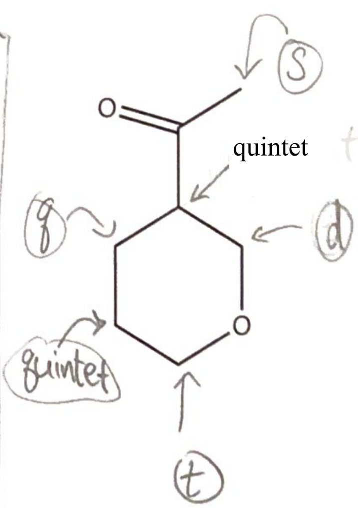








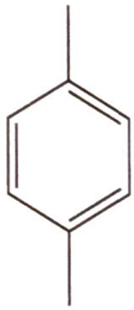


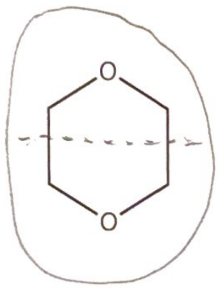


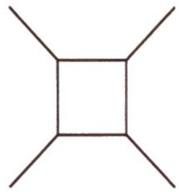
3.) Okay, last set of mini questions, so finish string here. For each problem, I am going to provide a set of NMR characteristics (it won't be a complete list), and then a few structures that ***could*** fit that description. Your job is to take the description, look at your options, and then pick the structure that correctly fits the description. You got this ☺ (**you made need the chemical shift chart I have linked/one from your book/find one on Google**).

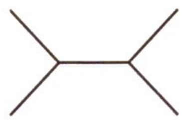
*Note: Remember the δ (which is the Greek lower case delta) means chemical shift

1.) This structure just has **one signal** in its HNMR spectrum.

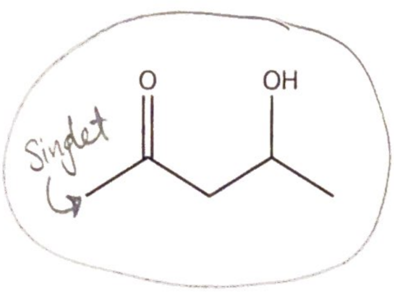


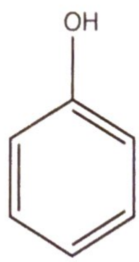


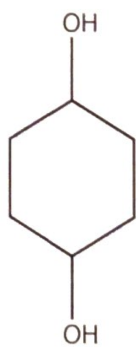


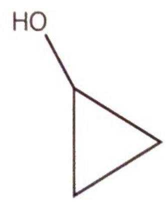


2.) This structure has a signal in its HNMR spectrum that has a **singlet splitting pattern**, and it has one signal in its spectrum that is $\boldsymbol{\delta}$ = **~4.1**.

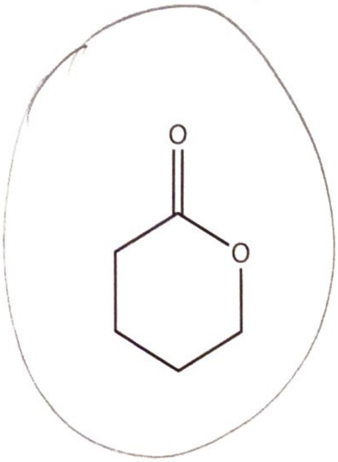




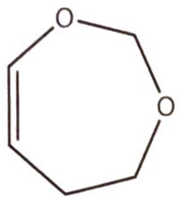




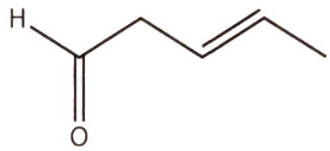
3.) This structure has two units of unsaturation and four unique signals in its HNMR spectrum.



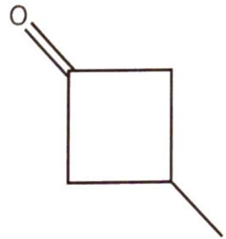
5 Signals



5 signals



3 signals



<u>BONUS CHALLENGE QUESTION:</u> Draw a structure that has **at least 6** carbons, **4** units of unsaturation, and would have **ONE** signal in its HNMR spectrum.

Benzene!

4 DoU
(ring + 3 π bonds)

There could be other answers!