CHEM 361B - Lecture 18 Activity

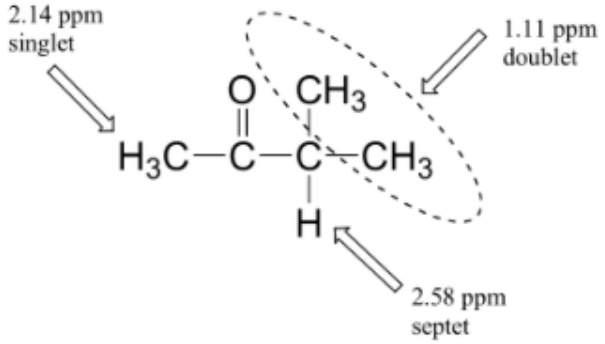
NMR

1. Consider a hydrogen atom in a 10 T magnetic field orientated along the z-axis
   (a) Show that the difference in energy between the two nuclear spin states of the proton in the hydrogen nucleus is 2.82×10^{-25} J.
   (b) Compare this value to the splitting between the $m = 0$ and the $m = -1$ electron state for the 2p orbital.

2. The Larmor Precession Frequency is the frequency at which a nucleus, whose magnetic moment is not aligned with an exterior B-field, precesses around the direction of the B-field.
   (a) Show that the Larmor precession frequency for a hydrogen atom in a 10 T magnetic field is 4.26×10^8 Hz.
   (b) Does the Larmor precession frequency increase or decrease when the B-field is dropped to 5 T.
   (c) Does the Larmor precession frequency increase or decrease if it were ^{13}C in a 10 T B-field instead.

3. As the shielding constant, σ, increases, shielding is said to increase. What happens to the chemical shift, δ, as shielding increases?

4. Explain why the indicated spin-spin coupling related peaks occur



5. Predict the number of NMR proton peaks and the multiplet splitting for each peak that you would observe for 1,1,1,2-tetrachloroethane.

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7. The NMR spectrum of acetaldehyde (ethanal) has lines at $\delta = 2.20$ and $\delta = 9.80$. Which feature can be assigned to the CHO proton?