NMR

Preparatory questions

1. Explain the difference between continuous wave and pulsed NMR.

2. What is the spin relaxation time? Describe how it is measured with pulsed NMR. Discuss how it can be obtained with continuous wave NMR.

3. Why should the proton nuclei in different compounds behave differently in the NMR experiment ?

4. In NMR spectrometers commonly used in medicine, the resonance frequency for the protons in water is 60MHz. If such an instrument was to be used to observe ^{19}F, what frequency of Rf. radiation would be required ?

5. In a magnetic field of strength 2.349 T, the resonance frequency of ^{15}N nuclei is 10.13 MHz. What is the resonance frequency of ^{15}N in a magnet of 11.745T ?

6. The gyro-magnetic ratio of the deuterium (^{2}H) nucleus is approximately 6.5 times smaller than that of the proton (^{1}H). In a magnet where a ^{1}H spectrum can be observed at about 400 MHz, what is the approximate frequency of Rf. radiation you would need to observe the ^{2}H NMR spectrum ?

7. Although the PSA-1 instrument is easy to use, there are a number of ways one can make a mistake. The following list gives some of the more common ones. Describe how you would tell whether each of the following mistakes was being made, based upon what you would see on the oscilloscope:

a. The "Tuning" on the RF receiver is set too low (not the "Frequency").
b. The cable between "RF out" and "Mixer in" is unplugged.
c. In a T2 (pulse echo) measurement, the A width is set too high.
d. In a T2 measurement, the delay time is set too long,
e. In a T1 (inversion pulse) measurement, the repetition time is too short.

8. The pulse echo method is supposed to give a good measurement of the true spin-spin relaxation (T2) time, even though the free induction decay follows the much shorter T2* time. Discuss why one should believe this, arguing from a reasonable model of molecular motion in a magnetic field gradient.

9. The FID signal following a $\pi/2$ pulse is stronger than the signal following a $3\pi/2$ pulse, which is stronger than the signal following a $5\pi/2$ pulse. Why? Give as complete an answer as you can.