ANSWERS TO PROBLEM SET 1
BCMB/CHEM 8190

1) Receptivities depend on gamma cubed (or observation frequency cubed) and I(I+1). Therefore for equal numbers of nuclei the receptiviteis relative to protons are: 2.94x10-1, 6.38x10-3, 1.04x10-3. With natural abundances they are: 8.64x10-2, 9.25x10-6, 3.85x10-6 1). Sensitivity is proportional to 1/T. Therefore at 4 versus 300K the relative sensitivitiy is 75.

2) Li-7 has 3 protons and 4 neutrons. The neutrons will be paired and will not contribute to the spin properties. The first 2 protons go into the 1s 1/2 level and are paired - they don't contribute. The single unpaired proton goes into a 1p 3/2 level. Here the proton spin has added to the ordital spin. Hence gamma has the same sign as that of the proton - positive S=3/2
N-15 has 7 protons, 8 neutrons. Again all neutrons are paired so we only consider protons. The single unpaired proton ends up in the 1p 1/2 level. Here the proton spin has subtracted from the orbital part, so the moment is opposite in sign from the proton, Hence, gamma is negative, S=1/2.
In both cases predictions agree with experiment.

3) The difference in precession frequency is (2.6752x10^8 x 11.7 x (60-55.2) x 10^-6)/2pi, or 2391Hz. The methyl resonance is 4.8 ppm upfiled of the OH resonance.

4) The easiest way to approach this problem is to linearize the equation we gave in class and either graph the data, or use your favorite linear least squares program. The equation after rearranging and laking the log of both sides is: ln ((M0-Mz)/M0) = ln2 - t/T1. Plotting and taking the slope of the best line to be 1/T1 we get a T1 of about 4.1s.