Physics 290 – Winter 2004

Assignement 6

Due March 11, 2004

The nuclear mangetic moment of ^{13}C is $\mu(^{13}\mathrm{C}) = 0.702\mu_N$. Recall that the proton momoment is $\mu(^{1}\mathrm{H}) = 2.79\mu_N$. The isotopic abundance $[^{13}\mathrm{C}]/[^{12}\mathrm{C}] \approx 0.011$ (1.1%).

1. What is the NMR frequency of ^{13}C at a magnetic field of 1.5 T?

2. Find the magnetization density of protons and ^{13}C in glucose ($C_6H_{12}O_6$) with density $\rho = 2.4$ gm/cm^3.

3. The chemical shift of fat vs tissue (water) protons is 3.5 ppm. What is the chemical frequency shift in Hz at 1.5 T?

The T_1 and T_2 of protons in grey matter and white matter (brain tissue) are given below.

Table 1: Typical relaxation times for protons in brain tissue [**?**].

	T_1	T_2
Grey Matter	1000 ms	110 ms
White Matter	650 ms	70 ms

A spin echo sequence is designed as follows:
$t = 0$ $\pi/2$ pulse
$t = 100ms$ π pulse
$t = 200ms$ π pulse

4. Sketch graphs of M_z and M_x as functions of time for $t = 0$ to $t = 1000$ ms.

5. Which tissue (grey or white) will appear darker (less signal) in a T_2 weighted image.

6. Gadolinium contrast agent shortens T_1. After injection it is carried to tissue by blood perfusion, which is generally increased in a tumor. How would a tumor appear different than adjacent normal tissue in a T_1 weighted MRI?