ANSWERS TO PROBLEM SET 2
BCMB/CHEM 8190

1) w = -gamma B1. if t x w = pi/2, B1 = -1/t x pi/2 x 1/gamma = 2.9 x 10-5 T

2) With the 90x sequence in pencil, which has rf set to 100kHz, you will find that a resonance set at 387,000 Hz will start to move off the z axis at the beginning of the rf pulse but return to the z axis by the end of the pulse. If we place the water resonance here it would not have an observable x or y component. A resonance at a smaller offset, say 10,000 Hz would experience a nearly perfect 90 degree pulse and end up on the y axis. These effects are the basis of many common water elimination sequences.

3) v = (2 pi (LC)**1/2)**-1 = 103 MHz. Q = 2 pi v L/R = 2 pi x 103 x 8/10 = 518. Tc = 5Q/v = 5 x 518/(103 x (10**6)) = 25 x 10**-6s

4) T2 = 1/(pi x delta v) = 0.16s. Actually the true T2 is not affected by magnet or processing conditions. The last two parts should have refrred to effective T2s or T2* - the apparent decay constant of the FIDs. T2* = 0.106s, T2* = 0.08s

5)
a) acqusition time should be approximately T2*, or 0.3s
b) the dwell time should be 1/(spectral width) or 1/10000 s. For a 0.3 s acquisition one needs at least 3000 complex points; the nearest power of two is 4096.
c) the Ernst formula says cos(pi/2(pw/pw90)) = exp(-aq/T1); optimum pulse angle is 20degrees; pw/pw90 = 20/90.
d) none if signal to noise is to be optimized
e) line broadening should be about 1/piT2 or 1Hz if signal to noise is to be optimized.