Physics 8.322, Spring 2003
Homework #1

Due **Tuesday, February 18** by 4:00 PM in the 8.322 homework box in 4-339B.

1. Sakurai: Problem 22, Chapter 5 (page 351)

2. Sakurai: Problem 28, Chapter 5 (page 353)

3. Sakurai: Problem 29, Chapter 5 (page 353)

4. Sakurai: Problem 30, Chapter 5 (page 353)

5. Consider a composite object, such as an atom, in a state of angular momentum

$$\mathbf{J}^2 = j(j+1)\hbar^2, \qquad J_z = j\hbar$$

at $t = 0$. An external magnetic field

$$\mathbf{B} = B_0\widehat{z} + B_1(\widehat{x}\cos\omega t + \widehat{y}\sin\omega t)$$

is applied, giving a total Hamiltonian

$$H = -\alpha\,\mathbf{J}\cdot\mathbf{B}$$

where α is a numerical constant.

(a) Write an exact formula for the state of the system at time $t > 0$

(b) Write the classical solution for $\mathbf{J}(t)$ at the resonant frequency $\omega = \alpha$

(c) Compare (a) and (b) at the resonant frequency, at a time t when $\langle J_z\rangle = 0$.