Phys 402  
Spring 2009  
Homework 2  
Due Friday, February 13, 2009 @ 9 AM

1. Griffiths, 2nd Edition, Problem 4.22 (a) and (b) only  Ang. Mom. raising operator \( L_z \) and \( Y_{\ell} \).


3. Griffiths, 2nd Edition, Problem 4.26 (a) only  Spin operator/matrix commutators


5. Griffiths, 2nd Edition, Problem 4.29  Eigenvalues and eigenfunctions of \( S_z \)

Extra Credit #3  

Extra Credit #4  
Griffiths, 2nd Edition, Problem 4.33  Spin precession in an oscillating magnetic field, time-dependent Schrödinger equation

Office Hours Thursday, 3:00 – 4:30 PM, Room 0360  
(see class web site for directions to the room)

TA (Wai-Lim Ku) Office Hours, Thursday 4:30 – 5:30 PM, Room 0104
1. The electron in a hydrogen atom occupies the combined spin and position state

\[
\Psi = R_{21}(r) \left( \frac{1}{\sqrt{3}} Y_{1}^{0}(\theta, \phi) \chi_{+} + \frac{2}{\sqrt{3}} Y_{1}^{1}(\theta, \phi) \chi_{-} \right)
\]

a) If you measured the orbital angular momentum squared \( (L^2) \), what values might you get, and what is the probability of each?

b) Same for the \( z \) component of orbital angular momentum \( (L_z) \)

c) Same for the spin angular momentum squared \( (S^2) \)

d) Same for the \( z \) component of spin angular momentum \( (S_z) \)
2. Show that it is impossible for a spin-1/2 particle to be in a state \( \chi = \begin{pmatrix} a \\ b \end{pmatrix} \) such that \( \langle S_x \rangle = \langle S_y \rangle = \langle S_z \rangle = 0 \). Hint: start by examining \( \langle \sigma_z \rangle \sim \langle S_z \rangle. \)