Physics 472 Midterm Exam #1 -- Monday, February 16, 2009

Total points = 20. Show all your work!

Useful relations about Angular Momentum:

$$[J_x, J_y] = i\hbar J_z \text{ and cyclic permutations.}$$

$$J^2|j,m\rangle = \hbar^2 j(j+1)|j,m\rangle \qquad\qquad J_z|j,m\rangle = \hbar m|j,m\rangle$$

$$J_+ = J_x + iJ_y \qquad\qquad J_- = J_x - iJ_y$$

$$J_+|j,m\rangle = \hbar\sqrt{j(j+1)-m(m+1)}\,|j,m+1\rangle \qquad J_-|j,m\rangle = \hbar\sqrt{j(j+1)-m(m-1)}\,|j,m-1\rangle$$

Spin-1/2:

$$\vec{S} = \frac{\hbar}{2}\vec{\sigma}, \qquad \text{where} \qquad \sigma_x = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \quad \sigma_y = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix} \quad \sigma_z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$

35. CLEBSCH-GORDAN COEFFICIENTS, SPHERICAL HARMONICS, AND d FUNCTIONS