Physics 472 Midterm Exam #1 -- Monday, February 18, 2008

Total points = 20. Show all your work!

Useful relations about Angular Momentum:

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

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

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

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

Spin-1/2:

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

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

Note: A square-root sign is to be understood over *every* coefficient, *e.g.*, for $-8/15$ read $-\sqrt{8/15}$.