Physics 472 – Spring 2009

Homework #3, due Friday, January 30

(Point values are in square brackets.)

1. [3] Griffiths problem 4.31. The results should look familiar from the Physics 471 final exam.

2. [4] Griffiths problem 4.32. The state of the system is given in Equation [4.163].

3. [4] Griffiths problem 4.34. We did this in class, but it's a good warm-up for the next two problems.

4. [5] Consider an electron in a hydrogen atom state with *l*=1. The total angular momentum is represented by the operator $\vec{J} = \vec{L} + \vec{S}$. The corresponding quantum number *j* can take the values j=3/2 or j=1/2. In class we showed how to use the lowering operator to express the eigenstates of J^2 and J_z, labeled $\left| j, m_j \right\rangle$, in terms of linear combinations of the states $\left| l, m_l \right\rangle \otimes \left| s, m_s \right\rangle$. Follow the same procedure here to construct all four states of the j=3/2 ladder and both states of the j=1/2 ladder. Check your results using the Clebsch-Gordan coefficients in Table 4.8.

5. [4] Griffiths problem 4.36. For part (a) you may use Table 4.8. For part (b), you may use either Table 4.8 or the results you derived in the previous problem. If you choose the latter, you need to invert the basis transformation, i.e. you need to express the appropriate $\left| l, m_l \right\rangle \otimes \left| s, m_s \right\rangle$ state as a linear combination of the $\left| j, m_j \right\rangle$ states.