
449 Homework #2

In[3]:= << "http://www.physics.wisc.edu/~tgwalker/448defs.m"

- 1) Write the function $f = \sin^3 \theta \cos \theta \sin(3\phi)$ as a series of spherical harmonics.
- 2) Write $z = r \cos \theta$ in terms of spherical harmonics. Likewise for x . Show how to get the same result by applying a rotation operator about the y -axis.
- 3) Calculate $\int d\Omega Y_{1,-1}(\theta, \phi) Y_{2,1}(\theta, \phi) Y_{3,0}(\theta, \phi) Y_{2,0}(\theta, \phi)$ by expanding each pair of Y 's as a series of spherical harmonics and using the orthogonality of the Y 's.
- 4) Find the lowest 8 energy levels (and their degeneracies) for the potential $V = b r$.
- 5) For $l_1 = 0$,
$$S(n_2, l_2, n_1, l_1) = \sum_{m_1, m_2, i} \langle n_2 l_2 m_2 | r_i | n_1 l_1 m_1 \rangle \langle n_1 l_1 m_1 | r_i | n_2 l_2 m_2 \rangle = \left(? \int_0^\infty dr r P_{n_2 l_2} P_{n_1 l_1} \right)^2$$
- 6-7) Exercises 10&11 in the Supersymmetry handout.
- 8) Hydrogen: $S(3p, 2s) = ?$
- 9) How many radial zero crossings are there for the 5p $m=1$ state of hydrogen? Plot the probability distribution in the x - z plane. (Use ContourPlot)