Physics 325, Winter 2002 **Problem set #1** Due: Fri. 1/18/02

Assigned problems. *All five are to be turned in; two will be graded and will be worth 50 points each.*

1. Use operator methods to find the spherical Bessel functions $j_3(r)$ and $n_3(r)$. Construct the spherical Hankel functions $h_3^{(1)}$ and $h_3^{(2)}$. (See p. 179 in Gasiorowicz and class notes (my semi-intelligible version of the notes are posted on the class website)).

2. Consider a particle in a spherical box with radius a:

$$V(r) = \begin{cases} 0 & 0 \leq r < a \\ \infty & a < r \end{cases} .$$

a) Find a formula for the energies of the $\ell = 0$ ("s-wave") bound states. Sketch $R(r)$ for the first three $\ell = 0$ eigenstates.

b) Solve graphically for the energies of the $\ell = 1$ ("p-wave") boundstates. Sketch $R(r)$ for the first three $\ell = 1$ eigenstates.

3. Gasiorowicz, Chapter 12, #6.

4. Gasiorowicz, Chapter 12, #2. Hint: you need to compute the quantity $|\langle\psi_i|\psi_f\rangle|^2 = |\int d^3r\, \psi_i^* \psi_f|^2$, where $\psi_i(\vec{r})$ is the wavefunction of the electron initially about the tritium nucleus, and $\psi_f(\vec{r})$ is the final state, the ground state about the He^3 nucleus. You can assume that the only thing that the nuclear transition involves is an instantaneous change of the nuclear proton number Z.

5. Gasiorowicz, Chapter 12, #5.