362L Homework Set 6 **Due April 3 in class.**

[“H & G” refers to our textbook. Show a *complete solution* to each question, explaining things in your words. Many of the questions are quite simple and straightforward. Do not copy stuff that you don’t understand and don’t explain out of some on-line collection of “solutions”. Your entire grade in this class is pretty much based on homework, so take it seriously; this assignment covers a variety of topics as presented in class lectures.]

(1) Mass Formula:

(a) 16.15.

(b) You can find in various places tables of nuclear masses in amu (atomic mass units), which are easily converted to MeV/c^2. Calculate the binding energy of the last neutron in $_7N^{15}$, and of the last proton in $_8O^{15}$, and compare to the similar energies of the last neutron in $_7N^{16}$ and in $_8O^{16}$. [The typical binding energy per nucleon for nuclei is of course roughly -8 MeV, but as we saw in class it varies from near zero for very light nuclei to a peak near iron, and then drops to about -7 MeV for heavy nuclei. The notation for a specific nucleus means $_Z$Chemical Symbol^A. The notation is redundant since someone who had memorized the periodic table would know Z from the chemical symbol, but no physicist ever bothers to memorize the periodic table, for obvious reasons.]

(2) Independent Particle Model:

(a) 17.19 in H & G.

(b) The ground state of $_{56}Ba^{137}$ is $3/2^+$. The first two excited states are $1/2^+$ and $11/2^+$. What values would you have expected from the independent particle model? Have you got an explanation for any discrepancy you find?

(c) Suggest values for the spin and parity of the ground states of the following nuclei: $_{15}P^{31}$, $_{30}Zn^{67}$ and $_{49}In^{115}$.

(3) Optical Model: Show that if the potential in the one-dimensional Schrödinger equation is complex, $U(x) = V(x) + iW(x)$, probability is not conserved.

Hint: `http://tinyurl.com/yaly5gec`