Physics 137B Section 1: Problem Set #6
Due: 5PM Friday March 12 in 2^{nd} floor LeConte-Birge Cross-Over

Suggested Reading for this Week:

- Bransden and Joachain (B& J) Sections 10.4-10.6
- A table of electron configurations can be found on page 192 of Griffiths

Homework Problems:

1. B& J Problem 10.5
2. B& J Problem 10.6
3. Consider two identical particles in a 1-dimensional harmonic oscillator potential, one in state $|n\rangle$ and the other in state $|m\rangle$. Suppose the particles interact via a potential $V(x_1,x_2) = \lambda(x_1 - x_2)^2$, where λ is a small number. To first order in perturbation theory, find the value(s) of energy for the case where
   (a) The particles have spin 0
   (b) The particles have spin $\frac{1}{2}$
4. Show that the ground states for the first three elements in the "neon configuration" ($Z = 11 to 18$) are consistent with *Hund's rules*:
   1 The lowest energy state is the *LS* multiplet with largest value of *s*
   2 When more than one value of ℓ is associated with the maximum *s* value, the lowest energy state among those satisfying the exclusion principle is the one with the largest ℓ.
   3 For a given ℓ subshell containing *n* electrons, the lowest energy level has $J = |L - S|$ if the subshell is no more than half filled and has $J = |L + S|$ if it is more than half full

Note: Different texts list Hund's rules in different order. This is the order quoted in Liboff. Griffiths switches the order of rules 2 and 3.

5. For this problem, we will concentrate on the following 3 atoms: Boron ($Z = 5$), Carbon ($Z = 6$) and Nitrogen ($Z = 7$).

   (a) Find the electron configuration for each element

   (b) Find the corresponding total angular momentum. List all possibilities if more than one angular momentum is allowed.

   (c) Use Hund's rules to resolve the ambiguities in (b)