Physics 4410 Homework #6
Due Wednesday, Oct. 8, IN CLASS. Recall: late homework will not be accepted.
Be sure to show your work and explain what you are doing.

The first midterm will be on Monday, Oct. 6th, in class.

1) (30 points) Two identical, non-interacting particles are placed in a one-dimensional harmonic oscillator potential \( V(x) = \frac{1}{2} m \omega^2 x^2 \). Assume the particles are in the same spin state as each other, and that one particle is in the ground state and the other is in the first excited state, of the oscillator.

Write down and normalize the wave function for this state, assuming the particles are
a) identical bosons;
b) identical fermions.

Compute the root-mean-squared average distance between the particles, defined by
\[ \bar{x}_{12} = \sqrt{\langle (x_1 - x_2)^2 \rangle}, \]
assuming the particles are
c) identical bosons;
d) identical fermions.
e) Interpret these results in a simple statement.

Remark: harmonic oscillator wave functions are given in Sec. 2.3 of Griffiths.

2) (10 points) What is the electronic configuration for the carbon atom (Z=6)? Using Hund’s rules, decide what is the ground state of this atom. Express your answer in spectroscopic notation. Warning: your answer must also account for fermion exchange symmetry.