Phys 122, HW #7; Due Wednesday 4/8 (but a longer HW than usual!)

1. What do you expect would be the electron configuration of element Z=121? (121 protons and electrons) Use the notation like $(1s)^2(2s)^2(2p)^6$, etc.

2. Paying attention to selection rules ($\Delta l=1$) , list all the paths by which a Hydrogen atom in the 4P state might decay to the ground state (in "nl" notation; ignore m's). You are not allowed to make a transition between two states with the same energy. (so no 4P->4S transitions, etc.)

3. Chapter 9, Problem 36 (Same in 3rd and 4th editions)

4: How hot would you have to make a collection of hydrogen atoms so that 2% of the electrons were found in the n=2 shell? Use Maxwell-Boltzmann statistics and don't forget to take the degeneracies into account; The probabilities should be proportional to the degeneracy "g" multiplied by f(E). (Also, don't consider any higher energy shells)

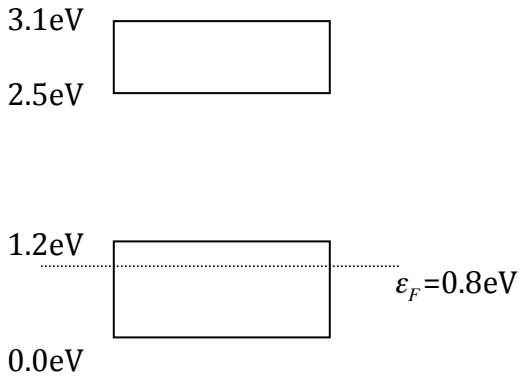
5. The lowest five energy states in the Helium atom (Z=2) have the following energy levels (assuming at least one electron is in the ground state.)

_____ 3p; -1,4eV
_____3s; -1.7eV
_____2p; -3.4eV
_____2s; -4.0eV

_____1s; -24.5eV

A) Find one wavelength of light that you could shine on a collection of helium atoms to make a laser. Consider selection rules for all transitions. Explain your reasoning!!
B) What wavelength(s) would the output laser beam have?
C) Calculate the quantum efficiency of the laser.

6: Consider the following energy-band structure in a solid.



The higher-energy band goes from 2.5eV to 3.1eV. The lower energy band goes from 1.2eV to 0.0eV. The Fermi energy is at 0.8eV and is marked with a dashed line.

A) Is this an insulator, conductor, or semiconductor? Justify/explain your answer.

B) Calculate ALL possible photon energies that can be absorbed by this solid at absolute zero. (Leave answers in eV)

C) Explain how your answer to part B is likely to change if it is heated up to high (~1000 Kelvin) temperatures.