Modern Physics — Homework 7
Due Friday October 31 at 4 p.m.

Each week you should review both your answers and the answer key for the previous week's homework to make sure that you understand all the questions and how to answer them.

1. Your first homework question is to submit one homework correction. Select one problem for which you had the wrong answer. On a fresh sheet of paper, 1) identify the question number you are correcting, 2) state (copy) your original wrong answer, 3) explain where your original reasoning was incorrect, the correct reasoning for the problem, and how it leads to the right answer. If you got all the answers correct, then state which was your favorite / most useful homework problem and why.

NOTE: I recommend revisiting the probability worksheet from HW 6, if you did not get 4 or 5 on those two problems. THIS WEEK I'll allow you to correct two problems (for a max of 5 regular points and 5 bonus points) so that you can correct both problem 3 and 4 from the worksheet. You do need to carefully explain any errors in your reasoning from your original answer.

2. The potential for the 1-dimensional infinite square well is a reasonable approximation of the potential for an electron in an isolated length of very thin wire.

(a) What is the smallest possible energy (in eV) – the ground state - for an electron in a 0.01 m (1 cm) wire?

(b) How much energy (in eV) does an electron at room temperature (300K) have? Remember that the thermal energy is given approximately by kT where k is Boltzmann's constant.

(c) What length wire (in nm) would have the energy difference (energy spacing) between the ground state energy level and the next energy level up as equal to this thermal energy of an electron at room temperature?

(d) Looking at the electrons energy levels in the wire.

True	False	As the wire gets longer, the wavelength of the electron in the lowest energy state gets longer.
True	False	As the wire gets longer, the ground state energy level gets lower.
True	False	As the wire gets longer, the energy differences between the energy levels get larger.
True	False	If you double the length of the wire, the energy spacing between levels n=1 and n=2 will decrease and be equal to 0.5 times what it was.
True	False	The quantization of energy levels and the fact there is a gap between allowed levels only become large and important (relative to the typical thermal energies important in describing the behavior of the electron) when the length of the wire becomes submicroscopic as it does in nanotechnology.

From the textbook (Harris):
5.7, 5.15, 5.16, 5.22, 5.24, 5.32, 5.34

Please use at least one sheet of paper for each problem. (That is, don't put more than one problem on a given page.) Feel free to use the clean back side of old print-outs. Remember to include phrases explaining your work. All work must be clear and easy for me to understand in order to receive full credit.