C455A - Homework 2
Due Tue Oct 10 by 5pm

Circle your answers. Submit your problems IN ORDER.
Staple your work together.

1) P1.20 – photoelectric effect (you may not remember but you did problems like this in Freshman chemistry)

2) P2.11 – operators and eigenfunctions

3) P4.5 – acceptable wavefunctions

4) P4.12 – superposition wave function

5) P4.14 – probability and particle in a box

6) P4.16 – particle in a 2D box

7) P2.21 (You should be familiar with the concept of *orthogonal vectors* from your math and physics courses. Although we will not spend much time on of *orthogonal functions* in lecture, they will be reviewed in discussion, and in your text reading, and you will be responsible for this material). In short, two functions, f(x), and g(x), are said to be orthogonal over the interval from a to b if $\int_a^b f^*(x)g(x)dx = 0$ unless f(x) = g(x).)

8) By explicitly applying the normalization condition $\int_{-\infty}^{\infty} \psi^* \psi dx = 1$ find the value of the normalization constant ('A' in lecture) for the steady state (solutions to the 1D time-independent Schrödinger eqn) wave-functions for the particle in an infinite square well for all possible values of 'n'.

9) Treat γ-carotene, one of the precursors of vitamin A, as a linear conjugated system containing 11-double bonds. Use the particle in a box model to estimate the energy of the electronic absorption band for γ-carotene. Compare the calculated value with the observed transition at 460 nm. The agreement will be poor (but you shouldn't be off by orders of magnitude). Can you figure out why such a simple 'free electron model' is breaking down (i.e. why did the model work better for butadiene)? Hint: do electrons attract or repel one another?

10) An electron is placed in a 1D box of length L (i.e. one wall at x=0, the other at x=L). If an electron is in the first excited state (in other words, the n=2 state), determine the probability that the electron will be found in the middle 1/3 of the box.