Physics 330, Spring 2009
HW#5 30 points

Problems from Tipler and Llewellyn:

1. **6.1, 6.2 (5 points)** Show that the wavefunction $\Psi(x,t) = Ae^{kx-wt}$ does not satisfy the time independent Schrödinger equation. Show that $\Psi(x,t) = Ae^{i(kx-wt)}$ satisfies both the time-dependent Schrödinger equation and the classical wave equation (Eq. 6-1).

2. **6.10 (5 points)** A particle is in the ground state of an infinite square well potential given by equation 6-21. Find the probability of finding the particle in the interval $\Delta x = 0.002L$ at (a) $x = L/2$, (b) $x = 2L/3$, and (c) $x = L$. (Since Δx is very small, you need not do any integration.)

3. **6.16 (5 points)** The wavelength of light emitted by a ruby laser is 694.3 nm. Assuming that the emission of a photon of this wavelength accompanies the transition of an electron from the $n = 2$ level to the $n = 1$ level of an infinite square well, compute L for the well.

4. **6.32 (5 points)** Find $\sigma_x = \sqrt{< x^2 > - < x >^2}, \sigma_p = \sqrt{< p^2 > - < p >^2}$, and σ_x, σ_p for the ground state wave function of an infinite square well. (Use the fact that $< p >= 0$ by symmetry and

$$< p^2 >=< 2mE >$$

from Problem 6-31.)

5. **6.41 (5 points)** The period of a macroscopic pendulum made with a mass of 10 g suspended from a massless cord 50 cm long is 1.42 s. (a) Compute the ground state (zero-point) energy. (b) If the pendulum is set into motion so that the mass raises 0.1 mm above its equilibrium position, what will be the quantum number of this state? (c) What is the frequency of motion in (b)?

6. **6.45 (5 points)** In a particular semiconductor device an oxide layer forms a barrier 0.6 nm wide and 9 V high between two conducting wires. Electrons accelerated through 4 V approach the barrier. (a) What fraction of the incident electrons will tunnel through the barrier? (b) Through what potential difference should the electrons be accelerated in order to increase the tunneling fraction by a factor of 2?