Due: Friday, 9/12, 2:10pm, PHYS360 Assignment 2
Reading:

1. Griffiths, Ch.2, pg. 24-59.
2. Prepare for Reading Quiz: Friday, 9/12, questions on anything in Griffiths, pages 1-59, but especially:
   a) pg 3 – 5
   b) be able to show $\langle \Delta j \rangle = \langle j - \langle j \rangle \rangle = 0$, pg. 8
   c) be able to show $\sigma^2 = \langle j^2 \rangle - \langle j \rangle^2$, pg. 9
   d) be able to show that if $\Psi(x,0)$ is normalized, $\Psi(x,t)$ is normalized for all *t*, pg. 13-14
   e) be able to show that the solution to Sch. Eq. of separate variables is a state of definite total energy, e.i., show $\sigma_H^2 = \langle H^2 \rangle - \langle H \rangle^2 = 0$, pg. 27
3. Optional: Applet Simulations (Physlet on CD), Problem 6.2, Problem 10.3, 10.4, 10.5 (if you do these problems, write the answers on a separate sheet)

Problems:

1. Problem 2.2

2. A particle in a one-dimensional box $0 \le x \le a$ is in the state:

$$\Psi(x,0) = \frac{1}{\sqrt{10a}} \sin(\frac{\pi x}{a}) + A\sqrt{\frac{2}{a}} \sin(\frac{2\pi x}{a}) + \frac{3}{\sqrt{5a}} \sin(\frac{3\pi x}{a})$$

   a) Find *A* so that $\Psi(x,0)$ is normalized
   b) What are the possible results of measurements of the energy, and what are the respective probabilities of obtaining each result?
   c) The energy is measured and found to be $\frac{2\pi^2\hbar^2}{ma^2}$. What is the state of the system immediately after the measurement?

3. In class, we considered the following state for a particle trapped in a one-dimensional box:

$$\Psi(x,0) = \frac{i}{2}\sqrt{\frac{2}{a}} \sin(\frac{\pi x}{a}) + \sqrt{\frac{1}{a}} \sin(\frac{3\pi x}{a}) - \frac{1}{2}\sqrt{\frac{2}{a}} \sin(\frac{4\pi x}{a})$$

What is the expectation value for the energy in this system?

4. A particle in the harmonic oscillator potential is in the state:

$$\Psi(x,0) = \frac{1}{\sqrt{2}}\psi_0(x) + \frac{1}{\sqrt{2}}\psi_1(x)$$

a) Check whether $\Psi(x,0)$ is normalized

b) Find the state at time t, $\Psi(x,t)$

c) Show that $\langle x \rangle$ and $\langle p \rangle$ oscillate in time.

d) If you measured the energy of this particle, what value might you get and with what probabilities?

5. Show that

$$[\hat{N}, \hat{a}_-] = -\hat{a}_-, \qquad [\hat{N}, \hat{a}_+] = \hat{a}_+$$

6. Problem 2.5
7. Problem 2.6
8. Problem 2.7