Phys 3810, Fall 2008
Problem Set #2, Hint-o-licious Hints

1. *Griffiths*, **2.10** Use (2.66) and you can use the result for $\psi_1(x)$ from 2.47. You will find:

$$\psi_2(x) = \frac{1}{\sqrt{2}}\, a_+ \psi_1(x) = \frac{1}{\sqrt{2}} \left(\frac{m\omega}{\pi\hbar}\right)^{1/4} \left(\frac{2m\omega}{\hbar} x^2 - 1\right) e^{-\frac{m\omega}{2\hbar} x^2}$$

2. *Griffiths*, **2.11** This one can be a little tedious; it will be OK if you just do the $\psi_0(x)$ state *or* the $\psi_1(x)$ state. For ψ_0, the nonzero answers are

$$\langle x^2 \rangle = \frac{\hbar}{2m\omega} \qquad \langle p^2 \rangle = \frac{\hbar m\omega}{2}$$

and for ψ_1 the nonzero answers are

$$\langle x^2 \rangle = \frac{3\hbar}{2m\omega} \qquad \langle p^2 \rangle = \frac{3\hbar m\omega}{2}$$

For part (c), recall how T and V are related to p^2 and x^2, respectively. Then use the results from part (a).

3. *Griffiths*, **2.15** The classicam turning point for the ground state is $a = \sqrt{\frac{\hbar}{m\omega}}$. The probability we want is

$$P = \int_{|x|>a} |\psi_0(x)|^2 \, dx$$

I get $P = 0.157299$ (probability to be where, classically, it shouldn't be). But whatever probability you get, make sure it's less than 1.

4. *Griffiths*, **2.19** Use the definition of J from Problem 1.14 and be careful with the complex conjugates. You get an answer which makes sense, as it is proportional to the classical velocity.

5. *Griffiths*, **2.21**