PHYS420 (Spring 2002)
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Homework # 11
(due Monday, May 6^{th}, 2002)

Problems

1. Show, for the infinite well, that the average position $< x >$ is independent of the quantum state. *Hint: Use the integral formula:* $\int_0^{2n\pi} u \cos u \, du = 0$ *(for integer n)*

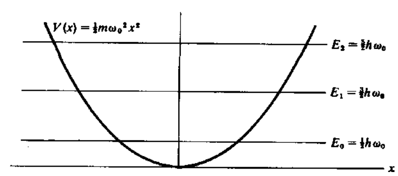
2. *Carefully* sketch the wave function and the probability density for the n = 4 state of a particle in a *finite* potential well.

3. **SMM, Chapter 5, problem 26.** *Hint: Check Example 5.13 if you are stuck.*

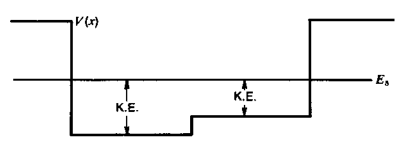
4. Calculate $< x >$, $< x^2 >$, and Δx for a quantum oscillator in its ground state.
Hint 1: Is the integral, over all x, of an odd function zero?
Hint 2: Use the integral formula $\int_0^{\infty} u^2 e^{-au^2} du = \frac{1}{4a}\sqrt{\frac{\pi}{a}}$ $\quad a > 0$

5. **SMM, Chapter 6, problem 1.**

6. Sketch careful, qualitatively accurate plots for the stated wave functions in each of the potentials shown. *Important: Check that your wave function has the correct symmetry, number of nodes, relative wavelengths, maximum values of amplitudes and relative rate of decrease outside the well.*
(a) The ground state, 1^{st} and 2^{nd} excited wave functions of the quantum oscillator. Realize that this corresponds to the 1^{st}, 2^{nd} and 3^{rd} bound state.



(b) The 5^{th} bound state of the finite square well with a two level floor.



(c) The 5^{th} bound state of the finite square well with a ramped floor.