Phys 122: Midterm #2 NAME ________________________________

Sample Test (From actual previous midterms!)

#1. A particle with mass M is in an infinite square well with width D. (30 pts)

A) What is the smallest energy that this particle could possibly have?

B) Suppose you measure the energy of the particle and it has an energy equal to 9 times the answer to part A). Give an equation for the resulting wavefunction and sketch it on an appropriately **labeled** diagram (label values on both axes!). Make sure you also show the wavefunction outside the well.

C) After your energy measurement from part b, what is the probability that a position measurement will find that the particle is in the middle *fifth* of the well? You just need to give an expression that a mathematician could solve with no knowledge of physics; DO NOT solve or simplify your expression!

D) Give an expression for the wavelength of a photon that might be emitted from this well. (*After* the above energy measurement described in part B.)

#2. Suppose there is some potential V(x) for which the normalized solutions to the time-independent Schrodinger equation are known functions $\psi_n(x)$, and the associated energies are $E_n = (n-0.5)\hbar\omega$ for some known constant ω. (20 pts.)

The wavefunction for some particle is given at time t=0 by:

$$\psi = A\left(\psi_1 - 2\psi_2 + 3\psi_3\right)$$

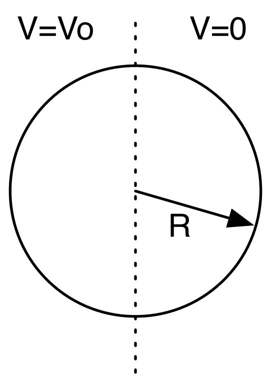
(ψ_1 is the normalized ground state, etc.) A is an unknown constant.

a) If an energy measurement is made on this particle, what results might one measure, and with what probability for each possible result? (You can give your probabilities in terms of A, but for full credit you must solve for A using normalization.)

b) What is the wavefunction at a later time t, in terms of $\psi_n(x)$ and ω?

3. A particle of mass M is constrained to travel in a circular path of radius R. (Say, it's on a wire or something; don't worry about centripetal forces.)

When the particle is on the left side of the dotted line, it has potential energy Vo. When the particle is on the right side of the dotted line, it has no potential energy.



A) In terms of the total energy E, find the particle's deBroglie wavelength on the right side of the dotted line.

B) In terms of the total energy E, find the particle's deBroglie wavelength on the left side of the dotted line. (E is the same as part A, but the wavelength isn't.)

C) In terms of some integer "n" (and other given parameters) find the allowed energies (E) of this particle. (Take into account that your answers for part A and part B are different, and yet still consider an entire round trip.)