

Homework Assignment 8

Due: Tuesday November 17, 11:59 pm, UBlerns Digital Dropbox

PHY 410: choose any two problems. PHY 505: work all three problems

1. Add code to `inwell.cpp` to compute the eigenfunction $\psi_n(x)$ after it has found an eigenvalue E_n . Make plots of the normalized eigenfunctions for a few of the lowest eigenstates and compare with the corresponding analytic solutions from your quantum mechanics textbook.

<http://www.physics.buffalo.edu/phy410-505/topic5/lec-5-1.pdf>

2. Compare the numerical wavefunctions generated by the program `schroedinger.cpp` to the analytical formulas in your quantum mechanics textbook.

Add a term x^n to the harmonic oscillator Hamiltonian. Consider the cases $n = 3, 4$. Generate the spectrum of eigenvalues numerically and explain the changes you observe.

<http://www.physics.buffalo.edu/phy410-505/topic5/lec-5-2.pdf>

3. Add a quartic x^4 perturbation to the harmonic oscillator Hamiltonian. Estimate the ground state energy using `vmc.cpp` and compare with one other method, for example, first order perturbation theory, or the `schroedinger.cpp` program. Plot and compare the normalized probability densities of the unperturbed and perturbed oscillator.

<http://www.physics.buffalo.edu/phy410-505/topic5/lec-5-3.pdf>