

Homework Assignment 3

Complete the following problems.

This assignment is due by 11:59 pm on December 11, 2018.

1. Consider a one-dimensional particle in a box where the potential is ∞ for $x < 0$ and $x > L$. In the range from 0 to L , let the potential energy be given by $V(x) = mx$. Using $\hbar = m = L = 1$, write a Mathematica notebook that solves for the eigenfunctions and eigenvalues of the first five states of this system. Use the linear variational method to carry out this numerical problem. The standard one-dimensional particle-in-a-box eigenfunctions should be used as your basis set.
 - a. How does the ground state energy vary as a function of the number of basis functions? To explore this point, begin by using the two lowest energy states of the standard particle-in-a-box system as your set of basis functions. Then, use the first three states of the standard particle-in-a-box as your basis set. Follow this by numerical tests using four, five, six, seven, eight, nine, and ten states. Plot the ground state energy as a function of the number of basis functions used.
 - b. Repeat the previous experiment with the potential function changed to $V(x) = 10mx$.
 - c. Plot the ground state wavefunction for the previous two problems using an appropriately converged basis set size. Comment on the effect of the added potential on the shape of the ground state wavefunction.