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1. Is the energy you calculated above higher or lower than the ground state energy of the ordinary particle in a box system (without the delta function potential)?

Question is answered in scanned sheet. En = 0.049298

The energy that was calculated in the code is lower than the ground state energy of the ordinary particle in a box system (without the delta function potential).

1. Why do you think mixing in functions that correspond to excited states in the ordinary particle in a box system actually helped to improve (i.e. lower) your energy in the system with the delta function potential?

Mixing in functions allows more eigenvalues to be present, thereby increasing orbital energy and the expansion coefficient. The more eigenvalues that are present the more regional space is covered which can better represent (optimize) the ground state energy.

1. Increase the number of basis functions to 6 (so that  is a 6x6 matrix and  is a vector with 6 entries) and repeat your calculation of the variational estimate of the ground state energy. Does the energy improve (lower) compared to what it was when 3 basis functions were used?

When you increase the matrix from 3x3 to 6x6, we see the 6x6 matrix has a lower trial ground state energy. The 6x6 is a better representation of the true ground state energy.