

1 Delta Function Well

Consider a particle with mass m in a one dimension potential:

$$V(x) = -\gamma\delta(x)$$

where γ is positive.

- Sketch a graph of the potential.
- What are the dimensions of the constant γ ?
- For this potential, there is only one bound state. Solve for the energy eigenstate and value of the energy of the bound state.

Hint: There are actually two approaches you can use to solve this. The first approach is to work with the δ function directly and use the appropriate boundary conditions for an infinite potential. The second approach is to start with the solution to a finite square well and then turn it into a delta function well by taking the limit that the width of the well goes to zero.

- Sketch the wave function of the bound state.

2 Normalize the Eigenstates of the Finite Well

None

Consider a particle of mass m in a finite potential well:

$$V(x) = \begin{cases} V_0 & x < -a \\ 0 & -a < x < a \\ V_0 & a < x \end{cases}$$

The even solutions are expressed as

$$\phi(x) = \begin{cases} Ae^{qx} & x < -a \\ D \cos kx & -a < x < a \\ Ae^{-qx} & a < x \end{cases}$$

Normalize the even solutions and use the boundary conditions to help you solve to the A and D parameters in terms of q and k .