

1 Particle in a Box Solve Schrodinger

Consider a quantum particle with mass m in a 1-D box where the potential is:

$$V = \begin{cases} \infty & x < 0 \\ 0 & 0 \leq x \leq L \\ \infty & L < x \end{cases}$$

- (a) What is the Hamiltonian for this system?
- (b) Use a separation of variables procedure to solve the Schrödinger Equation for this system and find the general solution $\Phi(x, t)$. (You saw the solution in Ph425 but now I want you to solve it yourself.)

2 Particle in a Box Review

As a review of the infinite square well system, consider a quantum particle with mass m is a 1-D box from $0 \leq x \leq L$. The initial state of the particle is:

$$\psi(x, 0) = \sqrt{\frac{2}{3L}} \sin\left(\frac{2\pi x}{L}\right) + \frac{2i}{\sqrt{3L}} \sin\left(\frac{3\pi x}{L}\right)$$

- (a) Write down the energy eigenvalues and eigenstates for this system. (You don't have to re-solve for them in this problem.)
- (b) If you measured the energy of the system at $t = 0$, what is the probability you would measure the value $E = 9\pi^2\hbar^2/2mL^2$?
- (c) What is the expectation value of the energy at $t = 0$
- (d) What is the uncertainty of the energy at $t = 0$
- (e) Plot the probability density of the system.
- (f) If instead you measured the position of the system at $t = 0$, what is the probability you would find the particle between $x = L/4$ and $x = L/2$?
- (g) What will be the state of this particle at a later time t ?