

Rest of this class was mathematica demo.

Particle in a box

Stationary states

Most general solution:

Probability to measure x within $[x, x+dx] = |\Psi(x,t)|^2 dx$

$j(x,t) = \frac{\hbar}{2mi} \left(\Psi^* \frac{\partial \Psi}{\partial x} - \Psi \frac{\partial \Psi^*}{\partial x} \right)$

$\frac{\partial \rho}{\partial t} + \frac{\partial j}{\partial x} = 0$

$\Psi_n(x,t) = \frac{\sqrt{2}}{L} e^{-i \frac{E_n t}{\hbar}} \sin\left(\frac{n\pi x}{L}\right)$

$E_n = \frac{\hbar^2 \pi^2 n^2}{2mL^2}$

$C_n \in \mathbb{C}$
(8 time independent)

$\Psi(x,t) = \sum_{n=1}^{\infty} C_n \Psi_n(x,t)$

$\langle \dot{x} \rangle(t) = \int_0^L dx \Psi^*(x,t) \Psi(x,t) \dot{x}$

$\langle P^n \rangle(t) = \int_0^L dx \Psi^*(x,t) (-i\hbar)^n \frac{\partial^n \Psi(x,t)}{\partial x^n}$

$E_n = E_1 n^2$

$\frac{x}{L} \Rightarrow x \in [0,1]$

$\frac{E_n t}{\hbar} = \left(\frac{E_1 t}{\hbar} \right) n^2$

$t \in [-\infty, \infty]$

$\Psi(x,0) = \sqrt{2} \sin(\pi x)$

$\int_0^1 \sqrt{2} \sin(\pi x) \Psi(x,0) = \int_0^1 \sum_n C_n \left(\sqrt{2} \sin(n\pi x) \cdot \sin(\pi x) \sqrt{2} \right)$

$\int_0^1 \Psi^*(x,0) \Psi_n(x,0) = C_n$

$C_m = \sqrt{2} \int_0^1 dx \Psi_m^*(x,0)$