Review

Particle can be described by a wave function Ψ(x,t):

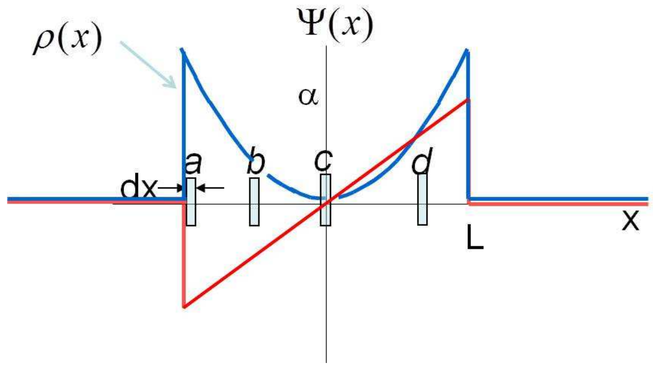
$$|\psi|^2 = |\psi(x)|^2 = \text{Probability density}$$

$$\int_{\Delta x} |\psi(x)|^2 dx = \text{Probability to find particle in } \Delta \text{x}$$

$$\text{Constraints:}$$

$$|\psi(x)|^2 > 0$$

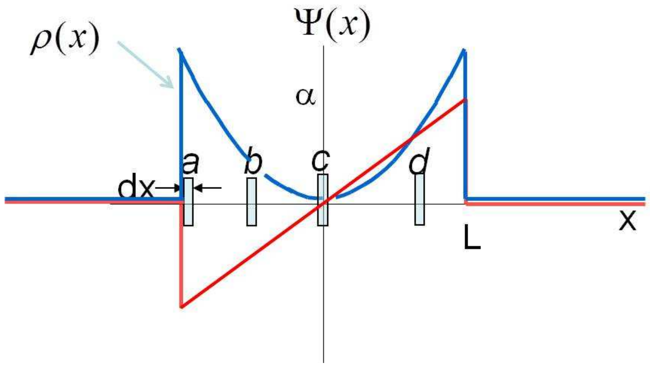
$$\int_{-\infty}^{\infty} |\psi(x)|^2 dx = 1 : \text{Normalization}$$



$$\Psi(x) = \alpha x / L \text{ from } x = -L \text{ to } x = +L$$

$$= 0 \text{ elsewhere}$$

$$\rho(x) = \left|\Psi(x)\right|^2 = \frac{\alpha^2 x^2}{L^2}$$



$$\Psi(x) = \pm\sqrt{\frac{3L}{2}}x : \text{from } x = -L \text{ to } x = L$$

$$= 0 : \text{elsewhere}$$

$$\left|\Psi(x)\right|^2 = \frac{3L}{2}x^2$$

Is $|\Psi(x)|^2 > 1$ for certain x?

(A)Yes (B) No

(C) Depends

Solution of wave equation must satisfy:

- de Broglie relation: $\lambda = h/p$

- equation for total, kinetic and potential energy:
  TE = KE + PE

- superposition principle

If Ψ_1 is a solution and Ψ_2 is a solution,
then $\Psi = \Psi_1 + \Psi_2$ is also a solution.

Equation must be a linear homogeneous differential equation

Consider the time-independent Schrödinger equation:

$$\frac{d^2\Psi(x)}{dx^2} = -\frac{2m}{\hbar^2}\left[E - V(x)\right]\Psi(x)$$

Is Ψ(x) = 0 a possible solution?

(A)Yes, of course

(B) Math-wise: Yes, physics-wise: No

Consider the time-dependent Schrödinger equation:

$$-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\Psi(x,t) = i\hbar\frac{\partial}{\partial t}\Psi(x,t)$$

Is $\Psi(x,t) = A\sin(kx-\omega t)$ a possible solution?

(A)Yes, this is the typical wave-like solution

(B) No, this does not work