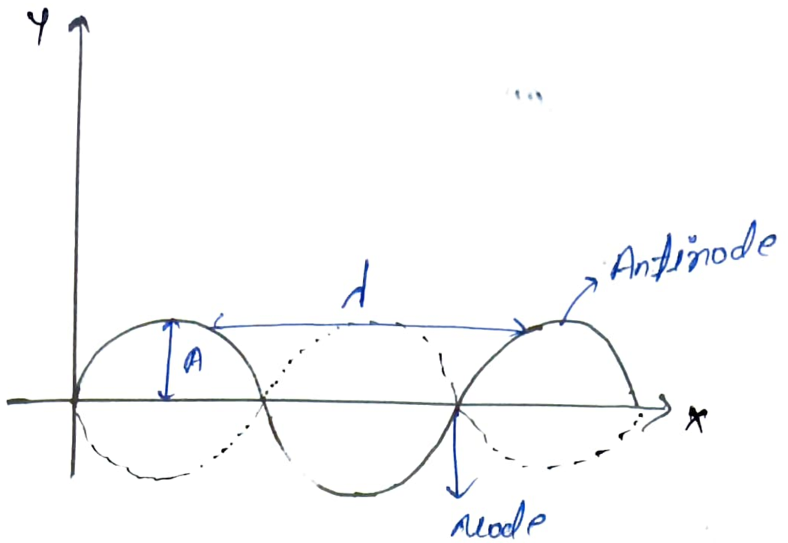


Forward = backward → Standard or stationary wave

$c = \frac{x}{t}$

$x = ct$ —— ①

wave travel from left to right

$\phi_1 = A\sin 2\pi\left(\frac{x}{\lambda} - vt\right)$ — ②

$\phi_2 = A\sin 2\pi\left(x/\lambda + vt\right)$ — ③

$\phi \propto \phi_1 + \phi_2$

$\phi = a_1\phi_1 + a_2\phi_2$

$= A\sin 2\pi\left(x/\lambda - vt\right) + A\sin 2\pi\left(x/\lambda + vt\right)$

$= 2A\sin 2\pi\left(x/\lambda\right) \cdot \cos 2\pi vt$ — ④

Schrodinger eqn :-

microsystem = e^-, p^+, n → these contens – PE, KE

$e = \overset{\text{mass}}{m} \rightarrow x$

$$\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m}{h^2}(E - V)\psi = 0$$

$$\frac{d^2\psi}{dx^2} = \frac{1}{c^2}\frac{d^2\psi}{dt^2} \quad — ①$$

$$\phi(x,t) = \overset{x\text{-function}}{2A\sin 2\pi(x/\lambda)}\ \overset{t\text{-function}}{\cos 2\pi\nu t} \quad \text{--- (ii)}$$

$$= \psi(x) \cdot f(t)$$

$$= \psi(x) \cdot \cos 2\pi\nu t \quad \text{--- (iii)}$$

$$\frac{d^2\phi}{dx^2} = \frac{d^2\psi}{dx^2} \times \cos 2\pi\nu t \quad \text{--- (iv)}$$

$$\frac{d\phi}{dt} = -2\pi\nu \sin 2\pi\nu t\ \psi(x)$$

$$\frac{d^2\phi}{dt} = -2\pi\nu \times 2\pi\nu \times \cos 2\pi\nu t \times \psi(x)$$

$$= -4\pi^2\nu^2 \cos 2\pi\nu t\ \psi(x) \quad \text{--- (v)}$$

Substituting (iv) and (v) in (i)

$$\frac{d^2\psi}{dx^2}\cos 2\pi\nu t = \frac{1}{c^2} \times \left(-4\pi^2\nu^2 \cos 2\pi\nu t \times \psi(x)\right)$$

we know,

$$c = \lambda\nu$$

$$\therefore \frac{d^2\psi}{dx^2} = \frac{1}{\lambda^2\nu^2}\left(-4\pi^2\nu^2\psi(x)\right)$$

$$\Rightarrow \frac{d^2\psi}{dx^2} = \frac{-4\pi^2}{\lambda^2}\psi(x)$$

From de-broglie

$$\lambda = \frac{h}{mv}$$

$$= \frac{-4\pi^2}{\left(\frac{h^2}{m^2v^2}\right)}\psi(x)$$

$$= \frac{-4\pi^2 m^2 v^2}{h^2}\psi(x) \quad \text{--- (vi)}$$

Total Energy

$$E = KE + PE$$

$$E = \frac{1}{2}mv^2 + V$$

$$\frac{1}{2}mv^2 = E - V$$

$$mv^2 = 2(E-V)m \quad \text{— (VII)}$$

$$\frac{d^2\psi(x)}{dx^2} = \frac{-4\pi^2 2(E-V)m}{h^2} = \frac{-8\pi^2 m(E-V)\psi}{h^2}$$

$$\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m}{h^2}(E-V)\psi = 0 \quad \text{— 1D}$$

$$\frac{d^2\psi}{dx^2} + \frac{d^2\psi}{dy^2} + \frac{8\pi^2 m}{h^2}(E-V)\psi = 0 \quad \text{— 2D}$$

$$\frac{d^2\psi}{dx^2} + \frac{d^2\psi}{y^2} + \frac{d^2\psi}{dz^2} + \frac{8\pi^2 m}{h^2}(E-V)\psi = 0 \quad \text{— 3D}$$

Probability distribution of wave function

$$P \propto |\psi|^2 dx$$

$$P \propto |\psi|^2 dx\,dy$$

$$P \propto |\psi|^2 dx\,dy\,dz$$

ds = volume element

Normalize:

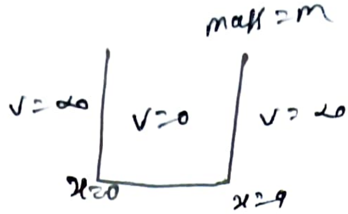
$$\int_{-\infty}^{\infty} \psi_i^* \psi_j \, ds = 1 \qquad i = j$$

Orthogonal

$$\int_{-\infty}^{\infty} \psi_i^* \psi_j \, ds = 1 \qquad i \neq j$$

1-D kinetic Energy :

Particle in a 1D box



outside the box :

$$\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m}{h^2}(E - \infty)\psi = 0 \quad \text{—(i)}$$

$E = 0$

$$\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m}{h^2}(0 - \infty)\psi = 0$$

$$\frac{d^2\psi}{dx^2} = \frac{8\pi^2 m}{h^2}\infty\psi = 0 \quad \text{—(ii)}$$

$$\frac{1}{\infty}d^2\psi = \frac{8\pi^2 m}{h^2} = 0$$

Inside the box :

$x = 0, \; x = a, \; V = 0$

$$\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m}{h^2}E\psi = 0 \quad \text{—(iii)}$$

$$\frac{d^2\psi}{dx^2} + k^2\psi = 0 \quad \text{—(iv)}$$

$\psi = A\sin kx + B\cos kx$

At, $x = 0, \; \psi = 0$

$0 = A\sin k.0 + B\cos k0$

$\therefore B = 0$

(v) $\Rightarrow \psi = A\sin kx$ —(vi)

At $x = a, \; \psi = 0$

$0 = A\sin ka$

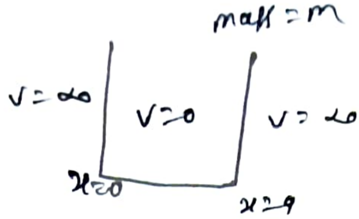
$A = 0, \; \sin ka = 0$

$\downarrow$

Not accurate

1-D kinetic Energy :

Particle in a 1D box



outside the box :

$$\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m}{h^2}(E-\infty)\psi = 0 \quad \text{--- (i)}$$

$E=0$

$$\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m}{h^2}(0-\infty)\psi = 0$$

$$\frac{d^2\psi}{dx^2} = \frac{8\pi^2 m}{h^2}\infty\,\psi = 0 \quad \text{--- (ii)}$$

$$\frac{1}{\infty} d^2\psi = \frac{8\pi^2 m}{h^2} = 0$$

Inside the box :

$x=0$, $x=a$, $V=0$

$$\frac{d^2\psi}{dx^2} + \frac{8\pi^2 m}{h^2}E\psi = 0 \quad \text{--- (iii)}$$

$$\frac{d^2\psi}{dx^2} + k^2\psi = 0 \quad \text{--- (iv)}$$

$\psi = A\sin kx + B\cos kx$

At, $x=0$, $\psi=0$

$0 = A\sin k.0 + B\cos k0$

$\therefore B=0$

(v) $\Rightarrow \psi = A\sin kx$ --- (vi)

At $x=a$, $\psi=0$

$0 = A\sin ka$

$A=0$, $\sin ka = 0$

$\downarrow$

Not accurate

$\therefore \sin ka = 0 = \sin n\pi \Rightarrow ka = n\pi$

$$k = \frac{n\pi}{a} \quad \text{— (vii)}$$

$$k^2 = \frac{n^2\pi^2}{a^2}$$

$$ka = n\pi$$

$$\frac{8\cancel{\pi^2}m}{h^2} E = \frac{n^2\cancel{\pi^2}}{a^2}$$

$$\boxed{E = \frac{n^2h^2}{8ma^2}} \qquad n = 1, 2, 3 \text{ ---} \quad (n \neq 0)$$

Q $CH_2 = CH - CH = CH_2$

Soln:- $CH_2 = CH - CH = CH_2$

$2 \times C = C + 2 \times C = C$

$2 \times 0.154\,nm + 2 \times 0.154\,nm$

$= 0.57\,nm$

$$E_1 = \frac{n^2h^2}{8ma^2} = \frac{1^2h^2}{8 \times 9.1 \times 10^{-31} \times (.57)^2}$$

$$E_2 = \frac{n^2h^2}{8ma^2} = \frac{2^2h^2}{8 \times 9.1 \times 10^{-31} \times (0.57)^2}$$

$$E_3 = \frac{n^2h^2}{8ma^2} = \frac{3^2h^2}{8 \times 9.1 \times 10^{-31} \times (0.57)^2}$$