Spin 1/2 ; Spin 1

+ ———	2 state	+ ———	3 states
		0 ———	
− ———	2x2 matrices	− ———	3x3 matrices

$\begin{pmatrix} a \\ b \end{pmatrix}$ $\begin{pmatrix} a \\ b \\ c \end{pmatrix}$

① finite states but alot

→ 10, 20, 100 $\begin{pmatrix} a_1 \\ a_2 \\ \vdots \\ a_{100} \end{pmatrix}$

100 x 100

② infinite states

↳ position representation state vector

⇒ wavefunction

$$\hat{H}|E_i\rangle = E_i|E_i\rangle$$

Ham operator

Eeigen states

E eigenval

$$H = T + V \Rightarrow^{1D} H = \frac{p_x^2}{2m} + V(x)$$

$$\hat{H} = \frac{\hat{p}_x^2}{2m} + V(\hat{x})$$

$$\boxed{\hat{x} \doteq x \qquad \hat{p} = -i\hbar \frac{d}{dx}}$$

position rep of operators

$$|\psi\rangle \doteq \psi(x)$$

gen state vector

position dep cont. function

$$|E_i\rangle \doteq \varphi_E(x)$$

energy eigenstate

Energy Eigenvalue Problem

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

Probability function

$$P(x) = |\Psi(x)|^2$$

$$1 = \int_{-\infty}^{\infty} P(x)\,dx = \int_{-\infty}^{+\infty} |\Psi(x)|^2 dx$$

normalization

Probability Energy States

$$P_{E_n} = |\langle E_n | \Psi \rangle|^2 = \left| \int_{-\infty}^{\infty} \varphi_n^*(x)\, \Psi(x)\, dx \right|^2$$

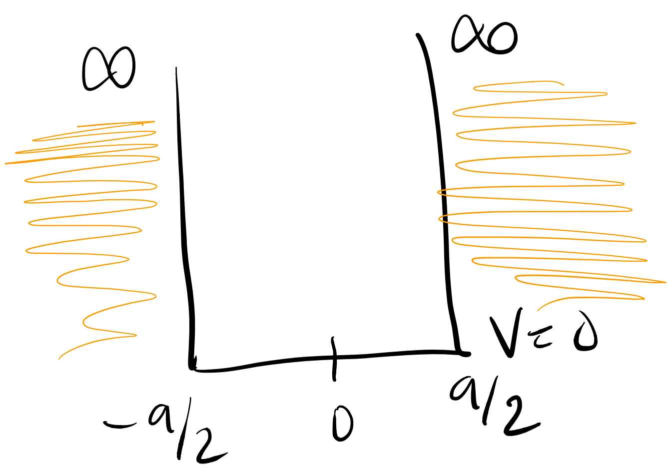
Expection Value

$$\langle x \rangle = \langle \Psi | x | \Psi \rangle = \int_{-\infty}^{\infty} \Psi^* x \Psi \, dx$$

Infinite Square Well

$$V = \begin{cases} \infty & x < -a/2 \\ 0 & -a/2 < x < a/2 \\ \infty & x > a/2 \end{cases}$$

$$-\frac{\hbar^2}{2m}\frac{d^2}{dx^2}\phi_E(x) + V(x)\,\phi_E(x) = E\phi_E(x)$$



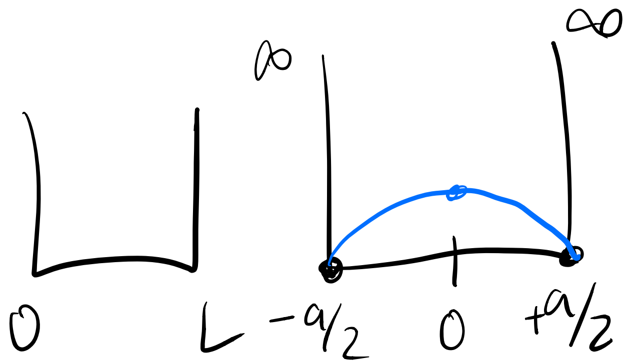
$$\boxed{-\frac{\hbar^2}{2m}\frac{d^2\varphi}{dx^2} = E\varphi}$$

$$k^2 \equiv \frac{2mE}{\hbar^2} \qquad \frac{d^2}{dx^2}\varphi(x) = -k^2 \varphi(x)$$

$-k^2 > 0$

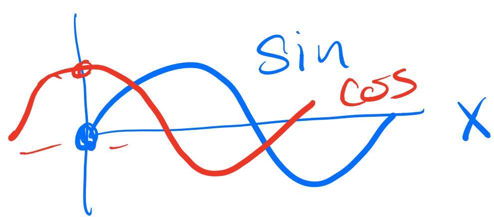
$$\varphi(x) = Ae^{-ikx} + Be^{+ikx}$$

$$\varphi(x) = C\cos(kx) + D\sin(kx)$$



$$\varphi(x = \pm a/2) = 0$$

symmetric around zero



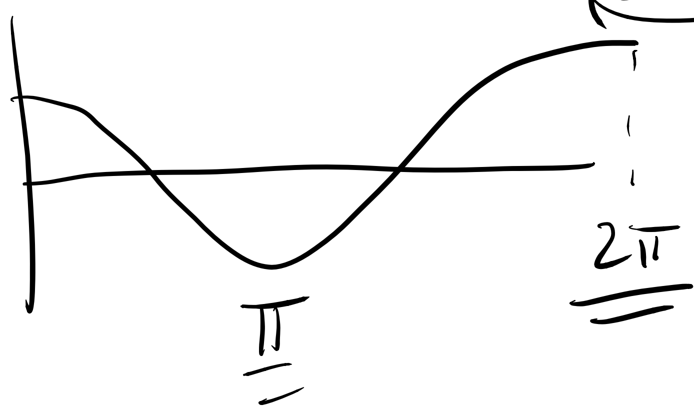
$$\varphi = \underline{C\cos(kx)}$$

$$\cos\left(k\frac{a}{2}\right) = 0$$

$$\cos\left(\frac{n\pi}{2}\right) = 0$$

$$\boxed{k = n\pi/a}$$ $n = 1, 3, 5, \ldots$

$2n-1$



$$k_n = \sqrt{\frac{2mE_n}{\hbar^2}} \qquad k_n = \frac{n\pi}{a}$$

$n = 1, 3, 5 \ldots$

$$\hookrightarrow \varphi_n(x) = C\cos(k_n x)$$