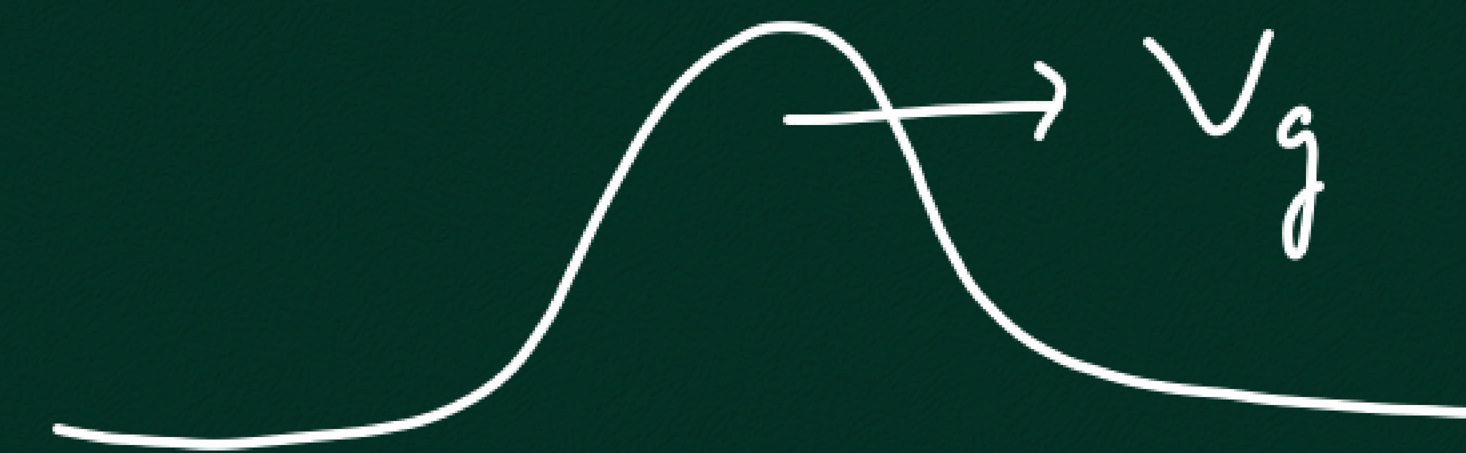
$$\left[-\frac{\hbar^2}{2m}\frac{d^2}{dx^2}+V(x)\right]\psi(x,t)=i\hbar\frac{\partial\psi}{\partial t}$$

Srhodinger Eqn
(1926)

$\psi(x,t)$



Classical

Waves

$$\frac{\partial^2\psi}{\partial x^2}-\frac{1}{v_0^2}\frac{\partial^2\psi}{\partial t^2}=0$$

$$\psi(x,t) \sim e^{i(kx-\omega t)}$$

$$p = \hbar k$$

$$\frac{\hbar}{i}\frac{\partial}{\partial x}\psi = \underbrace{\hbar k}_{=p}\,\psi$$

$$\boxed{p \to -i\hbar\frac{\partial}{\partial x}}$$

$$\left(-i\hbar\bar{\nabla} \text{ in 3D}\right)$$

$$E = h\nu$$

$$\boxed{E \to i\hbar\frac{\partial}{\partial t}}$$

$$i\hbar\frac{\partial}{\partial t}\psi = \underbrace{\hbar\omega}_{E}\,\psi$$

k_0

$\omega(k)$

$\omega(k_0) = \omega_0$

$$\frac{\partial^2}{\partial x^2}\underbrace{\psi(x)\phi(t)} = -k^2\psi(x)\,\phi(t)$$

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

$$p^2\psi = 2m(E-V)\psi$$

$$(-i\hbar)^2\frac{\partial^2}{\partial x^2}\psi = 2m\left(E - V(x)\right)\psi$$

$$-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\underset{\uparrow\atop \varphi(t)}{\psi} + V(x)\underset{\uparrow\atop \varphi(t)}{\psi} = E\underset{\uparrow\atop \varphi(t)}{\psi}$$

$$\left[-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2} + V(x)\right]\underbrace{\psi(x)\varphi(t)}_{\Psi(x,t)} = i\hbar\frac{\partial}{\partial t}\underbrace{\varphi(t)\,\psi(x)}_{\Psi(x,t)}$$

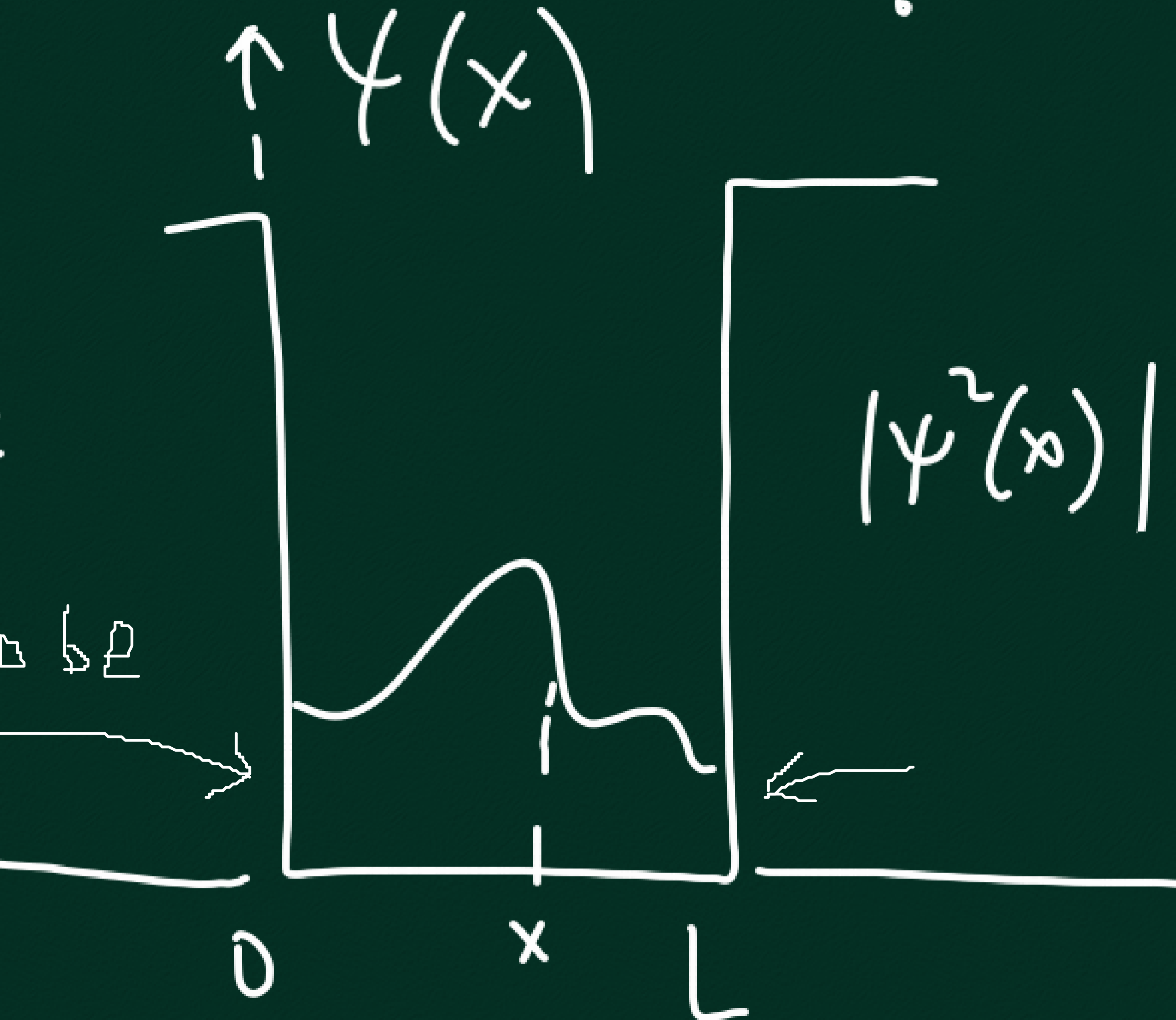
$$\underbrace{\left[-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}+V(x)\right]}\psi(x)=E\,\psi(x) \qquad E=?$$

$$\hat{O}(x)$$

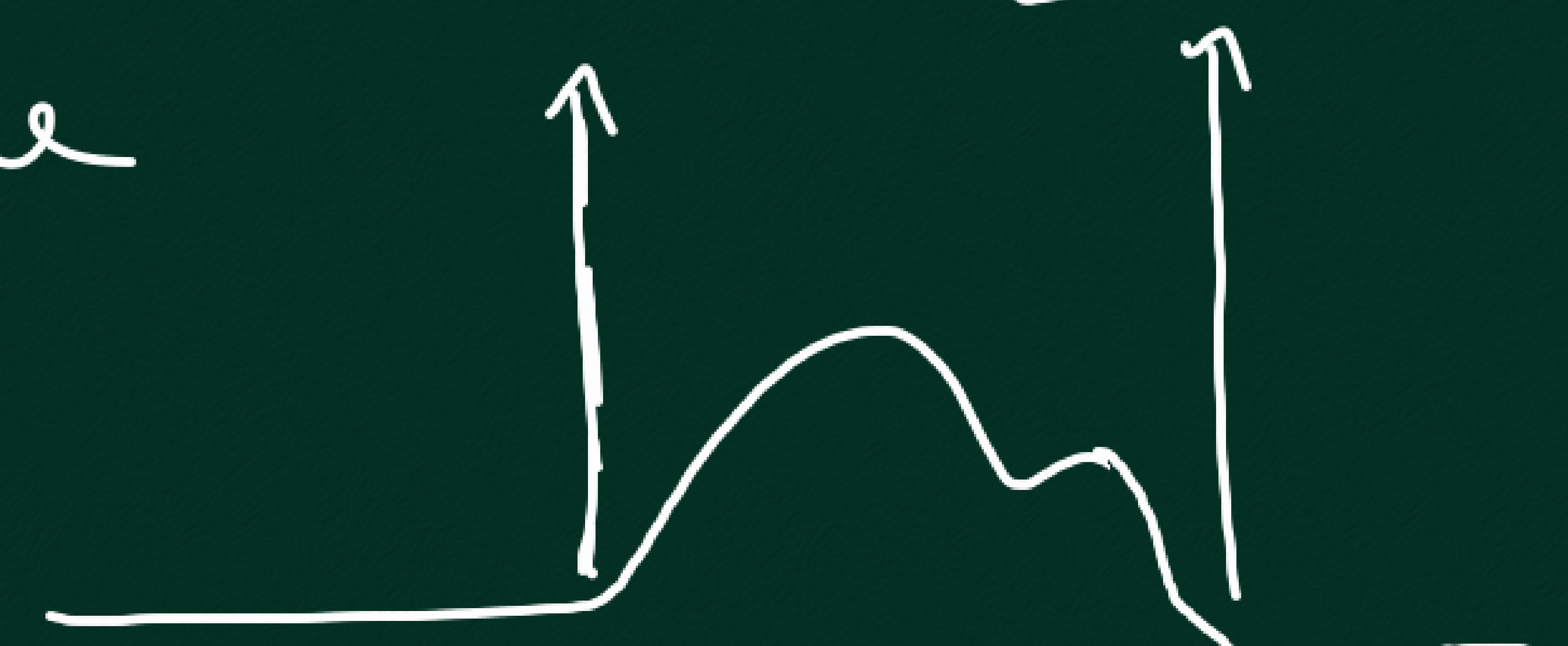
differential operator

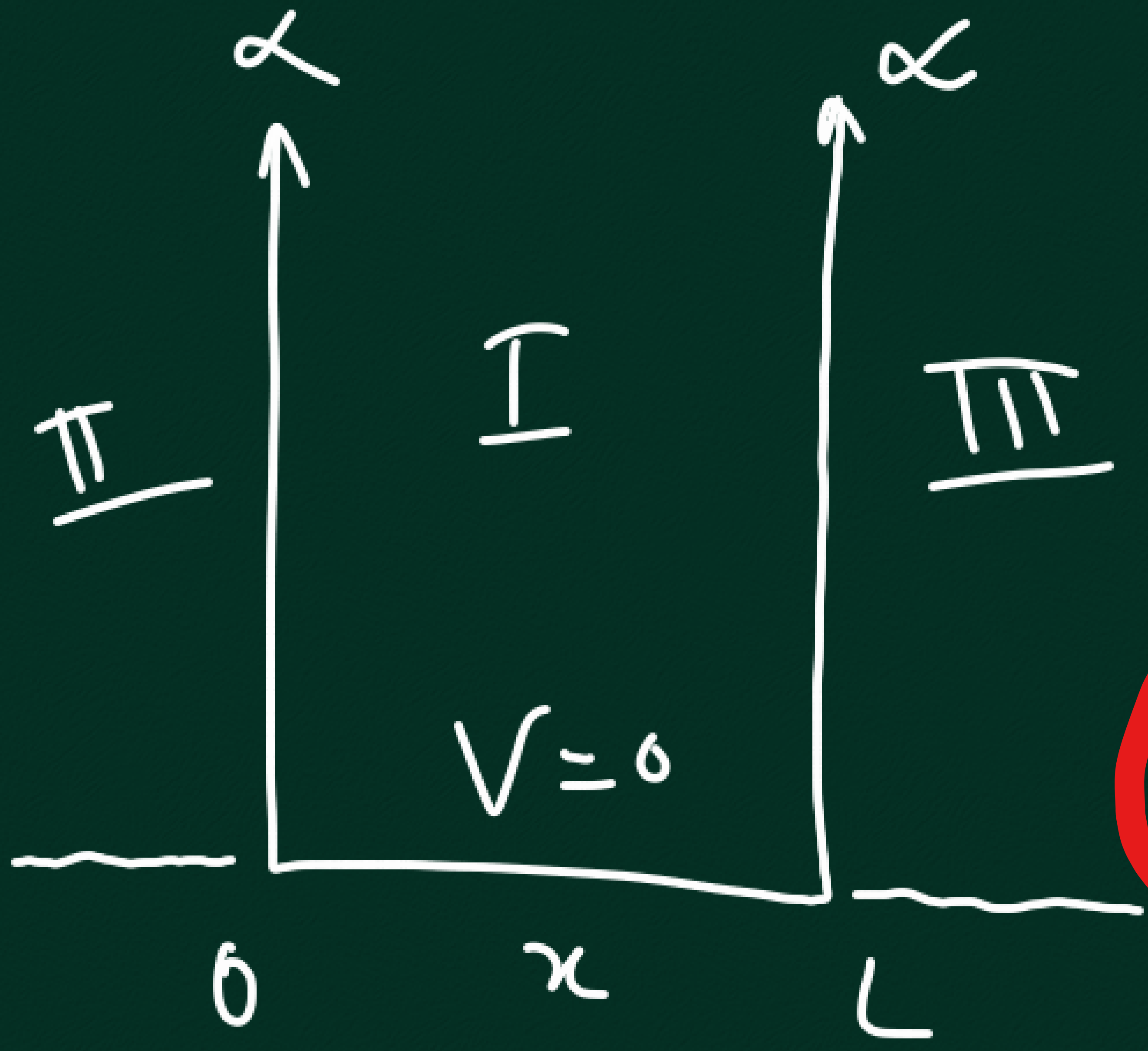
$$\hat{p}=-i\hbar\frac{\partial}{\partial x}$$

Need to be contins



$$\left.\begin{aligned} A\,\bar{v} &= \lambda\,\bar{v} \\ [\;]\,|\;| &= \lambda\,|\;| \end{aligned}\right\} \text{Eigen Value probem}$$





B.C.

$$\psi(0) = 0 \rightarrow A + B = 0 \Rightarrow A = -B$$

$$\psi(L) = 0 \rightarrow A\left(e^{ikL} - e^{-ikL}\right) = 0$$

$$2iA \sin kL = 0$$

$A = 0$ nothing

if $E<0$ then exponential soln

$$\left[-\frac{\hbar^2}{2m}\frac{d}{dx^2} + \underset{\downarrow 0}{V(x)}\right]\psi(x) = E\,\psi(x)$$

I : $$\frac{d}{dx^2}\psi(x) = -\left(\frac{2mE}{\hbar^2}\right)\psi(x), \quad E > 0$$

$$\psi''(x) = -k^2\psi(x), \quad k^2 = \frac{2mE}{\hbar^2}$$

$$\psi(x) = Ae^{ikx} + Be^{-ikx}$$
$$= A\sin kx$$

$$e^{i\theta} = \cos\theta + i\sin\theta$$

$$\cos\theta = \frac{e^{i\theta} + e^{-i\theta}}{2}$$

$$\frac{\beta}{L^2} n^2$$

$$\sin kL = 0$$

$$\Delta E = \left((n+1)^2 - n^2\right)\frac{\beta}{L^2}$$

$$kL = \pm n\pi, \quad n = 1, 2, \ldots \quad = (2n+1)\frac{\beta}{L^2}$$

$$k = \pm \frac{n\pi}{L} \Rightarrow k \text{ is discrete}$$

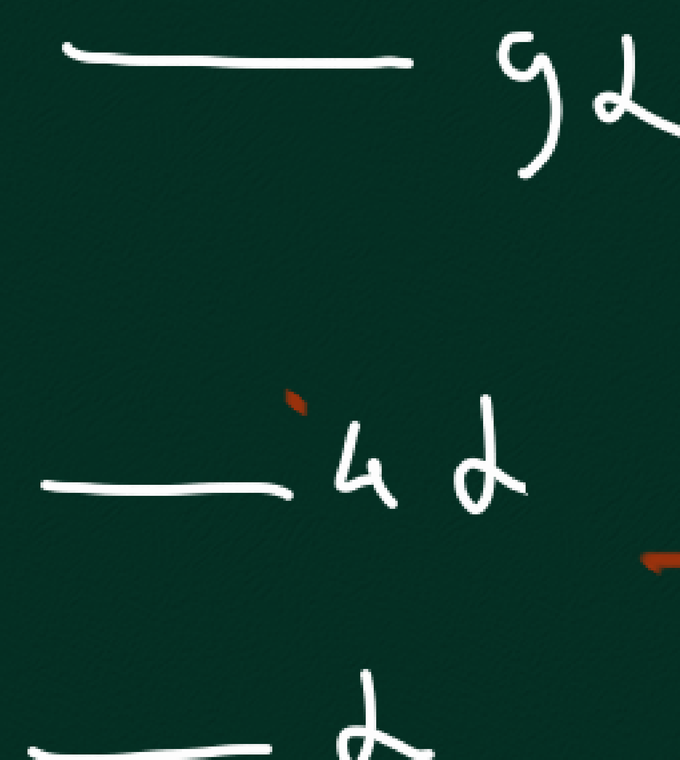
$$E = \frac{\hbar^2}{2m}\left(\frac{\pi}{L}\right)^2 n^2 = \alpha n^2$$

$\Rightarrow E$ is Quantized now

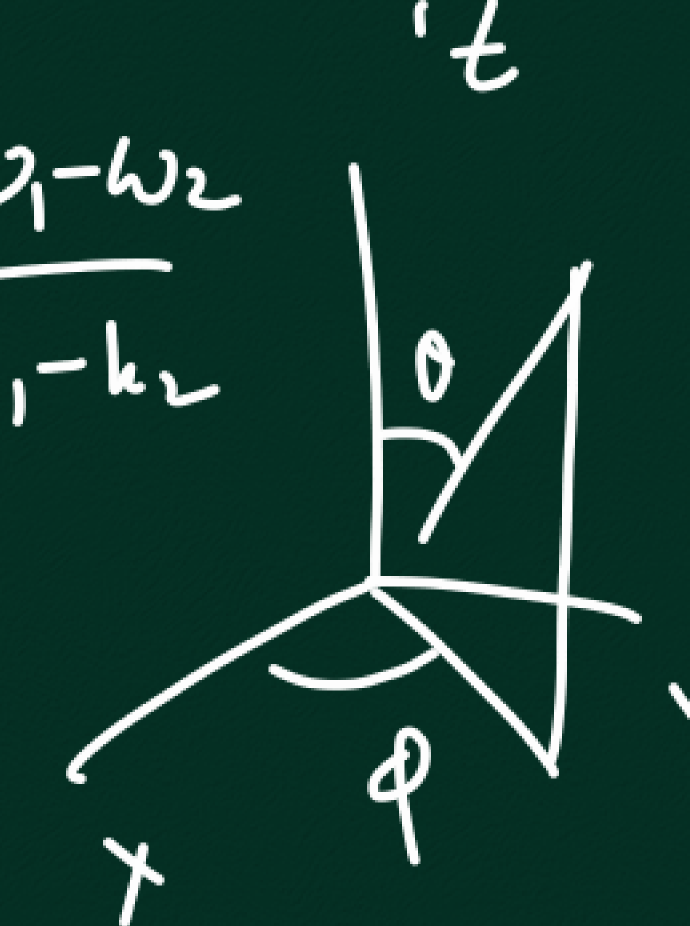
$$E_1 = \alpha$$

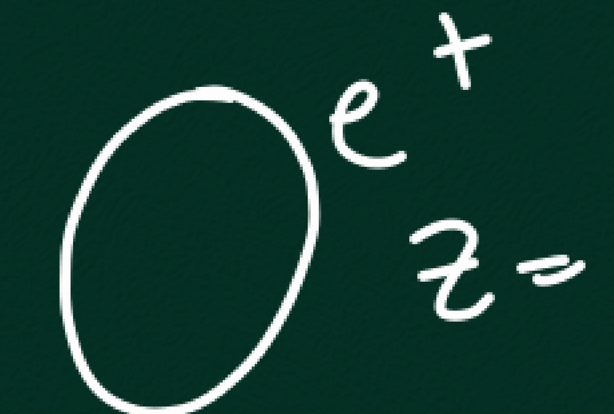
$$E_2 = 4\alpha$$

$$E_3 = 9\alpha$$

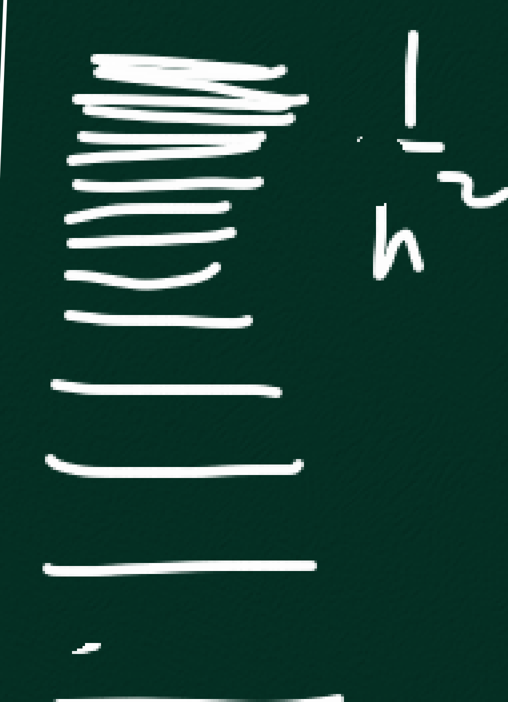


$$\frac{d\omega}{dk} = \frac{\omega_1 - \omega_2}{k_1 - k_2}$$





$$\Psi(\bar{r}) = \chi(r)\, g(\theta)\, f(\varphi)$$



$$g(\theta) = g(\theta + \pi)$$

$$f(\varphi) = f(\varphi + 2\pi)$$