Particle in a 2-D box $V=0$

$$-\frac{\hbar^2}{2m}\left(\frac{\partial^2\psi}{\partial x^2}+\frac{\partial^2\psi}{\partial y^2}\right)=E\psi \qquad \psi(x,y)$$

$$\psi(x,y)=X(x)Y(y) \qquad E=E_x+E_y$$

$$\frac{\partial^2\psi}{\partial x^2}=Y\frac{d^2X}{dx^2} \qquad \frac{\partial^2\psi}{\partial y^2}=X\frac{d^2Y}{dy^2} \qquad X'', Y''$$

$$-\frac{\hbar^2}{2m}(YX''+XY'')=EXY$$

divide by XY

$$-\frac{\hbar^2}{2m}\left(\frac{X''}{X}+\frac{Y''}{Y}\right)=E=E_x+E_y$$

$$-\frac{\hbar^2}{2m}\frac{X''}{X}=E_x \qquad -\frac{\hbar^2}{2m}\frac{Y''}{Y}=E_y$$

$$-\frac{\hbar^2}{2m}\frac{d^2X}{dx^2}=E_xX$$

same as in 1D

box from 0 – L

$$X=\left(\frac{2}{L}\right)^{1/2}\sin\frac{n\pi x}{L}$$

more generally, dimension of box L_1, L_2

$$X_{n_1}(x)=\left(\frac{2}{L_1}\right)^{1/2}\sin\frac{n_1\pi x}{L_1}$$

$$Y_{n_2}(y)=\left(\frac{2}{L_2}\right)^{1/2}\sin\frac{n_2\pi x}{L_2}$$

$$\psi_{n_1,n_2}(x,y)=X_{n_1}(x)\,Y_{n_2}(y)$$