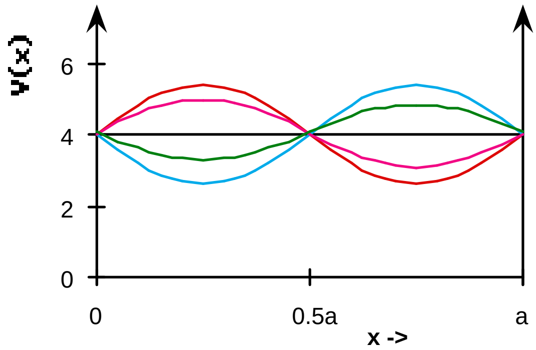
Time Dependence

$$\frac{-\hbar^2}{2m}\nabla^2\Psi + V(x,y,z,t)\Psi = i\hbar\left(\frac{\partial\Psi}{\partial t}\right)$$



if $V(x,y,z,t) = V(x,y,z) \longrightarrow$ separable $\qquad \Psi(x,y,z,t) = \Psi(x,y,z)\Psi(t)$

$$\frac{1}{\Psi(x,y,z)}\left(\frac{-\hbar^2}{2m}\nabla^2\Psi(x,y,z) + V(x,y,z)\Psi(x,y,z)\right) = \frac{1}{\Psi(t)}\, i\hbar\left(\frac{\partial\Psi(t)}{\partial t}\right)$$

$$\frac{1}{\Psi(x,y,z)}H\Psi(x,y,z) = \frac{1}{\Psi(t)}\, i\hbar\left(\frac{\partial\Psi(t)}{\partial t}\right)$$

$$\frac{1}{\Psi(x,y,z)}\left(\frac{-\hbar^2}{2m}\nabla^2\Psi(x,y,z) + V(x,y,z)\Psi(x,y,z)\right) = E$$

$$E = \frac{1}{\Psi(t)}\, i\hbar\left(\frac{\partial\Psi(t)}{\partial t}\right)$$

$$i\hbar\left(\frac{\partial\Psi(t)}{\partial t}\right) = E\,\Psi(t)$$

$$\frac{d\Psi(t)}{\Psi(t)} = \frac{E}{i\hbar}\,dt \qquad\qquad \frac{d\Psi(t)}{\Psi(t)} = \frac{-iE}{\hbar}\,dt$$

$$\ln\Psi(t) = \frac{-iE}{\hbar}\,t$$

$$\Psi(t) = e^{-i E t/\hbar}$$

$$\Psi(x,y,z,t) = \Psi(x,y,z)\, e^{-i E t/\hbar}$$

$$e^{-i E t/\hbar} = \cos\left(\frac{E t}{\hbar}\right) - i\sin\left(\frac{E t}{\hbar}\right) \qquad \sim \cos(2\pi\nu t) \qquad \nu = \frac{E}{2\pi\hbar} \qquad E = h\nu$$