$$\vec{F}(x) = -k\,\vec{x}$$

$$U(x) = \frac{1}{2}\,k\,x^2$$

$$\frac{-\hbar^2}{2m}\frac{d^2\Psi}{dx^2} + U\Psi = E\Psi$$

$$\frac{-\hbar^2}{2m}\frac{d^2\Psi}{dx^2} + \frac{1}{2}kx^2\Psi = E\Psi$$

$$\frac{d^2\Psi}{dx^2} + -\frac{2m}{\hbar^2}\frac{1}{2}kx^2\Psi = -\frac{2m}{\hbar^2}E\Psi$$

$$\frac{d^2\Psi}{dx^2} = \frac{m}{\hbar^2}kx^2\Psi - \frac{2m}{\hbar^2}E\Psi$$

$$\frac{d^2\Psi}{dx^2} = (\frac{km}{\hbar^2})x^2\Psi - (\frac{2mE}{\hbar^2})\Psi$$

$$\Psi(x) = Ae^{-\alpha x^2}$$

$$\frac{d\Psi(x)}{dx} =$$

$$\frac{d\Psi(x)}{dx} = -2\alpha x Ae^{-\alpha x^2} = -2x\alpha\Psi$$

$$\frac{d^2\Psi}{dx^2} = -2\alpha Ae^{-\alpha x^2} + -2\alpha x A(-2\alpha x)e^{-\alpha x^2}$$

$$\frac{d^2\Psi}{dx^2} = -2\alpha Ae^{-\alpha x^2} + 4\alpha^2x^2Ae^{-\alpha x^2}$$

$$\frac{d^2\Psi}{dx^2} = -2\alpha\Psi + 4\alpha^2x^2\Psi$$

$$x(t) = A\,cos(\omega t)$$

$$E = \frac{1}{2}kA^2$$

$$\omega = \sqrt{\frac{k}{m}}$$

$$\frac{d\Psi}{dx} = (...)x\,\Psi$$

$$\alpha = \frac{\sqrt{km}}{2\hbar}$$

$$E = \frac{1}{2}\hbar\sqrt{\frac{k}{m}}$$

$$L \sim \frac{1}{\sqrt{\alpha}}$$

$$E = \frac{1}{2}\hbar\,\omega$$

$$E = h\,\nu$$

$$\Psi_0(x) = Ae^{-\alpha x^2}$$

$$\Psi_1(x) = Bxe^{-\alpha x^2}$$

$$E_0 = \frac{1}{2}\hbar\,\omega$$

$$E_1 = \frac{3}{2}\hbar\,\omega$$

$$E_n = \frac{(2n+1)}{2}\,\hbar\,\omega$$