

Homework Solutions

Time Dep vs. Time Incl
Schrödinger Eqn

$$1) \quad \Psi(x,t) = T(t) \varphi(x)$$

$$i\hbar T' \varphi = -\frac{\hbar^2}{2m} T \varphi'' + V(x) T \varphi \quad \text{divide by } T \varphi$$

$$\Rightarrow i\hbar \frac{T'}{T} = -\frac{\hbar^2}{2m} \frac{\varphi''}{\varphi} + V(x) = E$$

$$\Rightarrow -\frac{\hbar^2}{2m} \varphi'' + V(x) \varphi = E \varphi$$

$$\Rightarrow \boxed{-\frac{\hbar^2}{2m} \frac{d^2 \varphi}{dx^2} + V(x) \varphi(x) = E \varphi(x)}$$

$$2) \quad \cancel{\frac{\hbar^2}{2m} \varphi} \quad i\hbar \frac{T'}{T} = E \Rightarrow i\hbar T' = ET$$

$$\Rightarrow i\hbar T' - ET = 0 \Rightarrow T' - \frac{E}{i\hbar} T = 0$$

$$\Rightarrow \left(D - \frac{E}{i\hbar} \right) T = 0 \Rightarrow D = \frac{E}{i\hbar} = -\frac{iE}{\hbar}$$

$$\Rightarrow \boxed{T = k e^{-\left(\frac{iE}{\hbar}\right)t}}$$