Name

5.73

Quiz 3

1.

$$\hat{H}\psi_n = E\ \ \psi$$

$$\hat{H}\Psi = i\hbar\frac{\partial\Psi}{\partial t}$$

$$\Psi\ (\ ,\ ) = \psi\ \ ^{-\ \ /\hbar}$$ where ψ_n is an eigenstate of $\hat{H}$

$$\Psi(x,t) = \sum_n \ \ \psi\ \ ^{-\ \ /\hbar}$$ superposition of eigenstates of $\hat{H}$

$$\int_{-\infty}^{\infty}\psi^*\psi\ \ \ \ = 0 \text{ if } \ \neq$$

$$= 1 \text{ if } n=m$$

A. What, if any, is the time dependence of $|\Psi_n(x,t)|^2$?

B. Let $\Psi(x,t) = 2^{-1/2}\left[\psi_1 e^{-iE_1 t/\hbar} + \psi_2 e^{-iE_2 t/\hbar}\right] = 2^{-1/2} e^{-iE_1 t/\hbar}\left[\psi_1 + \psi_2 e^{+i\omega_{12}t}\right]$ and $= \omega_{12} \equiv (E_1 - E_2)/\hbar$. Assume that ψ_1 and ψ_2 are real, not complex. Solve for $|\Psi_n(x,t)|^2$.

2. Let $\psi(x) = e^{-ikx}$, $E_{|k|} = \dfrac{\hbar^2 k^2}{2m} + V_0$, and $\psi(x,t) = e^{i(-kx - E_{|k|}t/\hbar)}$. Think of Ψ(x,t) as a rigid object, Ψ(x,0), moving along the x-axis at a constant velocity. This is the phase velocity, v_ϕ. The motion of the constant phase point is described by

$$x_\phi(t) = x_\phi(0) + v_\phi t.$$

Solve for v_ϕ.

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