Name

5.73

Quiz 3

September 9, 2002

1.

$$\hat{H}\psi_n = E_n\psi_n$$

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

$$\Psi_n(x,t) = \psi_n e^{-iE_n t/\hbar} \qquad \text{where } \psi_n \text{ is an eigenstate of } \hat{H}$$

$$\Psi(x,t) = \sum_n a_n\psi_n e^{-iE_n t/\hbar} \qquad \text{superposition of eigenstates of } \hat{H}$$

$$\int_{-\infty}^{\infty}\psi_n^*\psi_m dx = 0 \quad \text{if } n \neq m$$

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

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

B. **Error! Objects cannot be created from editing field codes.**
and $= \omega_{12} \equiv (E_1 - E_2)/\hbar$. Assume that ψ_1 and ψ_2 are real, not complex. Solve for $|\Psi(x,t)|^2$.

2. Let $\psi(x) = e^{-ikx}$, $E_{|k|} = \frac{\hbar^2 k^2}{2m} + V_0$, 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.