Assignment 10; Phys 191 Name ________________

When you include time-dependence, quantum wave functions are solutions to the Schrödinger equation:

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

The *Hamiltonian* operator $\hat{H}$ is the total energy. With a 1D particle in a box, that's just the kinetic energy: $\hat{H} = \hat{K}$. All quantum states can be expressed as a superposition of the energy eigenfunctions we have found before. Say your wave function combines the first and second energy levels:

$$\Psi(x,t) = N\left[\psi_1(x)e^{-i\omega_1 t} + i\psi_2(x)e^{-i\omega_2 t}\right]$$

Here, ψ_n refers to the nth energy eigenfunction and $\omega_n = K_n/\hbar$. N is a normalization constant.

1. (30 points) Show that Ψ satisfies the Schrödinger equation. (Plug it in.)

2. (20 points) You know that the ψ_n are normalized:

$$\int_0^L dx\,\psi_1^*\psi_1 = \int_0^L dx\,\psi_2^*\psi_2 = 1$$

Show that ψ_1 and ψ_2 are *orthogonal*:

$$\int_0^L dx\,\psi_1^*\psi_2 = 0$$

3. (50 points) Find N, the normalization constant.