Physics 214 **Quiz 5-1 [20 points]** **Week 6**

An electron is prepared in a superposition of two energy eigenstates, $\psi \propto (3\psi_1+4\psi_2)$. ψ_1 and ψ_2 are individually normalized wave functions, and have energies of $E_1 = 2$ eV and $E_2 = 7$ eV, respectively.

a) [4 points] Suppose you measure the electron's energy. What result or results might you obtain?

2 eV and 7 eV

b) [6 points] What are the probabilities of the various possible results?

P(E1) = 9/25   P(E2) = 16/25

c) [5 points] Suppose you were to measure the energies of a large number of particles that are each described by the wave function ψ. What will be the average value of your energy measurements?

$<E> = (9/25*2 + 16/25*7)$ eV = 5.56 eV

d) [5 points] Consider the time dependence. At $t = 0$, the probability density is $P(x,0)$. When is the next time that the probability density $P(x,t)$ returns to its $t = 0$ value (i.e., $P(x,t)$ = P(x,0))? You should give a numerical answer, in seconds.

The interference term goes like $e^{i(w1-w2)t}$ so we get back to the origina P(x,t) when t = 2 π/(w1-w2) = h/(E2-E1) = $8.27*10^{-16}$ sec.