28) A particle of mass m subject to a harmonic oscillator potential is initially in the ground state, $\phi_0(x)$. The mass carries a charge q and at time $t = 0$ an electric field E_0 is applied in the $+x$ direction, giving rise to a potential $-qEx$.

(a) At what time t will the probability of finding the oscillator in state $\phi_1(x)$ be maximized?

(b) Find the corresponding maximum value of $|c_1(t)|^2$.

29) A hydrogen atom is in the ground state when an external electric field pulse is applied along the z direction. The field is zero for $t < 0$, and for $t > 0$ follows the equation $E = E_0 e^{-t/\tau}$. Find the probability that the atom will end up in the 2p state, $(n, l, m) = (2,1,0)$, at times $t \gg \tau$. Neglect spontaneous decays back to the ground state.

30) Calculate the mean lifetime of the 2p state of hydrogen. The lifetime is the same for all values of the magnetic quantum number m, so you may choose any convenient value.