Q.M. H.W. # 7

From Griffiths: # 11.27

From Saxon:

Problem 15 A harmonic oscillator of mass m, charge e and classical frequency ω is in its ground state.

(a) A uniform electric field $\mathscr{E}$ is turned on at $t = 0$ and is then turned off at $t = \tau$. Use first-order time dependent perturbation theory to estimate the probability that the system is excited to its nth state.

From Ohanian:

19. Suppose that an electron in a one-dimensional harmonic-oscillator potential $\frac{1}{2}m\omega_0^2x^2$ is subjected to an oscillating electric field $\mathscr{E} = \mathscr{E}(0) \cos \omega t$ in the x direction.

(a) If the electron is initially in the ground state, what is the probability that the electron will be in the nth excited state at time t?

(b) If $\omega = \omega_0$, perturbation theory will fail at some time t. What is the critical time?

From D. Ferry:

4. At $t < 0$, an electron is assumed to be in the $n = 3$ eigenstate of an infinite square potential well, which extends from $-a/2 < x < a/2$. At $t = 0$, an electric field is applied, with the potential $V = Ex$. The electric field is then removed at time τ. Determine the probability that the electron is in any other state at $t > \tau$.

$t > \tau$

From Griffiths 1st ed.:

Problem 9.18 Justify the following version of the energy-time uncertainty principle (due to Landau): $\Delta E \Delta t \geq \hbar/2$, where Δt is the time it takes to execute a transition involving an energy change ΔE, under the influence of a constant perturbation ([redacted]) Explain more precisely what ΔE and Δt mean in this context.

(Δt is the time it takes for $P(t)$ to reach a peak in its oscillation.)