1. (from last week). Complete Griffiths 7.7. This problem asks you to apply the variational method for H⁻ and Li⁺ ions, following the approach in the text.

2. (Gasiorowicz 15.1) A hydrogen atom is placed in a time-dependent electric field that points in the z-direction. The magnitude of the field $E(t)$ is given by:

$$E(t) = \begin{cases} 
0 & t < 0 \\
E_0 e^{-\gamma t} & t \geq 0.
\end{cases}$$

What is the probability that a hydrogen atom, which is initially in the ground state, makes a transition to the 2p state as $t \to \infty$?

3. (Gasiorowicz 15.4) Consider a particle in the $n$th state of a one-dimensional harmonic oscillator; the energy is $E_n = \hbar \omega (n + \frac{1}{2})$. Suppose that this system experiences the perturbation

$$V(t) = \begin{cases} 
0 & t < 0 \\
\lambda x \cos \omega_1 t e^{-\alpha t} & t \geq 0.
\end{cases}$$

Calculate the probability of a transition to the $m$th state. For what values of $m$ are the transitions allowed? Discuss what happens when $\omega \to \omega_1$ and $\alpha \to 0$. (Hint: Use the creation and annihilation operator method to calculate matrix elements.

4. Griffiths 9.18. This problem asks for the response of the ground state of the infinite square-well potential to a time-dependent perturbation in one-half of the well.