

Homework VIII - PHYS652

1. Given a harmonic oscillator in the ground state. At time $t = 0$ the oscillator is *suddenly* exposed to a constant homogeneous electric field ϵ that persists. Determine the probability for finding the harmonic oscillator in the n -th oscillator state.
2. a) shankar: 18.3.1
b) derive the equation of motion for the operator Ω_I in the interaction picture.
3. Heisenberg picture: Precession of the electron spin in a magnetic field $\mathbf{B} = B\hat{z}$
 - a) Determine the equation of motion for the spin operator \mathbf{S} in the Heisenberg picture, and find the solution from the initial conditions $\mathbf{S}(t = 0) = \mathbf{S}(0)$.
 - b) Determine the electron state $\Psi(t)$ in the Schroedinger picture assuming $\Psi(0) = (a, b)$.
 - c) Determine the probability for finding $S_z = \hbar/2$ at time t , if the spin at time $t = 0$ was "oriented" in the negative x -direction.
4. A particle with spin $s = 1/2$ experiences following magnetic field $\mathbf{B} = \delta(t)\lambda B_0\hat{x} + B\hat{z}$. Find the solution in the Schroedinger picture by 1) transforming into the interaction picture $\Psi_I(t) = e^{iH_0t/\hbar}\chi(t)$, and solving the corresponding equation of motion for $\Psi_I(t)$. 2) Find the Schroedinger state from back transformation of $\Psi_I(t)$ into the Schroedinger picture.