

Homework Set 12

Due November 20

1. Consider a one-dimensional simple harmonic oscillator with classical angular frequency ω_0 . It is in the ground state until time $t = 0$, when a small time-dependent potential is turned on

$$V(t) = F_0 \hat{x} \cos(\omega t), \quad (1)$$

where F_0 is a constant.

Obtain the expectation $\langle x \rangle$ as a function of time to first order in time-dependent perturbation theory.

Is this procedure valid for $\omega \simeq \omega_0$?

Note the useful relation for energy eigenstates of the simple harmonic oscillator

$$\langle n' | \hat{x} | n \rangle = \sqrt{\frac{\hbar}{2m\omega_0}} \left(\sqrt{n+1} \delta_{n',n+1} + \sqrt{n} \delta_{n',n-1} \right) \quad (2)$$