

Problem E9:

The wave function

$$\Psi(x, t) = \left[\frac{\alpha}{2\pi} \right]^{\frac{1}{4}} \left[e^{-i\omega_0 t} + 2\sqrt{\alpha} x e^{-3i\omega_0 t} \right] e^{-\alpha x^2}$$

(where $\alpha = \sqrt{km}/2\hbar$) is a normalized, non-stationary solution to the time dependent Schrodinger equation for the harmonic oscillator problem. Find $\langle x \rangle$ as a function of time for this wave function. You should be able to write your answer in the form $\langle x \rangle = A \cos \omega_0 t$.