P631, Autumn 2009 Exercise 4

In class we considered a particle in a harmonic oscillator potential with wave function at $t = 0$ given by,

$$\Psi(x, t = 0) = \frac{1}{2}(\phi_2(x) + \phi_3(x))$$

and found using,

$$\hat{x} = \sqrt{\frac{\hbar}{2m\omega}}(\hat{a} + \hat{a}^\dagger)$$

that

$$\langle \hat{x} \rangle = \sqrt{3}\sqrt{\frac{\hbar}{2m\omega}}$$

.

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We will now look at what happens at $t > 0$.

(1) What is $\Psi(x, t)$?

(2) What are $\hat{a}\Psi(x, t)$ and $\hat{a}^\dagger\Psi(x, t)$?

(3) What is $\langle \hat{x} \rangle$ for general t ?