5393 Quantum Mechanics
Homework 8

Reading Assignment	Sakurai	Chapter 2
Problems	Sakurai	Chapter 2 prob. 2.15, 2.16, 2.19
Date Due		Oct. 20, 2016 *by* 5:00 pm

Comments and Hints:

1. Problem 2.16:

   (a) The term $\{\tilde{\mathbf{x}}, \tilde{\mathbf{p}}\} = \tilde{\mathbf{x}}\tilde{\mathbf{p}} + \tilde{\mathbf{p}}\tilde{\mathbf{x}}$ is the anti-commutator.

Additional Problem:

1. The wave function at $t = 0$ for a particle in a harmonic oscillator potential, $V(\tilde{\mathbf{x}}) = \frac{1}{2}m\omega^2\tilde{\mathbf{x}}^2$, is of the form

$$\psi(x, 0) = Ae^{-(\alpha x)^2/2}\left[\cos\beta\, H_0(\alpha x) + \frac{\sin\beta}{2\sqrt{2}}\, H_2(\alpha x)\right],$$

   where β and A are real constants, $\alpha^2 \equiv \frac{m\omega}{\hbar}$, and Hermite polynomials are normalized so that

$$\int_{-\infty}^{+\infty} e^{-\alpha^2 x^2}\left(H_n(\alpha x)\right)^2\, dx = \frac{\sqrt{\pi}}{\alpha}2^n n!.$$

   (a) Derive an expression for $\psi(x, t)$ that is properly normalized.

   (b) What are the possible results of a measurement of the energy of the particle in this state and what are the relative probabilities of getting these values?

   (c) What is $\langle\tilde{\mathbf{x}}\rangle$ at $t = 0$? How does it change with time?