Expectation Values for the Infinite Well Ground State

This process is fully outlined in Example 5.5 on pages 173-176 for an infinite well with boundaries at $x = 0$ and $x = L$. Answer all of the following questions for the particle in the ground state of this infinite well. You may just copy the work, but copy very carefully and include all steps. Please try to understand the process as you write it down.

1. Find the expectation value for $x$, the position of the particle.

2. Find the expectation value for $x^2$, the position squared of the particle.

3. Find the standard deviation uncertainty $\Delta x$ of the position of the particle.

4. Find the expectation value of the momentum $p$ of the particle.

5. Find the expectation value of $p^2$, the momentum squared, of the particle.

6. Use the expectation value of $p^2$ to write the expectation value of the kinetic energy of the particle.

7. Find the standard deviation uncertainty $\Delta p$ of the momentum of the particle.

8. Evaluate the product $\Delta x \Delta p$ using your results from section 3 and section 7, and explain why this is a little larger than the minimum value of $\hbar/2$. 