Homework 10 (10 points each problem)

1. Derive the momentum distribution of the ground state of Harmonic Oscillator (HO)

2. Test the uncertainty priciple for the ground state of HO

3. Calculate $\langle \psi_n \left| V \right| \psi_n \rangle$ and $\langle \psi_n \left| \frac{p^2}{2m} \right| \psi_n \rangle$ for HO

4. Calculate $\langle \psi_n \mid x \mid \psi_{n+1} \rangle$, $\langle \psi_n \mid x \mid \psi_{n-1} \rangle$ and $\langle \psi_n \mid x \mid \psi_n \rangle$

5. Show that (derive) $\psi_n(x) = \sqrt{\frac{1}{2^n n!}} \left[\frac{m\omega}{\pi\hbar}\right]^{\frac{1}{4}} e^{-\frac{z^2}{2}} H_n(z)$

6. Express p^2 operator in coordinate space through polar coordinates

7. Using $\hbar \mathbf{L} = [\mathbf{r} \times \mathbf{p}]$, optain expression for L^2 and L_z operators in coordinate space using polar coordinates

8 (bonus). Solve Problem 3.7, for the case when masses are equal.