

Due September 23, 1999

1. a) Calculate $\langle P_x^2 \rangle$ for the ground state of the harmonic oscillator?
b) Use this to calculate the uncertainty in P_x .
2. For the particle-on-a-ring problem, consider the wave function $\psi = e^{-2i\phi}$.
a) What is the z-component of the angular momentum ($\hat{\ell}_z$)?
b) What is the average of the z-component of $\hat{\ell}_z$?
3. Show that a harmonic oscillator in its $v = 1$ level can reach the $v = 0$ and $v = 2$ levels upon absorption of infrared light.
4. Consider the $2P_z$ orbital of the H atom. Can you know precisely the values of L^2 and L_z for this orbital? Why or why not?
5. Show that the $1s \rightarrow 2p$ transition in the H atom is dipole allowed, but that the $1s \rightarrow 2s$ transition is dipole forbidden.