

**Quantum Mechanics**  
**CH 602**  
**Fall 2006**  
**Foster**

Homework 5. Due: **Monday, October 23, 2006.**

1. Point out the similarities and differences between the one-dimensional particle-in-a-box and the harmonic oscillator wave functions and energies.
2. Locate the nodes of the harmonic oscillator wavefunction for state  $n=6$ .
3. Assume that a  $^{12}\text{C}^{16}\text{O}$  is adsorbed on a platinum surface in such a way that the carbon atom is held stationary. Find the vibrational frequency of the vibrating oxygen atom. The  $^{12}\text{C}^{16}\text{O}$  stretch for gas phase carbon monoxide occurs at  $2180\text{ cm}^{-1}$ .
4. The force constant in hydrogen iodide is found to be  $k=313.8\text{ Nm}^{-1}$ . (a) What is the separation between its vibrational energy levels? (b) At what wavenumber do you expect to witness its fundamental vibrational transition in an IR spectrum? (c) What is the relative probability of finding the HI molecule with its bond length 10% greater than its equilibrium value of 161 pm when it is in (i) the  $n=0$  state and (ii) the  $n=4$  state?
5. McQuarie chapter 5, #27.
6. McQuarie chapter 5, #28.
7. McQuarie chapter **6**, #3.
8. McQuarie chapter **6**, #7.
9. McQuarie chapter **6**, #9.
10. McQuarie chapter **6**, #13.