Due Friday, 11/19/99, in class.

Show your work. Problem sets will be spot graded. Work must be shown.

\[ R = 0.08206 \text{ liter atm K}^{-1} \text{ mole}^{-1} = 8.314 \text{ J K}^{-1} \text{ mole}^{-1} \]

\[ h = 6.626 \times 10^{-34} \text{ J s}^{-1} \quad c = 2.9979 \times 10^8 \text{ m s}^{-1} \]

1. T,S,&W Ch 6 Pb 1
2. T,S,&W Ch 6 Pb 1 - But substitute the gas I\(_2\) for H\(_2\). Assume a collisional diameter for I\(_2\) of 30 Å.
3. The Boltzmann distribution can be used to predict the relative population of ground and excited states in various spectroscopic methods.
   a) In NMR spectroscopy (used to determine macromolecular structures and in medical imaging tools), the frequency (\(\nu\)) of the "light" (radio wave) corresponding to the energy gap is on the order of 400 MHz.
   b) In visible spectroscopy, the wavelength of the light corresponding to the energy gap is on the order of 400 nm.

For each of the above, calculate at room temperature (298 K) \(P_{\text{excited state}}\), the probability at equilibrium (in the absence of any excitation light) of finding the particle in the excited state (i.e., before any measurement is attempted).

4. T,S,&W Ch 6 Pb 9
5. T,S,&W Ch 6 Pb 16
6. T,S,&W Ch 6 Pb 26
7. T,S,&W Ch 7 Pb 4