Problem Set #6 — Chem 471 — Fall 1999

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

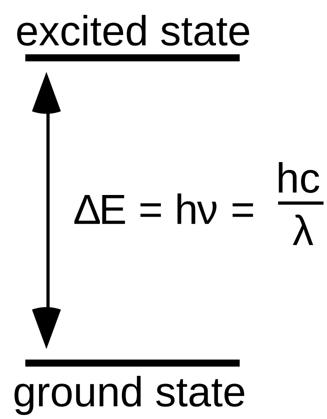
Show your work. Problem sets will be spot graded. Work must be shown.

R = 0.08206 liter atm K^{-1} $mole^{-1}$ = 8.314 J K^{-1} $mole^{-1}$

h = 6.626 x 10^{-34} J s^{-1} c = 2.9979 x 10^{8} 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 (ν) 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