Chem 534: Problem Set #3

Due in class: Thursday, Sept. 24th

(1) Consider a system of N distinguishable, independent particles, each of which has only two accessible states; a ground state of energy 0 and an excited state of energy ε. If the system is in equilibrium with a heat bath of temperature T, calculate A, U, S, and C_v. Sketch C_v versus T. Determine how your results would change if ε_o were added to both energy values (i.e., a change in the zero of energy)?

(2) Calculate the value of n_x, n_y, n_z for the case $n_x=n_y=n_z$ for a hydrogen atom in a box of dimension 1 cm^3 if the particle has kinetic energy $3kT/2$ for T=27ºC. What significant fact does this calculation illustrate?

(3) Using data from the NIST website,
http://physics.nist.gov/PhysRefData/Handbook/periodictable.htm
calculate the fractional population of the first few electronic energy levels of an oxygen atom at 25ºC.

(4) Calculate the entropy of 1 mole of argon at 298 K and 1 atm.