

ME 3007 – HW 2

Due 10/7/08

1. A system contains five indistinguishable fermions of a single species that can occupy one of four quantum energy levels that all have the same degeneracy. Determine and plot the total number of microstates for this type of system for energy level degeneracy values of 2, 5, 10, and 50, and plot the number of microstates as a function of the degeneracy.
2. The partition function of a hypothetical system is given by: $\ln Z = aT^4V$, where a is a constant. Evaluate the mean energy, the pressure, and the entropy.
3. The mean speed of a helium atom in helium gas at 27°C is around 1020 m/s. What is the internal energy of the gas per kmol?
4. Using the NIST Chemistry WebBook, look up the chemical properties of ammonia (specifically, the sections on Gas phase thermochemistry data, the IR Spectrum, and Vibrational and/or Electronic Energy Levels should prove useful).
 - a. Draw the molecular structure of ammonia.
 - b. How many degrees of freedom does ammonia have, and how many of those degrees can each be attributed to translational, rotational, and vibrational movement.
 - c. Using spectroscopic data, what is the constant pressure specific heat of ammonia at 300 K, 600 K, and 2000 K?
 - d. How well do those spectroscopic specific heats agree with those predicted by the Shomate equation?