Physics 227 Homework 5 - Due Feb. 27, 2009

Problem 1: Callen, 9.7-1.

Problem 2: Consider the atmosphere on the planet Isentropia. It has two curious properties: (i) the atmosphere acts as an ideal gas made of particles of mass m such that the entropy per particle is the same throughout the atmosphere. (ii) The atmosphere extends up only to a finite height, where it abruptly stops. In the problem below, assume that the height of the gas is sufficiently small that we can use linearized gravity $F_{grav} = -mg$ as we did in class. Use the principles of kinetic theory to solve this problem.

(a) Satellite measurements indicate that the density and temperature of the atmosphere at the surface of the planet are $n(h = 0) = n_0$ and $T(h = 0) = T_0$. Find the density and temperature of the atmosphere as a function of the height h above the surface of the planet.

(b) Find what the height of the atmosphere is as a function of the conditions on the ground, and other given information.

(c) What is the temperature of the atmosphere at the top?

(d) Find the total number of particles in a vertical column of area A, extending from the surface to the top of the atmosphere. Compare this number to the same in the exponential atmosphere considered in class. Interpret this result physically.