Phy 632: Problem Set 4
(Due: March 10, 2011)

22). Return to our derivation of the Boltzmann equation and rewrite the collision term in terms of the two-body density *after* the collision. Employ the molecular chaos assumption for the form of f_2 *after* the collision and show that $dH/dt \geq 0$ as a result. (Since it is natural to suppose the two-body density to be uncorrelated *before* the collision, in this exercise we suppose that time runs "backward.")

23). In this problem we derive the Boltzmann equation quickly. Consider particles of mass m on which an external, momentum-independent force $\mathbf{F}$ acts. If there are no collisions, show that $f_1(\mathbf{p}_1, \mathbf{q}_1, t) = f_1(\mathbf{p}_1', \mathbf{q}_1', t + \delta t)$, where $\mathbf{p}_1' - \mathbf{p}_1 = \mathbf{F}\delta t$ and $\mathbf{q}_1' - \mathbf{q}_1 = \mathbf{v_1}\delta\mathbf{t}$. Letting δt be infinitesimally small determine a differential equation for f_1. Include collisions through a term of form $\partial f_1/\partial t|_{\rm coll}$ and determine the modified form of your differential equation.

24). Kardar, Ch. 3, Problem #10 (parts a-d only). *Hint: The energy E and temperature T of the two-state atomic system are related by $E = N\epsilon/(1 + \exp(\epsilon/k_B T))$.*