3.1

Derive the Maxwell construction for a Van der Waals gas by considerations involving the minimization of the Gibbs free energy G(T,P,N) = Ng(T,P) instead of the Helmholtz free energy A(T,V,N) as discussed in the class.

3.2

(a) Show that for a function *f(x,t) = sin(xt)*

$$\frac{d}{dt}\int_0^L f(x,t)\,dx = \int_0^L \frac{\partial f(x,t)}{\partial t}\,dx$$

(b) Consider a one-dimensional harmonic oscillator with Hamiltonian

$H(q,p) = \frac{1}{2}(p^2 + q^2)$ (we have taken $m=k=1$)

Show that any phase space trajectory *x(t)* with energy *E* will, on the average, spend equal time in all regions of the constant energy surface $\Gamma(E)$. Here *x(t)* is an appropriate variable describing the phase space trajectory as a function of time *t*.

3.3

Problem 6.3 of Huang. Do only (a), (b), and (c). I will discuss the physics of part (d) later.

3.4

Problem 6.4 of Huang. This problem deals with entropy of mixing and the Gibbs paradox.