

PHYC - 505: Statistical Mechanics

Homework Assignment 4

Due February 25, 2014

1. Consider an infinite classical chain of identical masses coupled by nearest neighbor springs with identical spring constants.
 - (a) Write down the Hamiltonian of this system and the set of ordinary differential equations which are the Hamiltonian equations of motion.
 - (b) Write down explicitly the partial differential equation, which is the Liouville equation for the system, obeyed by the Gibbs ensemble density R .
 - (c) Comment on the problem of solution of these equations. Solve them if you can; make insightful comments :-) if you cannot. Careful now, do not hasten to give up on trying to solve them.
 - (d) Consider the integral over all phase space of the quantity $R \ln R$. Do you think that quantity increases, decreases, or remains the same as time progresses?
 - (e) Comment on the quantum mechanical counterpart of this system regarding each of a, b, c, and d above.
2. Specify the physical conditions under which the members of a Gibbs ensemble might interact with one another and write down an example of the Liouville equation in such a case.
3. Read any of the many statistical mechanics books available to you about Gibbs ensemble theory and describe briefly what a grand canonical ensemble is, what kinds of systems it is relevant to, and what the meaning of the quantity 'chemical potential' that appears in that context is.