

PHYC - 505: Statistical Mechanics

Homework Assignment 3

Due February 18, 2014

1. Give an elementary derivation of the ideal gas equation of state $PV = NkT$ on the basis of kinetic theory arguments. Generalize the result in the manner of Van der Waals to incorporate attractive interactions and excluded volume. Develop on the basis of this generalized equation a mean field theory like the Weiss one you learned for magnetic systems in class and calculate the critical temperature at which something suddenly happens. What happens?
2. Learn about, define, and give the interrelationships of at least four thermodynamic potentials.
3. Consider a 1-d chain of a large number N of alternating masses M and m interacting via nearest-neighbor springs of spring constant k and in contact with a heat bath at temperature T . Calculate the specific heat and explain with the help of a sketch its behavior. You should not forget quantization of the relevant oscillators.