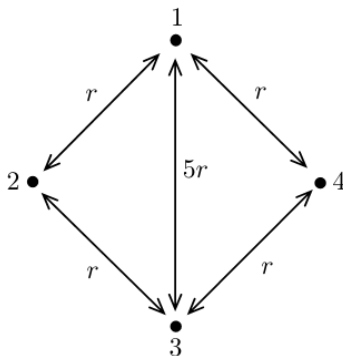


PHYC - 505: Statistical Mechanics

Homework Assignment 6

Due April 8, 2014

1. State and prove the H -theorem for the linear Boltzmann equation applicable to a gas in which the molecules collide with a fixed system of scatterers rather than among themselves. Show that the theorem leads to irreversibility and approach to equilibrium.
2. Consider a particle moving via transition rates on the four corners of a square labeled 1, 2, 3, and 4 counterclockwise, as shown. The rates for transitions between nearest neighbors are r , the rate between 1 and 3 is $5r$ and the rate between 2 and 4 is 0. Given that the system occupies corner 1 at $t = 0$, give an expression for the probability of occupation of corner 3, expressed as a function of the dimensionless time rt . You should show the \mathbb{A} -matrix responsible for the evolution of the probabilities, diagonalize \mathbb{A} , and derive the result.



3. Returning to equilibrium statistical mechanics, consider a gas of N non-interacting fermions at 0 K in a volume V , and calculate the Fermi energy, ϵ_F , (which is the chemical potential at $T = 0$) as a function of the density of the gas.