

PHYS6107 Homework 6, Due Friday March 13, 2009 at 5pm

- 1) As you learn from class, grand canonical partition function is a simple Laplace transformation of canonical partition function with respect to (μ, N) conjugate pairs. One can generalize such formulation to Gibbs free energy (grand thermodynamic potential is a special case of Gibbs free energy). This is described in page 247-248 in textbook. Rederive equation (9.54). Use it to calculate the average volume of an ideal gas of N particles which is in contact with a reservoir at constant T, P . (do not use thermodynamic relations, you have to calculate $\langle V \rangle$ using probability density function ρ).
- 2) Redo example 10.1. Notice the different results for quantum average (which is coherent) and statistical average (which is incoherent). What are the density matrix operator (with respect to the spin degree of freedom) of mixed state, pure state of a free electron?
- 3) Redo example 10.7 (calculate the matrix element of the density matrix operator in coordinate basis).
- 4) Redo example 10.4 (Wigner transformation).