Physics 410 - 2004

Thermal Physics

Problem Set 9

1. Relate the mean square fluctuation of the number of particles $\langle (N - \langle N \rangle)^2 \rangle$ to the derivative $(\partial^2 p / \partial \mu^2)_{\tau,V}$ [*Hint:* Use the relation between the Ω-potential, pV, and $\mathcal{Z}$](8 pt)

2. Derive the interrelation between the potential Ω and the grand partition function (grand sum) $\mathcal{Z}$ that was written in class, i.e., prove that the constant of integration in the solution of the differential equation that relates Ω to $\mathcal{Z}$ is equal to zero (5 pt)

3. Chapter 5, p. 145, problem 1 (4 pt)

4. Chapter 5, p. 145, problem 2 (4 pt)

5. Two fermions are in a system that has three single-particle states, with energies $\varepsilon_1, \varepsilon_2, \varepsilon_3$, and is at temperature τ. Find the average energy of the system. (8 pt)

You need to have 25 points (4 extra credit points)

The problems are from Kittel & Kroemer, *Thermal Physics*, 2nd edition, (Freeman, NY 1980).