Physics 410 - 2002

Thermal Physics

Problem Set 5

1. Chapter 3, p. 83, problem 4 [ignore the *note*] (4 pt)

2. Chapter 3, p. 84, problem 6 (6 pt)

3. Chapter 3, p. 86, problem 11 (5 pt)

4. Heat capacity for constant pressure is given by the expression

$$C_p = \tau \left(\frac{\partial \sigma}{\partial \tau} \right)_p .$$

   Using Maxwell relations, show that

$$[\partial C_P / \partial p]_\tau = -\tau [\partial^2 V / \partial \tau^2]_p \, (5\,\text{pt})$$

$$[\partial \tau / \partial p]_\sigma = (\tau / C_P)[\partial V / \partial \tau]_p \, (6\,\text{pt})$$

5. Using the canonical (Boltzmann) distribution for a classical system of **interacting** atoms of mass m, with the Hamiltonian

$$\mathcal{H}(p, q) = \frac{1}{2m} \sum_i \mathbf{p}_i^2 + U(\mathbf{q}_1, \mathbf{q}_2, \ldots, \mathbf{q}_N),$$

   find the (normalized) probability density for an atom to have a given momentum $\mathbf{p}$ [the Maxwell distribution] (9 pt)

You need to have 25 points out of 35 (10 points are extra credit).

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