Physics 410 - 2002
Thermal Physics

Problem Set 5


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

\[ \left[ \frac{\partial C_p}{\partial p} \right]_\tau = -\tau \left[ \frac{\partial^2 V}{\partial \tau^2} \right]_p \] (5 pt)

\[ \left[ \frac{\partial \tau}{\partial p} \right]_\sigma = \left( \frac{\tau}{C_P} \right) \left[ \frac{\partial V}{\partial \tau} \right]_p \] (6 pt)

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

\[ \mathcal{H}(p, q) = \frac{1}{2m} \sum_i p_i^2 + U(q_1, q_2, \ldots, q_N) \]

find the (normalized) probability density for an atom to have a given momentum \( p \) [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).