Physics 831 - 2002

Statistical Physics

Problem Set 2

1. Show that

$$[\partial C_P/\partial P]_T = -T[\partial^2 V/\partial T^2]_P$$
$$[\partial T/\partial P]_S = (T/C_P)[\partial V/\partial T]_P$$

   (5 pt)

2. Show that

$$\frac{\partial(u_1,u_2)}{\partial(x_1,x_2)} = \left[\frac{\partial(x_1,x_2)}{\partial(u_1,u_2)}\right]^{-1}, \qquad \frac{\partial(u_1,\ldots,u_n)}{\partial(x_1,\ldots,x_n)} = \frac{\partial(u_1,\ldots,u_n)}{\partial(v_1,\ldots,v_n)}\,\frac{\partial(v_1,\ldots,v_n)}{\partial(x_1,\ldots,x_n)}$$

   (5 pt)

3. Express the internal energy U in terms of the Helmholtz free energy A and its derivative $(\partial A/\partial T)_V$. Find a similar relation between the enthalpy H and the Gibbs thermodynamic potential G and $(\partial G/\partial T)_P$ (4 pt).

4. Problem 2.1 (4 pt)

5. Plot the state diagram in variables V (as the x-axis) and T (as the y-axis), for given total number of particles, for a system that experiences a first order phase transition. Explain how to find, for given V in the range of phase coexistence, partial volumes of each phase (6pt)

The problems are from Kerson Huang, *Statistical Mechanics*, 2nd edition, (Wiley, NY 1987).