UNIVERSIDADE FEDERAL SANTA MARIA
DEPARTAMENTO DE FÍSICA
Programa de Pós-Graduação em Física
List 3 Segundo semestre/2015
FSC 810 Mecânica Estatística

1) The Joule Effect. Consider a free expansion of a gas from an insulated chamber of volume V1 into an insulated evacuated chamber of volume V2. Such process causes cooling. Show that for a van der Waals gas the change in temperature is given by:

$$\bar{\Delta} T = \left(\frac{T_f - T_i}{T_i} \right) = \frac{2an}{3RT_i} \left(\frac{1}{V_f} - \frac{1}{V_i} \right)$$

2) The Helmholtz free energy is given by:

$$A = N\varepsilon_0 - Nk_B T \ln\left(e \frac{V}{N} \right) - NcT \ln(k_B T) - N\nu T$$

in which e = 2.718, N is the number of particles, V is the volume, T is the temperature and c and ν are constants.
a) Compute the entropy as a function of V and T;
b) Find the internal energy U as a function of T and N;
c) Find the Gibbs free energy and the enthalpy;
d) Find the entropy as a function of P and T.
e) Find the heat capacity at constant volume.
f) Find the heat capacity at constant pressure.
(g) Show that if the process is adiabatic, $T^{\gamma} P^{1-\gamma}$ in which $\gamma = \frac{c_P}{c_V}$.

3) Discuss about the entropy change in the following processes:
a) adiabatic;
b) isothermic;
c) isochoric;
e) isobaric.

4) Compute the Helmholtz free energy for *n* moles of a monatomic ideal gas and express it in terms of its natural variables. The equation of state and the entropy are:
PV=nRT
and

$$S = \frac{5}{2} nR + nR \ln\left(\frac{V}{V_0} \right) \left(\frac{n_0}{n} \right) \left(\frac{T}{T_0} \right)^{\frac{3}{2}}$$

5) a) Discuss the difference between the Gibbs free energy and the Helmholtz free energy.
b) Show that:

$$U = -T^2 \left(\frac{\partial}{\partial T} \frac{A}{T} \right)$$

Solve the problems 3.1, 3.2, 3.4 ,3.10, and 3.11 from the book
A modern Course in Statistical Physics, L. E. Reichl, second edition.