## PHY 3513 Fall 2000 – Homework 5

## Due at the start of class on Friday, October 13.

Answer all questions, including any additions to textbook problems. To obtain full credit, you must explain your reasoning and show all working. Please write neatly and include your name on the front page of your answers.

1. Callen Problem 3.2-1. This problem illustrates the point that for a single-component simple system, there are two (not three) independent first partial derivatives of the fundamental equation.

You should start by inverting a pair of simultaneous equations for T(s, v) and P(s, v) to obtain s(T, P) and v(T, P). You should then determine  $\mu(T, P)$  via three separate methods (do them all!):

- (a) calculate  $\mu(s, v)$  from the fundamental relation, then substitute for s and v;
- (b) use the Euler equation;
- (c) integrate the Gibbs-Duhem relation.
- 2. Callen Problem 3.3-2.

You should write down the total differential ds and integrate it to obtain s(u, v). (Don't forget to check your final result by comparing its partial derivatives against the total differential you began with.)

- 3. Callen Problem 3.4-5, modified as follows:
  - (i) Rather than assuming that the gas is monatomic ideal (as stated by Callen), instead take it to be simple ideal with an arbitrary value of c.
  - (ii) Replace part (e) by the following: "From the result of (c) or (d), for what value of  $\eta$  is Q = 0? For this case, show that  $PV^{\gamma} = \text{constant}$ , and express  $\gamma$  in terms of c."

In part (c) you should use the First Law, while in part (d) you should start with the fundamental equation for S.