Problem Set 8

Please staple problems 1 & 2 and 3 & 4.

1. Electrons in a Semiconductor
   Schroeder 7.34

2. Greenhouse Effect
   Schroeder 7.55

3. Photon Gas
   
   (a) Compute equilibrium number of photons in a box of volume $V$ and temperature $\tau$.

   (b) How does your result for (a) compare to the expression for the entropy of the photon gas? Calculate the entropy per photon, $\sigma/N$.

   (c) Show that the pressure of a photon gas in equilibrium is $1/3$ times the energy density $u = U/V$. What is the value of $C_P$ for the photon gas?

4. Neutrino Background
   Schroeder 7.48
   Hint: In part (a) use the fact that in chemical equilibrium the sum of chemical potentials of the reactants must be equal to the sum of chemical potentials of the products. We will prove this later, when we get to Chapter 5.6 (see equations 5.95 and 5.102 in Schroeder).