10.40 Thermodynamics **Fall 2003**
Problem Set 2

1. Problem 4.3

2. You are asked to prove that $\Delta \underline{S}$ for an irreversible, adiabatic process is always > 0. Consider the following closed system cyclic process for an ideal gas.

   I. An irreversible, adiabatic expansion from point 1at T_A , P_A to point 2 at T_B, P_B where $T_A > T_B$ *and* $P_A > P_B$.
   II. A reversible, isothermal compression from point 2 to point 3 at T_B
   III. A reversible, adiabatic compression from point 3 to point 1

   (a) Assuming only *PdV* work, sketch a possible cyclic path for steps I –III on a *P-V* diagram.

   (b) Using the exact differential, state function characteristics of $\underline{S}$ prove that $\Delta \underline{S}$ for step I is always > 0 for an ideal gas expanding adiabatically and irreversibly from point 1 at T_A ,P_A to point 2 at T_B,P_B

   (c) Is $\Delta \underline{S}$ for step I > 0 for a non-ideal gas as well? Explain your answer.

3. Problem 4.18

Be sure to state and justify all assumptions made