5.60/BE.110: Thermodynamics and Kinetics (r08)
Recitation Handout for 9/21/2006

Appetizers:

1. The combustion of ethanol in a constant-volume calorimeter produces 1364.34kJ/mol at 25°C. What is the value of $\Delta_r H°$ for the following combustion reaction?

   $C_2H_5OH(l) + 3O_2(g) = 2CO_2(g) + 3H_2O(l)$

2. In an adiabatic bomb calorimeter, the combustion of 0.5173g of ethanol causes the temperature to rise from 25.0 to 29.289°C. The heat capacity of the bomb, the products, and the other contents of the calorimeter is 3576J/K. What is the molar internal energy of combustion of ethanol at 25.0°C?

3. For part 2, what is the molar enthalpy of combustion?

Main Course: (Spring 2006, Exam I)

On a P vs. V diagram, sketch the following cyclic process for 1 mole of monatomic ideal gas:

State 1 --> State 2: Isothermal expansion from V_1 = 1.0L to V_2 = 5.0L at 300K
State 2 --> State 3: Adiabatic compression from V_2 = 5.0L to V_3 = 1.0L
State 3 --> State 1: (Close the cycle as necessary)

1. Is T in State 3 larger or smaller than T in State 1?
2. Is P in State 3 larger or smaller than P in State 1?
3. Which one of the following words describes the transformation from State 3 --> State 1?

   adiabatic, isochoric, isobaric, isoenergetic, isoentropic

4. Calculate work, heat for each step.
5. Overall, does this cycle constitute a heat *engine* or a heat *pump* (*i.e.* refrigerator)?
6. Define and compute the *efficiency* for the cycle.

Regarding the problem set:

- The values given in problem 2 does not constitute an actual cyclic process, use the following directions instead:

  Step 1: Isothermal expansion to 2L (State 1)
  Step 2: Adiabatic expansion to 3L (State 2)
  Step 3: Isothermal compression to 0.75L (State 3)
  Step 4: Adiabatic compression to 0.5L (State 0)