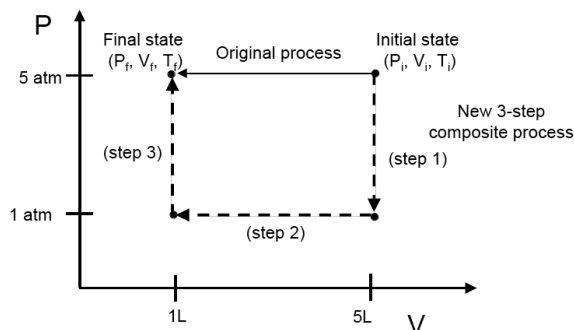


CHEM 3410: Physical Chemistry I — Fall 2009

Homework 2

Due in Class: September 14, 2009

- One mole of an ideal gas is compressed reversibly from 5L to 1 L at a constant pressure of 5 atm, and releases 5000 J of heat during this process.
 - Calculate the work and internal energy change in this process.
 - Determine the initial and final states (P , V , and T) of the gas.
 - Now consider a roundabout means of moving the gas from the given initial state to the same final state, as illustrated below. Use a 3-step reversible process, first a constant volume drop in pressure, followed by a constant-pressure compression, followed last by a constant-volume rise in pressure (steps 1, 2, and 3 in the sketch below).
 - What is the internal energy change of this composite process (step 1 + step 2 + step 3)?
 - Calculate the total heat transfer and work in this composite process and use the calculation to prove that heat and work are not state functions.



- One m^3 of **diatomic** ideal gas is subject to the following:
 - It is first expanded from an initial state at 298K and 15 atm pressure to a final state at 1atm. During this expansion the gas is thermally insulated from the environment (adiabatic process).
 - After this expansion the insulation is removed and the gas is allowed to cool (or heat) back to 298K, while keeping the pressure constant at 1atm.

What is the amount of work done on the gas in these two processes. It might be helpful if you draw the processes on an appropriate P - V (state) diagram.

HINTS:

- A good number to know would be how many moles of gas you are dealing with...remembering to work in a compatible set of units
- When drawing your P - V diagram, find P , V and T for each step in the process
- For an adiabatic process, the initial and final states are related by $P_i V_i^\gamma = P_f V_f^\gamma$ where $\gamma = \frac{C_p}{C_v}$ (Equation 2.77)