Homework 1, due Sept. 28, 2006

1. A tank of volume $2m^3$ contains oxygen at pressure of $10^4 Pa$, and temperature of $200^o C$. Assume that it behaves like an ideal gas.

   (a) How many kilomoles of oxygen are in the tank?

   (b) How many kilograms?

   (c) Find the pressure if the temperature is increased to $500^o C$.

   (d) At a temperature of $20^o C$, how many kilomoles should be withdrawn from the tank for the pressure to become $10^3 Pa$?

2.

(a) A system initially with volume 10 liters and temperature $T = 0^C$ is compressed **adiabatically** to a state with volume 5 liters and temperature $T = 100^o C$. In this process, 1000J of work is done on the system. By how much does the internal energy of the system change in this process?

(b) Instead, we start from the same initial state as above, and end at the same final state as above, by going through the following two steps. Step 1: the system is first heated **isochorically** (constant volume) to the final temperature $T = 100^o C$. Step 2: the system is then compressed **isothermally** (constant temperature) to the final volume of 5 liters. In the first step, 800J of heat had to be added to the system. In the second step, 1900J of heat flowed out of the system. Compute the energy changes and amounts of work done in each of these two steps.

(c) Can this system be regarded as an ideal gas? Why or why not?

3. The temperature of an ideal gas at initial pressure P_1 and volume V_1 is increased isochorically until the pressure has doubled. The gas is then expanded isothermally (constant temperature) until the pressure drops to its original value. Then it is compressed **isobarically** (constant pressure) until the volume returns to its initial value.

   (a) Sketch these processes in the P-V plane and the P-T plane.

   (b) Compute the work done in each process, and the net work done in the cycle, if $n = 2$ kilomoles, $P_1 = 10^5 PA$, and $V_1 = 2m^3$.