Physics 3B Week 4: The First Law of Thermodynamics

Name: Andrea Silvestri, ID#:

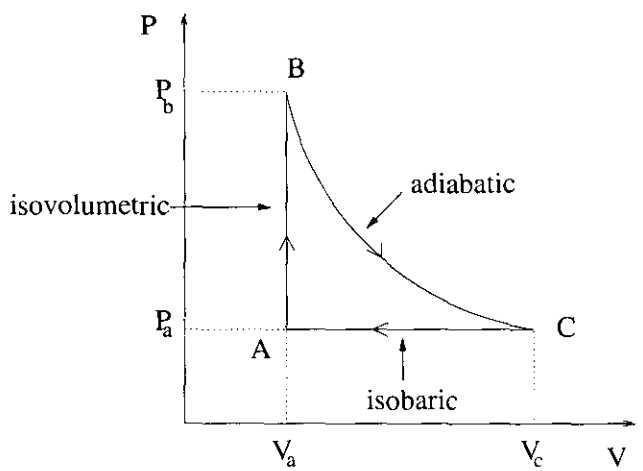
Who did you work with? 1., 2.

TA: Andrea Silvestri

Date: January 30, 2008 Day: Wednesday Hour: 8:00 - 12:50

1. Problem 1

Consider an ideal gas of diatomic molecules confined in a cylindrical volume of 2 liters. The gas is carried through a closed cycle, and its specific heat ratio is $\gamma = 1.40$. The gas's initial conditions start at atmospheric pressure and temperature 30 °C. The gas then goes through an isovolumetric process doubling its pressure, then a quasi-static adiabatic process until its reaches its initial pressure, and an isobaric process, which closes the cycle. (Ignore vibrational contribution of the molecules).
(1) Calculate the gas's temperature, pressure, and volume at the end of the isovolumetric process. (2) What is the gas volume after the adiabatic process? (3) Compute the work done on the gas during one cycle.



Given: V_A; γ; P_A; T_A; 1.) V = const.; 2.) $Q = 0$; 3.) P = const.; $P_B = 2P_A$; $P_C = P_A$

(1) Sol. first process is isovolumetric: $V_B = V_A$; the pressure $P_B = 2P_A$ and the temperature T_B:

$P_B V_B = nRT_B$ but $P_B V_B = 2P_A V_A = 2nRT_A$

$P_A V_A = nRT_A \Rightarrow$ ~~$nRT_B = 2nRT_A$~~ $\Rightarrow T_B = 2T_A$

~~$T_B = 2 \cdot 30^\circ C = 60^\circ C$~~ ~~$T_B = 333.15\ ^\circ k$~~

$T_A = 303.15\ ^\circ k$ $T_B = 606.3\ ^\circ k$