1. 簡答題

(a) Give the statements of the zeroth law and first law of thermodynamics. **(10 points)**

(b) Give the statements of the second law (in Kelvin/Plank, Clausius, and entropy) of thermodynamics. **(10 points)**

(c) Prove that for an ideal gas in a quasistatic adiabatic process the following equations are valid: (a) $TV^{\gamma-1} = $ constant; (b) $T^{\gamma}P^{1-\gamma} = $ constant. **(10 points)**

(d) Briefly describe the **kinetic theory of gases**, and use the pressure exerted on a wall: $P = \frac{2nm\cdot\vec{V_\perp}}{A\cdot t}$ (where **n** is the number of gas molecular, **m** is the mass of gas molecular, $V_\perp$ is the molecular velocity perpendicular to wall, **A** is the wall area, and **t** is the duration time) to get the relation between pressure P, volume V, and average kinetic energy $\overline{E_k}$ in $PV = \frac{2}{3}N\overline{E_k}$, where N is the total number of gas. **(10 points)**

(e) Two moles of helium gas are at 20 °C and a pressure of 200 kPa. Please find the volume of the gas. And if the gas is heated to 40 °C and its pressure reduced by 40%, what is the new volume? **(10 points)**

2. One mole of an ideal gas is taken through the cyclic process depicted in the following figure. From a to b it undergoes an isothermal expansion. (a) Find the work done by the gas in each segment, ab, bc, and ca. (b) What is the net heat flow in a complete cycle? **(10 points)**
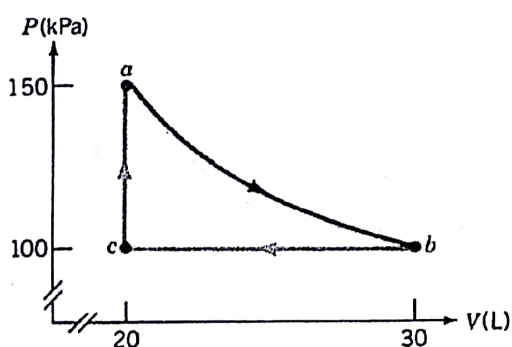

3. A gas undergoes the cyclic process depicted in right figure. In the process abc, the system absorbs 4500 J of heat. The internal energy at a is $U_a = 800$ J. (a) Determine U_c. The net heat absorbed during the complete cycle is 1000 J. For the process c to a find (b) the work done by the gas, and (c) the heat transfer. **(10 points)**
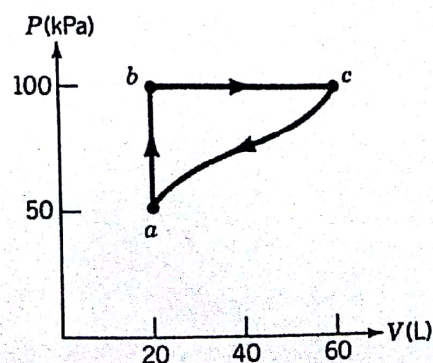
4. The heat capacity at constant volume of a sample of a monatomic gas is 8.45 cal/K. Find: (a) the number of moles; (b) the internal energy at 400 K; (c) the molar specific heat at constant pressure. **(10 points)**

5. After a steady state has been reached, a metal rod conducts 1000 J from a 400 K reservoir to one at 250 K during a certain time interval. Find the change in entropy of: (a) the hot reservoir; (b) the cold reservoir; (c) the rod; (d) the universe. **(10 points)**

6. An ideal gas (1.2 mol) is the working substance in an engine that operates on the cycle shown in Right Figure. Processes BC and DA are reversible and adiabatic. (a) Is the gas monatomic, diatomic, or polyatomic? (b) What is the engine efficiency? **(10 points)**
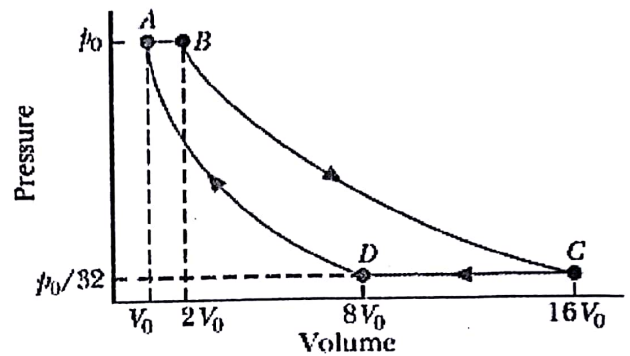
7. One mole of an ideal **diatomic gas** operate in the cycle shown in right figure, where Ta=600 K, Tc=200 K, and Pc=80 Kpa. Find (a) the work done per cycle; (b) the efficiency of the engine. **(10 points)**
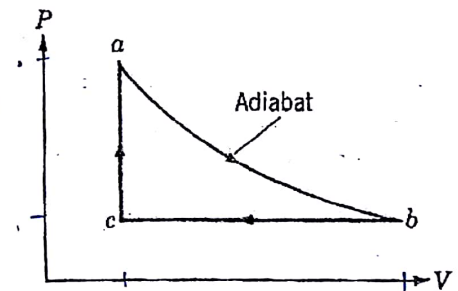
8. Two moles of an ideal monatomic gas is taken around the reversible cycle shown in right figure. Find: (a) the heat input and output in each step; (b) the work done in one cycle; (c) the efficiency. **(10 points)**
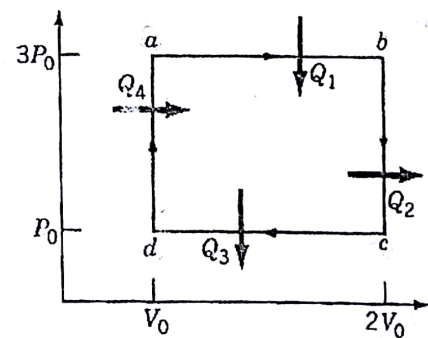
Note: Total 120 points; 各題計算過程需詳述，否則不與計分。