(I) A piston-cylinder device contains an ideal gas, whose mass and gas constant are m and R, respectively. Specific heat of the gas is independent of temperature. There is no friction between the piston and the cylinder, and the pressure of the gas is balanced with the ambient pressure. Heat is now slowly transferred to the gas, and the gas starts to expand. After the absorption of the heat Q by the gas, heat transfer is stopped, and the gas stops to expand. This process is quasi-static, and no external force acts on the piston during the process. The gas does the work L during the process. Answer the following questions using the given physical quantities. (25points)

(1) Express the change in internal energy ΔU of the gas.

(2) Express the temperature change ΔT of the gas.

(3) Express the specific heat at constant pressure c_p of the gas.

(4) Express the specific-heat ratio κ of the gas.

(5) Explain with reason how the increase in initial temperature of the gas will affect the entropy change ΔS of the gas.

☐Applicant of INTERNATIONAL MASTER'S PROGRAM should answer in English.

(II) A composite wall (area: A) consisting of two materials (thermal conductivity: k_A and k_B, thickness: L_A and L_B) is separated by a very thin heater with negligible contact thermal resistance and cooled by air on the top and bottom surfaces (heat transfer coefficient: h, temperature: T_∞). The heat flux of the heater is q and the heater temperature is T_h. Answer the following questions. (25points)

(1) Draw an equivalent thermal circuit for this system with all the thermal resistances.

(2) Obtain the heat fluxes q_A and q_B from the heater to the air, respectively.

(3) Obtain the heater temperature T_h. (Use k_A, k_B, L_A, L_B, h, T_∞, and q.)

(4) When q_A>q_B, draw the temperature distribution from the heater to the air.