Uva Wellassa University, Sri Lanka
End Semester Examination – January 2010
SCT 254-1 Thermodynamics (Repeat)

Time: One (01) hour

Total 05 Questions
Answer **four (04)** questions only

$R = 8.31$ J/ mol. K^{-1}
1 atm = 101, 325 Pa

01) I. What do you mean by external work, internal work, equation of state and quasi-static process?

(06 marks)

II. Show that the work done by an ideal gas during the quasi-static, isothermal expansion from an initial pressure P_i to P_f is given by

$$W = nRT \ln \frac{P_f}{P_i}$$

(12 marks)

III. Calculate the work done when the pressure of 1 mol of an ideal gas is decreased quasi-statically from 20 to 1 atm, the temperature remaining at 20 ^{0}C.

(07 marks)

02) I. Explain what is quasi-static adiabatic process.

(06 marks)

II. Derive the following formula for a quasi-static adiabatic process for the ideal gas, assuming γ to be constant :

$$T_f = T_i \left(\frac{P_f}{P_i} \right)^{(\gamma-1)/\gamma}$$

(12 marks)

III. Helium at 300 K is compressed quasi-statically and adiabatically to one fifth of its initial pressure. Assuming that the helium behaves like the ideal gas, calculate the final temperature. Take γ is 5/3 for helium.

(07 marks)

03) I. Distinguish between reversible and irreversible process.

(09 marks)

II. What are the conditions to be reversible?

(09 marks)

III. Use an indictor diagram (p-v diagram) to show reversible process.

(07 marks)

04) A high altitude balloon contains helium whose molecular weight is 4 grams/mole. At its maximum altitude the balloon's volume is 830 m^3. The outside temperature and pressure are -51.0 °C and 5.40 kPa at the balloon's maximum altitude. Assuming that the helium in the balloon is in equilibrium with the outside air temperature and pressure, i.e., they are the same:

I. What is the mass of the helium in the balloon at its maximum altitude?

(07 marks)

II. Assuming no lost of helium, what would be the volume of the balloon when it was launched from the ground where the air temperature and pressure are 22.0 °C and 101 kPa?

(12 marks)

III. If the volume of the balloon when it was launched was 61.0 m^3, how many atoms of helium were lost during the balloon's assent?

(06 marks)

05) I. State the Kelvin-Plank and the Clausius forms of the second law of thermodynamics.

(02marks)

II. Discuss the construction and working of a heat engine.

(06 marks)

III. Define its efficiency and show that the efficiency η depends only on the quantity of heat absorbed (Q_1) from and rejected (Q_2) to the respective heat reservoirs.

(05 marks)

IV. A Carnot engine absorbs 2000 J of heat from source of heat engine at 227 °C and rejects 1200 J of heat during each cycle to sink. Calculate

(a) efficiency of engine.
(b) temperature of sink.
(c) amount of work done during each cycle.

(12 marks)