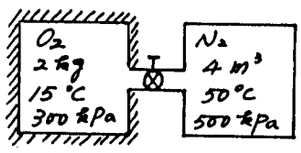
(1) (30%) An insulated tank which contains 2 kg of O_2 at 15°C and 300 kPa is connected to a 4-m^3 uninsulated tank which contains N_2 at 50°C and 500 kPa. The valve connecting the two tanks is opened, and the two gases form a homogeneous mixture at 25°C. Determine (a) the final pressure in the tank, (b) the heat transfer, and (c) the net change of entropy during this process. Assume $T_0 = 25°C$ and $\bar{R} = 8.314\ kPa \cdot m^3/kmol \cdot K$

	Molecular Weight	C_{v0}	C_{p0}
O_2	32 kg/kmol	0.6618 kJ/kg·K	0.9216 kJ/kg·K
N_2	28 kg/kmol	0.7448 kJ/kg·K	1.0416 kJ/kg·K



(2) (30%) (a) Plot a schematic arrangement of an ideal regenerative Brayton cycle, and the corresponding P-v and T-s diagrams.

(b) Show the turbine work, the compressor work and the net work on P-v diagrams.

(c) Derive the thermal efficiency of this cycle in terms of two parameters (T_{max}/T_{min}) and (P_{max}/P_{min})

T_{max}, T_{min} : The maximum and minimum temperatures of this cycle.

P_{max}, P_{min} : The maximum and minimum pressures of this cycle.

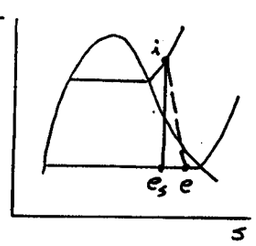
(3) (20%) For a steam turbine, we consider three different processes as follows : (i) the actual process from i to e with work output 600 kJ/kg and no heat transfer.

(ii) the isentropic process from i to e_s with work output 741.9 kJ/kg.

(iii) the reversible process from i to e with work output 729.3 kJ/kg.

(a) Explain the difference between processes (i) and (iii), and calculate the irreversibility of process (i).

(b) Explain the difference between processes (ii) and (iii), and add a device to make process (ii) approach to process (iii).



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(4) A closed system undergoes a cycle

(10%) (a) Is it possible for there to be a net transfer of work if there is no transfer of heat ? (2%)

(b) Is it possible for there to be a net transfer of heat if there is no transfer of work ? (2%)

(c) If the net work transfer is zero, does this mean that there is no heat transfer ? (3%)

(d) If the net transfer of heat is zero, does this mean that there is no work transfer ? (3%)

(5) It is proposed that nitrogen gas be compressed adiabatically, from

(10%) 100 KPa and 47°C to 280 KPa and 127°C. The proposed process is (a) Internally reversible, (b) Irreversible, or (c) Impossible). Explain. (10%)

[C_{p_0} of Nitrogen $\doteq$ 1.039 $\frac{KJ}{kg \cdot K}$]

[C_{v_0} of Nitrogen = 0.743 $\frac{KJ}{kg \cdot K}$]