3m0.06=100/500x0.3)=2/P1(P1=V2V

st law1Q-W= ΔU

for isothermal process then 0 But ΔU=

Q=W

J=Q48283)= -100/500ln(0.3 x1000x100)=2/P1ln(P1 V1 W=P

adiabatic2-3 process

$P_3 V_3^{\gamma} = P_2 V_2^{\gamma}$

$P_3 = P_2 \left(\frac{V_2}{V_3}\right)^{\gamma}$ then $P_3 = 500 x 1000 \left(\frac{0.06}{0.3}\right)^{1.4}$ = 52530 N/m2

$W = (P_2V_2 - P_3V_3)/(\gamma - 1) = \frac{0.06 x 500000 - 0.3 x 52530}{1 - 1.4}$ = 35602 J

Q=0 (adabatic)

Process 3-1

W=0

$\frac{T_3}{T_2} = \left(\frac{V_2}{V_3}\right)^{\gamma - 1}$ then T_3 = 293/(0.3/0.06)^{γ−1} = 153.91 K

Q31 = mCv (T1-T3)=(0.358x714)(293-153.91)= 35603 J

W 31=0

Is $\sum Q = \sum W$

Q12+Q23+Q31=W12+W23+W31

-48283+0+35603= -48283+35602+0

Then the 1st law of thermodynamics is verified.

3Ch. The molecular weight , adiabatic index, characteristic gas constant, density and partial pressure of gas mixture

EX. The volumetric analysis of a gas is as follows: N_2 30%, H_2 60%, O_2 10%. This gas is mixed with air in proportions 2 volume of gas to 1 volume of air. Take the molar specific heat capacity at constant volume for diatomic gas = 20 kJ/kg mol K . Air contains 21% by oxygen volume and the remainder is N_2. If the air-gas mixture is kept at 30 °C and 1.3 bar for temperature and pressure respectively. Determine for the air-gas mixture:

a) The mean relative molecular mass of the mixture(M_{av}).

b) The value of the adiabatic index of the mixture (γ).

c) The characteristic gas constant for the mixture(R).

d) The density of air

e) The partial pressure and mass fraction of O_2 in the mixture.

Q3) Mav= $\frac{2(28 x 0.3 + 2 x 0.6 + 32 x 0.1) + 1(32 x 0.21 + 28 x 0.79)}{3}$ = 18.146 kg/kg.mol

$$\bar{C}_{vav} = \frac{\sum n\bar{C}_v}{\sum n} = \frac{(2x(0.3+0.6+0.1)+1x(0.79+0.21))x20}{3} = 20\ \frac{kJ}{kg.mol.K}$$

$$Rm = \bar{C}_p - \bar{C}_v$$

$$\bar{C}_{pav} = 20 + 8.3143 = 28.3143\ \frac{kJ}{kg.mol.K}$$

$$\gamma = \frac{\bar{C}_{pav}}{\bar{C}_{vav}} = \frac{28.3143}{20} = 1.4157$$

$$R_{av} = \frac{R_m}{M_{av}} = \frac{8.3143}{18.146} = 0.4582\ \frac{kJ}{kg.K}$$

$$P_{air} = \frac{n}{n_T}P_t = \frac{1}{3}x130 = 43.334\ \frac{KN}{m^2}$$

$$R_{air} = \frac{R_m}{M_{air}} = \frac{8.3143}{(0.79x28+0.21x32)} = \frac{8.3143}{28.84} = 0.28829\ \frac{kJ}{kg.K}$$

$$\rho_{air} = \frac{P_{air}}{R_{air}T} = \frac{43.334x1000}{288.29(30+273)} = 0.496\ \frac{kg}{m^3}$$

$$P_{o_2} = \frac{n}{n_T}P_T = \frac{(2x0.1+0.21)}{3}x130 = 17.766\ \frac{KN}{m^2}$$

$$m_T = n_T M_{av} = 3x18.147 = 54.441\ kg$$

$$m_{o_2} = (2x0.1+0.21)32 = 13.12\ kg$$

$$m_{o_2}\% = \frac{m_{o_2}}{m_T} = 24.1\%$$