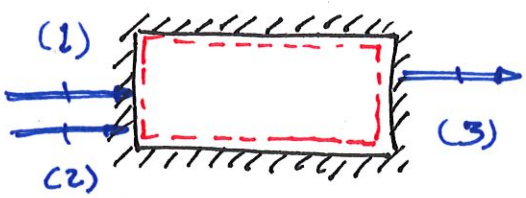

(1) $P_1 = 100\,kPa$
$T_1 = 350\,K \quad \dot{n}_a = 0.1\,kmol/s$

(2) $P_2 = 100\,kPa$
$T_2 = 550\,K \quad \dot{n}_v = 0.3\,kmol/s$

(3) $P_3 = 100\,kPa$

CoM →

$$\frac{dm_{sys}}{dt}\Big\rfloor_0 = \Sigma \dot{m}_{in} - \Sigma \dot{m}_{out} + \dot{n}_{gen}\Big\rfloor_0 - \dot{n}_{con}\Big\rfloor_0$$

$$0 = \dot{n}_a + \dot{n}_v - \dot{n}_3 \qquad \frac{\dot{n}_3}{\dot{n}_3} = \frac{\dot{n}_a}{\dot{n}_3} + \frac{\dot{n}_v}{\dot{n}_3} \Rightarrow 1 = y_{a,3} + y_{v,3}$$

$$y_{a,3} = \frac{\dot{n}_a}{\dot{n}_3} = \frac{0.1}{0.4} = 0.25$$

$$y_{v,3} = \frac{\dot{n}_v}{\dot{n}_3} = \frac{0.3}{0.4} = 0.75$$

CONSERVATION of MASS GIVES US THE MOLE FRACTIONS @ THE EXIT.

CoENERGY →

$$\frac{dE_{sys}}{dt}\Big\rfloor_0 = \dot{Q}\Big\rfloor_0 + \dot{W}\Big\rfloor_0 + \Sigma_{in} \dot{m}(h + \ldots) - \Sigma_{out} \dot{m}(h + \ldots)$$

$$0 = \dot{m}_a(h_a) + \dot{m}_v(h_v) - \dot{m}_3(h_3)$$

$$0 = \dot{n}_a(\bar{h}_a)_1 + \dot{n}_v(\bar{h}_v)_2 - \dot{n}_3 \bar{h}_3$$

$$\bar{h}_3 = \frac{\dot{n}_a}{\dot{n}_3}\bar{h}_{a,1} + \frac{\dot{n}_v}{\dot{n}_3}\bar{h}_{v,2}$$

$$= (0.25)\ " \quad + (0.75)\ "$$

$$= (0.25)[M_{AIR}\, h_{a,1}] + (0.75)(\bar{h}_{v,2})$$

$$= (0.25)\left[28.97\ \tfrac{kg}{k\cdot mol} \cdot 350.49\ \tfrac{kJ}{kg}\right] + (0.75)\left(18{,}601\ \tfrac{kJ}{k\cdot mol}\right)$$

$$= \underline{16{,}489\ kJ/k\cdot mol}$$

@ THE EXIT (3) MIXTURE SPECIFIC ENTHALPY GIVEN BY

$$\bar{h}_3 = y_{a,3}\,\bar{h}_{a,T_3} + y_{v,3}\,\bar{h}_{v,T_3}$$

$$= y_{a,3}[M_{AIR}\, h_{a,T_3}] + y_{v,3}\,\bar{h}_{v,T_3} \qquad (1)$$

THESE ARE BOTH FUNCTIONS of TEMPERATURE!

AND SO WE HAVE A GUESS & CHECK METHOD. WE MUST GUESS T_3, FIND h_{a,T_3} & $\bar{h}_{v,T_3}$, PLUG THEM INTO EQUATION ABOVE, & THEN SEE IF IT GIVES 16,489 kJ/k·mol. IF NOT, GUESS AGAIN!

START W/ $T_3 = 500\ K$ $\qquad h_{a,T_3} = 503.02\ kJ/kg$

$$\bar{h}_{v,T_3} = 16{,}828\ kJ/kmol$$

(1) GIVES

$$\bar{h}_3 = (0.25)[28.97][503.02\ \tfrac{kJ}{kg}] + (0.75)(16{,}828\ kJ/kmol)$$

$$= 16{,}264\ kJ/kmol$$

TOO LOW, MAKE IT HIGHER.

AFTER SEVERAL ITERATIONS . . .

(OR USE EES! SEE THE EES FILE...)

... $\boxed{T_3 = 507\,K}$

(b) AofS

$$\frac{dS_{sys}}{dt} = \sum_i \frac{\dot{Q}_i}{T_i} + \sum_{IN} \dot{n}\bar{s} - \sum_{OUT} \dot{n}\bar{s} + \dot{S}_{GEN}$$

$$\dot{S}_{GEN} = \dot{n}_3 \bar{s}_3 - \dot{n}_{a,1} \bar{s}_{a,1} - \dot{n}_v \bar{s}_{v,2}$$

$$= \dot{n}_3 \bar{s}_3 - \dot{n}_{a,1} M_{air} s_{a,1} - \dot{n}_v \bar{s}_{v,2}$$

$$\bar{s}_3 = y_{a,3} \bar{s}_{a,3} + y_{v,3} \bar{s}_{v,3}$$

$$= y_{a,3} M_{air} s_{a,3} + y_{v,3} \bar{s}_{v,3}$$

$$\dot{S}_{GEN} = \dot{n}_3 \left[y_{a,3} M_{air} s_{a,3} + y_{v,3} \bar{s}_{v,3} \right] - \dot{n}_{a,1} M_{air} s_{a,1} - \dot{n}_{v_2} \bar{s}_{v,2}$$

BUT $\dot{n}_3 y_{a,3} = \dot{n}_{a,1}$ & $\dot{n}_3 y_{v,3} = \dot{n}_2$ SO

$$\dot{S}_{GEN} = \dot{n}_{a,1} [M_{air}] [s_{a,3} - s_{a,1}] + \dot{n}_{v,2} [\bar{s}_{v,3} - \bar{s}_{v,2}]$$

$$= \dot{n}_{a,1} M_{air} \left[s^\circ_a(T_3) - s^\circ_a(T_1) - R \ln\left(\frac{y_a P_3}{P_1}\right) \right] + \dot{n}_{v,2} \left[\bar{s}^\circ_{v,3}(T_3) - \bar{s}^\circ_v(T_1) - \bar{R} \ln\left(\frac{y_v P_3}{P_1}\right) \right]$$

NOTE PARTIAL PRESSURES!

. . .

$= \boxed{0.2135\ kW/K}$