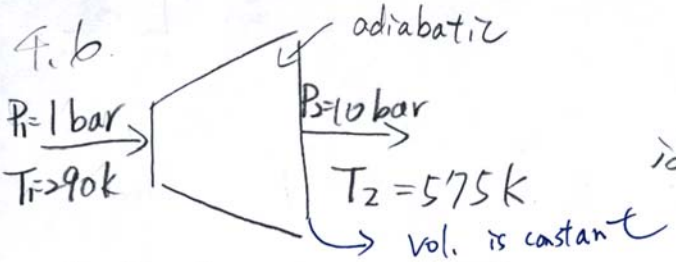
4.6 ①



ideal gas P.75 Example 3.4-4.

a) Find ΔS. Take the device as the system

$$d\underline{H} = Td\underline{S} + \underline{V}dP \qquad \underline{V} = \frac{RT}{P}$$

$$\Rightarrow d\underline{S} = \frac{d\underline{H}}{T} - \frac{\underline{V}dP}{T}$$

$$\Rightarrow \int d\underline{S} = \int C_P^* \frac{dT}{T} - \int R\frac{dP}{P}$$

$$\Rightarrow \Delta\underline{S} = C_P^* \ln\frac{T_2}{T_1} - R\ln\frac{P_2}{P_1}$$

$$= 29.3\ \frac{J}{mol\cdot k}\ln\frac{575}{90} - 8.314\ \frac{J}{mol\,k}\ln\frac{10}{1}$$

$$\doteq 20.1 - 19.1\ \frac{J}{mol\cdot k}$$

$$= 1\ \frac{J}{mol\cdot K}$$

b) From energy balance

$\frac{dU}{dt} = 0$ (S.S ⇐ operates continuously.) $= \dot{N}_1 \underline{H}_1 + \dot{N}_2 \underline{H}_2 + \cancel{\dot{Q}}^{\,0} + \dot{W}_S - P\cancel{\frac{dv}{dt}}^{\,0}$ (adiabatic)

$\Rightarrow \dot{W}_S = -\dot{N}_1 \underline{H}_1 - \dot{N}_2 \underline{H}_2 \quad \because \dot{N}_2 = -\dot{N}_1$

$\Rightarrow \frac{\dot{W}_S}{\dot{N}_1} = -\underline{H}_1 + \underline{H}_2$

$\Rightarrow \underline{W}_S = C_p^*(T_2 - T_1) = 29.3 \frac{J}{mol \cdot K}(515 - 290\ K)$

$= 8350.5 \frac{J}{mol}$

C)

$\underline{W}_S = 8350.5 \frac{J}{mol} > 7834.8 \frac{J}{mol}$ (P.128) ※

⇒ the process is irreversible

⇒ part of Work is converted into heat

⇒ increase of interal energy

⇒ Temp. of outlet flow is hrgher