[redacted]

1 a) $\dot{Q}_{aus} = ?\ kW$

$$0 = \dot{m}\left[h_e - h_a + \frac{w_e^2 - w_a^2}{2} + g(z_e - z_a)\right] + \dot{Q} - \dot{W}_t \quad \text{(isobar)}$$

$$0 = \dot{m}\left[h_e - h_a\right] + \dot{Q}_R - \dot{Q}_{aus}$$

$$\dot{Q}_{aus} = \dot{m}\left[h_e - h_a\right] + \dot{Q}_R = 0.3\ \frac{kg}{s}\left[292.98\ \frac{kJ}{kg} - 419.04\ \frac{kJ}{kg}\right] + 100\ kW$$

$$= \underline{62.182\ kW}$$

TAB A 2:

$$h_f(70°C) = 292.98\ kJ/kg = h_e$$

$$h_f(100°C) = 419.04\ kJ/kg = h_a$$

b) $\overline{T}_{KF} = ?\ K$

$$\overline{T} = \frac{\int_e^a T\,ds}{s_a - s_e} \overset{\text{isobar}}{=} \frac{du}{s_a - s_e} = \frac{q(T_2 - T_1)}{q \ln\left(\frac{T_2}{T_1}\right)} = \frac{298.15K - 288.15K}{\ln\left(\frac{298.15K}{288.15K}\right)}$$

$$= \underline{293.12\ K}$$

c) $\dot{S}_{erz} = ?$

s_a: TAB A2.

s_e: TAB A2.

$$0 = \dot{m}\left[s_e - s_a\right] + \sum \frac{\dot{Q}_j}{\overline{T}_j} + \dot{S}_{erz}$$

$$\dot{S}_{erz} = \dot{m}\left[s_a - s_e\right] - \sum \frac{\dot{Q}_j}{\overline{T}_j}$$

$$= 0.3\ \frac{kg}{s}\left[1.3069\ \frac{kJ}{kgK} - 0.9549\ \frac{kJ}{kgK}\right] - \frac{-62.182kW + 100kW}{293.12K}$$

$$= \underline{0.02341\ \frac{kJ}{K \cdot s}}$$

d) $\Delta m_{12} - ?$ $T_1 = 100°C$ $T_2 = 70°C$ $T_{Eig,12} = 70°C$

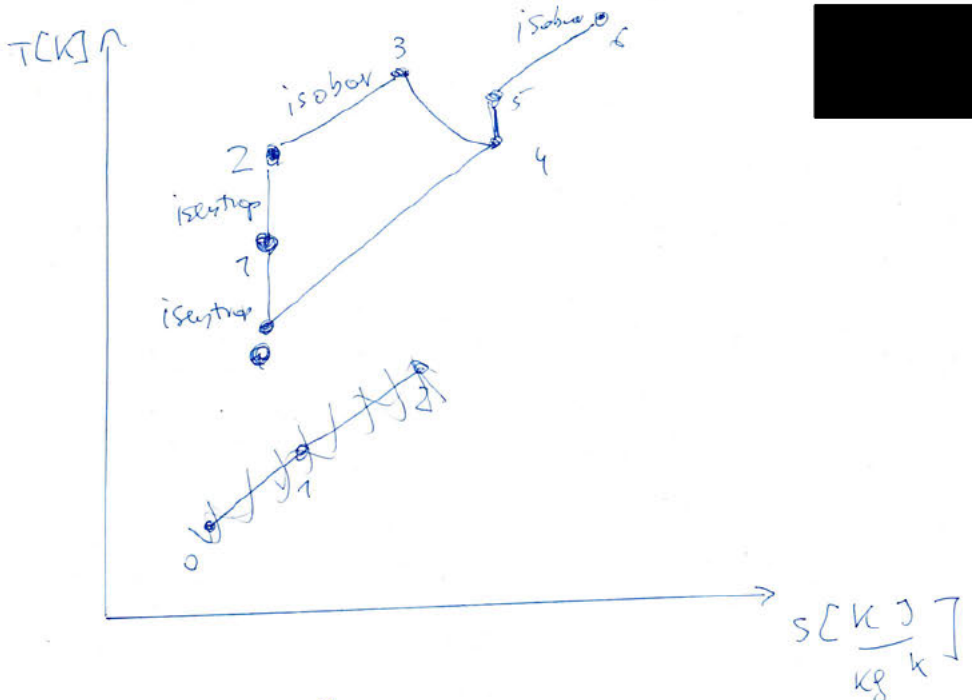
Energiebilanz halboffenes System:

$$\Delta E = m_2 u_2 - m_1 u_1 + \Delta \cancel{KE} + \Delta \cancel{PE}$$

$$= \sum_i \Delta m_i \left[h_i + \frac{w_i^2}{2} + g \vec{z}_i \right] + \sum_j Q_j - \sum_n \cancel{W_n}$$

$$=$$

2 a)



b) $w_6 - ?$; $T_6 - ?$

5-6 : isentrop → $n = \kappa$; $p_6 = p_0 = 0.1913\,bar$

$$\Rightarrow \frac{T_6}{T_5} = \left(\frac{p_6}{p_5}\right)^{\frac{\kappa-1}{\kappa}} \Rightarrow T_6 = T_5 \left(\frac{p_6}{p_5}\right)^{\frac{\kappa-1}{\kappa}} = 431.9\,K \cdot \left(\frac{0.1913\,bar}{0.5\,bar}\right)^{\frac{1.4-1}{1.4}}$$

$$= 328.075\,K$$

$$\Delta E = \Delta U + \Delta KE + \Delta PE = 0$$

$$0 = m\left(u^{is}(T_6) - u^{is}(T_5)\right) + \frac{m\left(w_6^2 - w_5^2\right)}{2}$$

$$= m\, c_v \left(T_6 - T_5\right) + \frac{1}{2} m \left(w_6^2 - w_5^2\right)$$

$$0 = 0.718\,\frac{kJ}{kg\,K}\left(328.075\,K - 431.9\,K\right) + \frac{1}{2}\left(w_6^2 - 270\,\frac{m^2}{s^2}\right)$$

$$\frac{1}{2}\left(w_6^2 - 270\,\frac{m^2}{s^2}\right) = 0.7188\,\frac{kJ}{kg\,K}\left(328.075\,K - 431.9\,K\right)$$

$$w_6 = 219.66\,\frac{m}{s}$$

$c_v = c_p - R$; $\frac{c_p}{\kappa} = c_v$

$c_v = 0.71857\,\frac{kJ}{kg\,K}$

c) $\dot{m}_{ges} = ?$ $\quad \Delta e_{x,Str} = e_{x,Str,6} - e_{x,Str,0}$

$$? = \left[h_6 - h_0 - T_0 (s_6 - s_0) + \frac{w_e^2}{2} + g z_e \right]$$

$$= \left[c_p (T_6 - T_0) - T_0 \left(c_p \ln\left(\frac{T_6}{T_0}\right) - R \ln\left(\frac{p_6}{p_0}\right) \right) + \frac{w^2}{2} \right] \quad (p_6 = p_0)$$

$$= 1.006 \frac{kJ}{kg\,K} (340\,K - 243.15\,K) - 243.15\,K \left(1.006 \frac{kJ}{kg\,K} \ln\left(\frac{340\,K}{243.15}\right)\right) + \frac{w^2}{2}$$

$$= 97.4311 \frac{kJ}{kg} - 0.48912 \frac{kJ}{kg} + \frac{510^2 - 200^2 \frac{m^2}{s^2}}{1} = 240 \frac{kJ}{kg}$$

d) $\dot{E}_{X,ver} = \dot{I}_0 \cdot \dot{S}_{erz} = e_{x,ver} \cdot \dot{m}$

$$\dot{S}_{erz} = \Delta S - \frac{Q_j}{T} = 100 \frac{kJ}{kgK} - \frac{1195 \frac{kJ}{kg}}{1289\,K} = 99.07$$

$\rightarrow e_x = 24{,}079\ M$

3.1) $p_{g,1} = ?\ bar$; $m_g = ?\ kg$

$$p_{g,1} = p_{atm} + \frac{m_k \cdot g}{A} = 1\,bar + \frac{32\,kg \cdot 9.81\,\frac{m}{s^2}}{(5 \cdot 10^{-2}\,m)^2 \pi} = 1.39\,bar$$

$$\rightarrow m_g = \frac{pV}{RT} = \frac{1.39 \cdot 10^5\,Pa \cdot 3.14 \cdot 10^{-3}\,m^3}{106.28\,\frac{J}{mol\,K} \cdot 773.15\,K} = 3.395\,g$$

$$R = \frac{8.314\,J/mol\,K}{50\,kg/kmol} = 106.28\,\frac{J}{mol\,K}$$

$$T_1 = 773.15\,K$$

5) $x_{ein,2} > 0$; $T_{g,2} = ?\,K$; $p_{g,2} = ?\ bar$

c) $Q_{12} = ?\ J$

$$Q_{12} = m c_V \Delta T$$

$$= 3.6\,g \cdot 0.633\,\frac{kJ}{kg\,K}\,(500 - 0.003^\circ C)$$

$$= 1.1394\,kJ$$

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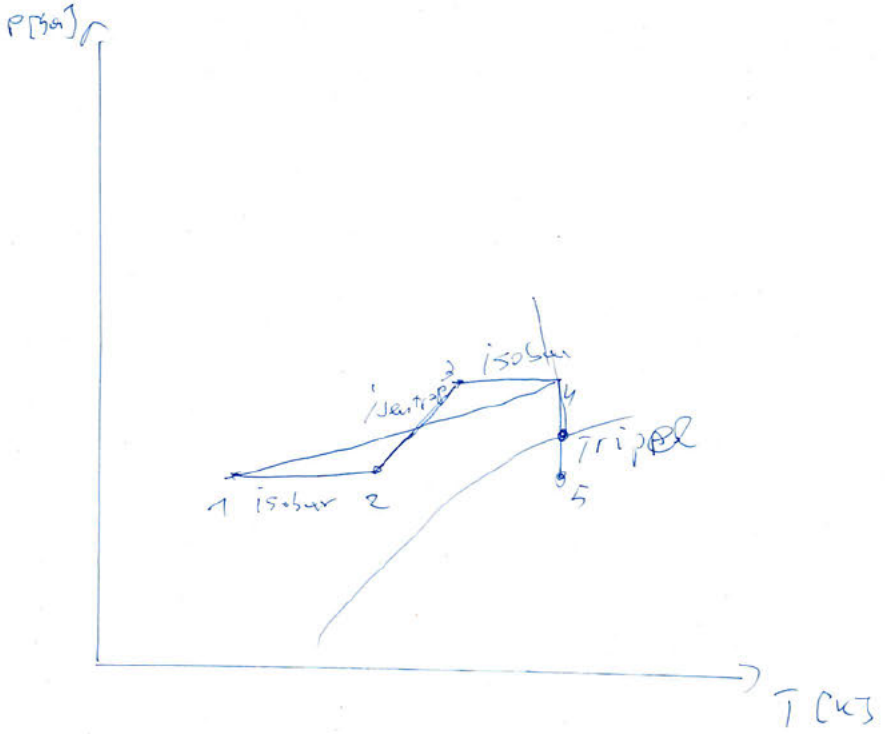
4 a)



5) $\dot{m}_{R134a}$

c) $\chi_1 = \dfrac{\phi - \phi_f}{\phi_g - \phi_f} =$

d) $\varepsilon_K = \dfrac{|\dot{Q}_{24}|}{|\dot{W}|_t} = \dfrac{\dot{Q}_{24}}{\eta\,|\dot{Q}_{ab}| + |\dot{Q}_{24}|} = \dfrac{\dot{W}}{\dot{Q}_K - \dot{Q}_{ab}} = \dfrac{\dot{W}}{(h_1 - h_2) + (h_3 - h_4)}$