[redacted]

1)

a) $\dot{Q}_{aus}$

$$\cancel{\frac{dE}{dt}}^{0 \text{ stationär}} = \sum \dot{m}_i h_i + \sum \dot{Q} - \cancel{\sum \dot{W}}^{0}$$

$\dot{m}_{ein} = \dot{m}_{aus} = 0.3\ kg/s$

$= 343.15\ K$

$h_1 = h(70°C) \quad h_2 = h(100°C)$

$\cancel{0 = \dot{m}_{ein}(h_1 - h_2) + \dot{Q}}$

$\cancel{\dot{Q}_{aus} = \dot{m}_{ein}(h_2 - h_1)}$

TAB A-2:

$$h_1 = hf + x(h_g - hf) \ @ 70°C = 292.98 + 0.005(2626.8 - 292.98)$$
$$= 304.64\ \frac{kJ}{kg}$$

$$h_2 = 419.04 + 0.005(2676.1 - 419.04) = 430.32\ \frac{kJ}{kg}$$

~~$\dot{Q}_{aus} = 0.3(430.32 - 304.64)$~~

$$0 = \dot{m}(h_1 - h_2) + \dot{Q}_R - \dot{Q}_{aus}$$

$$\dot{Q}_{aus} = \dot{m}(h_1 - h_2) + \dot{Q}_R = 0.3(304.64 - 430.32) + 100\ kW$$
$$= 62.296\ kW$$
$$= 62.3\ kW$$

b)

$$\bar{T}_{KF} = \frac{\int_{ein}^{aus} T\,ds}{s_{aus} - s_{ein}}$$

~~$p_{ein} = p_{aus}$~~ KF ~~...~~

isobar $p_{ein} = p_{aus}$

$$= \frac{h_{aus} - h_{ein}}{s_{aus} - s_{ein}} = \frac{c_p(T_{aus} - T_{ein}) + v^*\cancel{(p_{aus} - p_{ein})}^{0}}{c_p \cdot \ln\left(\frac{T_{aus}}{T_{ein}}\right)}$$

$$= \frac{T_{aus} - T_{ein}}{\ln\left(\frac{T_{aus}}{T_{ein}}\right)} = 293.15\ K$$

c) $\dot{S}_{erz}$ zu

Geschlossenes System $\frac{dS}{dt} = \sum \frac{\dot{Q}_j}{T_j} + \dot{S}_{erz}$

$\cancel{m(s_2 - s_1)} = \sum \frac{Q_j}{T_j} + \dot{S}_{erz}$

0 T const in Rührbe.

$$\dot{S}_{erz} = \frac{Q_{aus}}{T} = \frac{62300}{293{,}15} \frac{W}{K} = 212{,}5 \frac{W}{K}$$

d) $\dot{Q} = 0$

geschlossen 0 $Q_{R12} = Q_{aus\,12}$

$$\cancel{\frac{dE}{dt} = \sum \dot{m}_i h_i + \dot{Q} - \dot{W}}$$

$$\cancel{dU = 0}$$

$$\cancel{\Delta U = m_2 u_2 - m_1 u_1}$$

Halb offenes System $Q_{R12} = Q_{ges\,12}$

$$\frac{dE}{dt} = \sum \Delta m_i h_i + \sum Q - W$$

$$\Delta U = \sum \Delta m_i h_i$$

@ 20 °C @ 100 @

$$m_2 \cdot u_2 - m_1 \cdot u_1 = \Delta m_{12} \cdot h_1 \qquad m_2 = m_1 + \Delta m_{12}$$

e) ΔS_{12} $\Delta S_{12} = m_2 s_2 - m_1 s_1 = \sum \Delta m_i s_i + \cancel{\sum \frac{Q}{T}} + S_{erz}$

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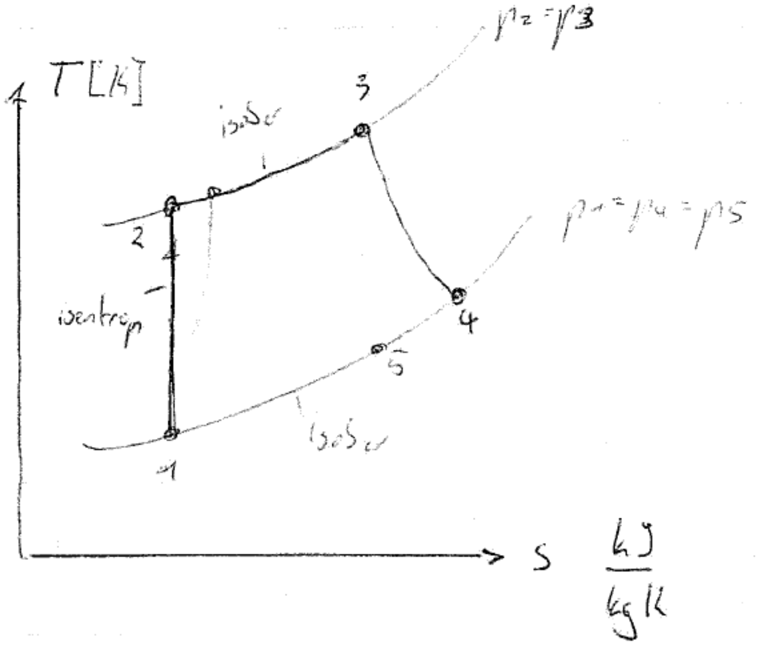
2)

a)



4 → 5 isobar
1 → 5 isobar

b) w_6, T_6 $\quad$ p_4, p_6, T_5 $\quad$, $p_6 = p_0 = 0.191$ Bar

Lubt:

$n = K = 1.4$

$$\frac{T_6}{T_5} = \left(\frac{p_6}{p_5}\right)^{\frac{n-1}{n}}$$

$$T_6 = T_5 \left(\frac{p_6}{p_5}\right)^{\frac{1.4-1}{1.4}}$$

$$= 431.9\,K \left(\frac{0.191 \cdot 10^5}{0.5 \cdot 10^5}\right)^{\frac{1.4-1}{1.4}} = 328.07\ K$$

$T_6 = 328.07$ K

w_6

$$\frac{dE}{dt}^{\,0} = \sum \dot m (h_i + ke_i) + \underbrace{\dot Q}_{0 \text{ adiabat}} - \dot W \quad \text{reversibel}$$

$\dot m_{ges} = \dot m_{in} + \dot m_K$

$0 = \sum \dot m (h_i + ke_i)$

$0 = \dot m \left(h_5 - h_6 + \frac{200^2}{2} - \frac{w_6^2}{2}\right)$

$\frac{\dot m_L}{\dot m_K} = 5.203$

$0 = \dot m \left(c_p (T_5 - T_6) + \frac{200^2}{2} - \frac{w_6^2}{2}\right)$

$q_b = \frac{\dot Q_{13}}{\dot m_K} = 1185$

c) $\dot{A}_{erst}$

$= \dot{m}_{ges}(h_6 - h_1 - T_0 ($

[redacted]

3)

a) p_{g1} m_g

$$p_g = p_{amb} + \frac{m_K \cdot g}{A} + \frac{m_{EW} \cdot g}{A}$$ $A = \frac{\pi}{4} \cdot D^2 = \frac{\pi}{4} \cdot (0,1)^2 = 0.00785\ m^2$

$$= 1 \cdot 10^5 + \frac{32 \cdot 9.81}{0,00785} + \frac{0,1 \cdot 9.81}{0.00785} = 140114$$

$p_{g1} = 1.401$ Bar

$pV = m R T$ $\quad R = \frac{\bar{R}}{M} = \frac{8.314}{50} = 0.16628$

$= 166,28 \frac{J}{mol K}$

$$m = \frac{pV_1}{RT_1} = \frac{1.401 \cdot 10^5 \cdot 3.14 \cdot 10^{-3}}{166.28 \cdot 773.15} = 0.0034\ kg$$

$= 3.42\ g$

b) $x_{Eis,2} > 0$ T_{g2} p_{g2} $\quad$ Gas isohoe wärmekapazität

~~$p_{g2} = p_g = 1.401$ Bar~~ $\quad x_1 = 0.6 \quad m_{EW} = 0.1 kg$

$T_{g,2}$ p_{g1} $\quad c_{vg} = 0.633 \frac{kJ}{kg K}$

$C_{mar} = 0.633 \cdot 3.42 \cdot 10^{-3} = 0.002164 \frac{kJ}{K}$

$= 2.164 \frac{J}{K}$

$p_{g2} = p_{g1}$ $\quad$ 1-2 isochor $\quad v = const \quad \frac{V}{m}$

$= 1.4$ Bar

$$\frac{dE}{dt} = 0 + Q - \cancel{W}^{0}$$ $\quad Q = m_{gas} c_v (T_2 - T_1)$

$\Delta U = Q$ $\quad \frac{Q}{m_{gas} \cdot c_v} = T_2 - T_1$ $\quad T_2 = T_1 + \frac{Q}{m_{gas} \cdot c_v}$

$m(u_2 - u_1) = Q$

$$T_2 = 773.15 + \frac{-0.002164}{3.42 \cdot 10^{-3} \cdot 0.633} =$$

$=$

c) $T_{g,2} = 0.003°C$ Q_{12}

$$\frac{dE}{dt} = \Sigma \dot{m} h_i + \dot{Q} - \dot{W}^0$$

ΔU

$m(u_2 - u_1) = Q$

$m \cdot c_v(T_2 - T_1) = Q$ $= 3.42 \cdot 10^{-3} \cdot 0.633(-273.47K - 773.15)$

$= -2.2657 \text{ kJ}$

$= -2265.8 \text{ J}$

d) $p_2 = 1.4$

$u_2 = c_v \cdot T_2 = 0.633 \cdot -273.47 = -173.10$

$X_2 = \cancel{\frac{u_2 - u_f}{u_g - u_f}}$

$\cancel{X_2 = \frac{u_2 - u_g}{u_f - u_g}}$

$\cancel{X_2 = -73.4 - 0.045}$

$\cancel{= -173.10 - 233.458}$

$$X_2 = \frac{u_2 - u_l}{u_F - l} =$$

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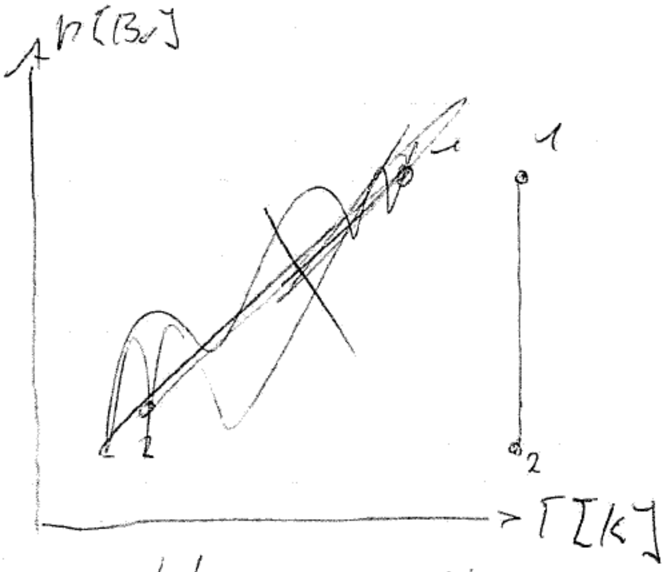
4 a)



b)

$$\underbrace{\frac{dE}{dt}}_{0 \text{ stat}} = \dot m_i h_i + \underbrace{\dot Q}_{0 \text{ adiabat}} + \dot W$$

$$0 = \dot m (h_2 - h_3) + \dot W$$

$h_2 = h_g(T_2)$ $\quad T_2 = -6°C$ $\quad p_3 = 8\,bar$

$s_2 = s_3$ isentrop

TAB A-10

$h_g(-4) = 244.9 \frac{kJ}{kg}$

$h_g(-8) = 242.54 \frac{kJ}{kg}$ $\quad h_2 = 242.54 + \frac{-6+8}{-4+8}(244.9 - 242.54)$

$= 243.72 \frac{kJ}{kg}$

$s_2 = 0.9239 + \frac{8-6}{8-4}(0.9213 - 0.9239)$

$= 0.9226 \frac{kJ}{kgK}$

h_3 @ 8 Bar: TAB A12 interpolieren

$s_3 = 0.9226$ $\quad s_{sat} = 0.9066 \frac{kJ}{kgK}$

$s_{40} = 0.9374 \frac{kJ}{kgK}$

$\rightarrow h_3 = 264.15 + \frac{0.9226 - 0.9066}{0.9374 - 0.9066}(273.15 - 264.15)$

$= 268.82 \frac{kJ}{kgK}$

$$W = \dot{m}(h_3 - h_2)$$

$$\dot{m} = \frac{W}{h_3 - h_2} = \frac{28 \cdot 10^{-3}\,kW}{268.82 - 243.72} = \underline{0.001115\ \frac{kg}{s}}$$

c)

$$x_1 = \frac{s_1 - sf}{sg - sf}$$

d)

$$\varepsilon_K = \frac{|\dot{Q}_{zu}|}{|\dot{W}_t|} = \frac{|\dot{Q}_K|}{|\dot{Q}_K| - |\dot{Q}_{KB}|}$$

e) Wäre ungünstig da man aus dem Gewünschten gebiet verschwindet