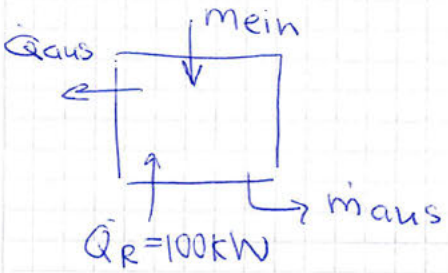
Aufgabe 1

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



$$0 = \dot{m}(h_{ein} - h_{aus}) + \dot{Q}$$

~~hein (70°C)~~

$$h_{ein} - h_{aus} = c^{if}(T_{ein} - T_{aus}) + v^{if}(p_{ein} - p_{aus})$$

($p_{ein} - p_{aus} = 0$)

$$h_{ein} - h_{aus} = c^{if}(288{,}15\,K - 298{,}15\,K)$$

da reversibler stationärer Prozess

b) $\overline{T} = \frac{\int_s^a T\,ds}{s_a - s_e} = h$

b) $\overline{T} = \frac{\int_s^a T\,dS}{s_a - s_e} \downarrow = \frac{h_a - h_e}{s_a - s_e}$

$$h_{ein} - h_{aus} = c^{if}(T_{ein} - T_{aus}) + v^{if}(p_{ein} - p_{aus})$$

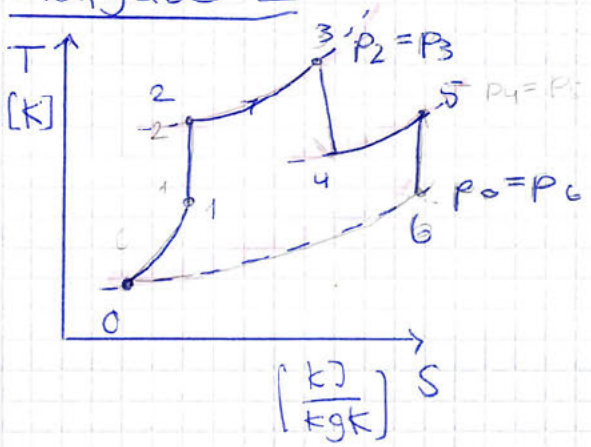
($p_{ein} - p_{aus} = 0$)

c) $0 = \dot{m}_{ein}(s_{ein} - s_{aus}) + \sum \frac{\dot{Q}_j}{T_j} + \dot{S}_{erz}$

d) $\frac{dE}{dt} = \dot{m}_w(h_{ein} - h_{aus}) + \sum \dot{Q} - W$

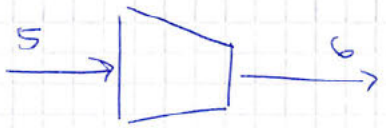
e) $\Delta S_{12} = m_2 s_2 - m_1 s_1 = \sum \frac{Q_j}{T_j} + S_{erz}$

Aufgabe 2



isobaren

b) $\dot{m}_6 = \rho_6 A_6 w_6$



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

$T_6 = 328.075K$

$\rho = \frac{1}{v_6}$ $\quad p_6 V_6 = m_6 R T_6$

$R = c_p - \frac{c_p}{n} = 0.287 \frac{kJ}{kgK}$

c) $\Delta e_{xstr} = \dot{m}_{ges}\left(h_6 - h_0 - T_0(S_6 - S_0)\right)$

$h_6 - h_0 = c_p(T_6 - T_0) = 97.4311 \frac{kJ}{kg}$

$T_6 = 340K \quad T_0 = -30°C = 243.15K$

$S_6 - S_0 = c_p \ln\left(\frac{T_6}{T_0}\right) - R \ln\left(\frac{p_6}{p_0}\right)$ ($p_6/p_0 \to 0$)

$= 0.3373 \frac{kJ}{kgK}$

$\Delta e_{xstr} =$

gehört zusammen

b) $\left(\frac{T_6}{T_5}\right) = \left(\frac{V_6}{V_5}\right)^{n-1}$

$\sqrt[n-1]{\frac{T_6}{T_5}}\, V_5 = V_6 =$

$p_6 V_6 = R T_6$

$v_6 = \frac{R T_6}{p_6} = 4.93 \frac{m^3}{kg}$

$\dot{m}_6 = \frac{1}{V_6} A_6 w_6$

$\frac{\dot{m}_6 V_6}{A_6} = w_6$

a) $0 = \dot{m}_{ges} \Delta ex_{str6.0} + \cancel{\dot{Q}} - \dot{W} - \dot{E}_{xverl}$

$\dot{W}_{06} =$

$\dot{E}_{xverl} = \dot{m}_{ges} \Delta ex_{str60} - \dot{W}$

Aufgabe 3

a) ges: p_{g1} m_g

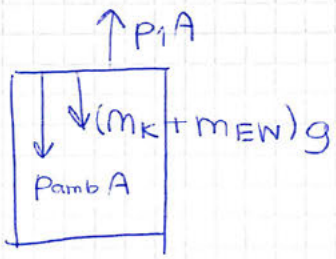
$\frac{kJ}{kmolK}$ $\frac{kmol}{kg}$

$T_{g1} = 500°C = 773.15K$

$V_{g1} = 3.14L = 0.00314m^3$

$R_g = \frac{\bar{R}}{M} = 0.1663 \frac{kJ}{kgK}$

$p_{g1} V_{g1} = m_g R_g T_1$



$A = 5cm^2 \pi = 0.00785m^2$

$p_{amb} A + (m_K + m_{EW})g = p_1 A$

$p_{amb} + \frac{g}{A}(m_K + m_{EW}) = p_1 = 1.4bar = p_{g1}$

$\frac{p_{g1} V_{g1}}{R_g T_1} = 3.42g = m_g$

b) ges: T_{g2}, p_{g2}

$p_{g2} = p_{g1} = 1.4bar$, da sich das Gewicht des EW nicht verändert.

$p_{2g} V_{2g} = m_2 R T_2$

$\frac{p_{2g} V_{2g}}{m_2 R} = \frac{1.4bar \cdot 3.14L}{3.42g \cdot 0.1663 \frac{kJ}{kgK}} = 7$

c) $\Delta E = Q_{12} - W_{12}$ $\quad W_{12} = \int p_{1g} dV = p_{1g}(V_2 - V_1)$

Systemgrenze um das Gas.

$\Delta E_{12} = m(u_2 - u_1)$

$u_{2f} - u_1 = c_v(T_2 - T_1) = 0.633(0.003 - 500) = -316.498 \frac{kJ}{kg}$

$\kappa = \frac{c_p}{c_v} = \frac{R + c_v}{c_v} = 1.263$ $\quad w_{12}^{rev} = \frac{R(T_2 - T_1)}{1 - n} = -112.822 \frac{kJ}{kg}$

$n = \kappa$

$W_{12}^{rev} = m w_{12}^{rev} = -0.386 \frac{kJ}{kg}$

$\Delta E_{12} = m(u_2 - u_1) = Q_{12} - W_{12}$

$u_2 - u_1 = -316.498 \frac{kJ}{kg}$

$W_{12} = -0.386 kJ$

$m(u_2 - u_1) + W_{12} = Q_{12} = -1.468 kJ$

$m = 3.42 g$

d) $T_{g2} = T_{2EW} = 0.003°C$

$\frac{u_2 - u_{fest}}{u_{flüssig} - u_{fest}} = x$

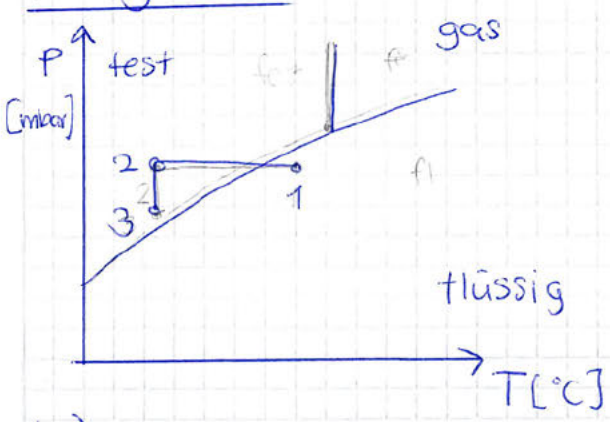
$u_{fest}(0.003°C) \overset{TAB1}{=} -333.442 \frac{kJ}{kg}$

$u_{flüssig}(0.003°C) = -0.033 \frac{kJ}{kg}$

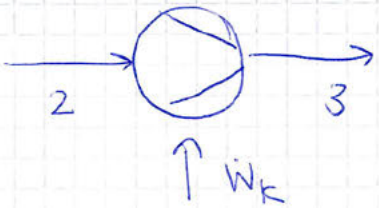
~~u_2~~

~~s_1~~

Aufgabe 4



b)



$$0 = \dot{m}(h_2 - h_3) - \dot{W}_K \qquad \frac{\dot{W}_K}{h_2 - h_3} = \dot{m}$$

~~$h_2 - h_3$~~ h_2(

$h_3(8\,bar) =$

$s_2 = s_3$

s_3

s_3 superheated $s_3(8\,bar) =$ TAB-12

c) $x = \dfrac{h_1 - h_f}{h_g - h_f}$

d) $\varepsilon_K = \dfrac{|Q_{zu}|}{|\dot{W}_t|} = \dfrac{|\dot{Q}_{zu}|}{|\dot{Q}_{ab}| - |\dot{Q}_{zu}|}$

e) Die Temperatur würde sich immer weiter senken, bis sie irgendwann stagniert, da keine Wärme mehr entzogen werden kann.