[redacted]

Aufgabe 1: Reaktor

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

Stat. FP

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

$$\dot{Q}_{aus} = \dot{m}(h_a - h_e) + \dot{Q}_R$$

(gesättigt siedend.)

$h_a = h_f$ @ 100°C = 419.04 kJ/kg. (TAB A2)

$h_e = h_f$ @ 70°C = 292.98 kJ/kg.

$$= \frac{0.3\,kg}{s}(419.04 - 292.98) + 100\,kW$$

$$= 137.818\,kW$$

b) $\overline{T}_{KF} = \overline{T} = \frac{\int_e^a T\,ds}{s_a - s_e}$ ⇒

$T\,ds = \frac{\not{T} \cdot dQ}{\not{T}} =$

c_v = konst.

p = konst.

$v\,\not{dp} + T\,ds = dh$

$T\,ds \cdot \dot{m} = dh \cdot \dot{m}$

$dh = c_p(T_2 - T_1)$

$s_a - s_e = c_p \cdot \ln\left(\frac{T_2}{T_1}\right) - R \ln\left(\frac{p_2}{p_1}\right)$

(da mit c_p = konst.).

$$\overline{T} = \frac{c_p(T_2 - T_1)}{c_p \cdot \ln\left(\frac{T_2}{T_1}\right)} = \frac{10°K}{\ln\left(\frac{298.15}{288.15}\right)} = 293.12°K$$

$$= 19.97°C$$

c) $\dot{S}_{er2}$.

$$0 = \dot{m}(s_e - s_a) + \frac{\not{\dot{Q}_R}}{\not{T_{KW}}} + \frac{\dot{Q}_{aus}}{T_{KW}} + \dot{S}_{er2}$$

$$\dot{S}_{er2} = \dot{m}(s_a - s_e) - \frac{\dot{Q}_{aus}}{T_{KW}}$$

$T_W = \approx \not{288.15} 85°C = 358.15°K$

$s_a = 1.3094$ kJ/kg·K

$s_e = 0.9549$ kJ/kg·K.

$\dot{S}_{er2} = -0.278$? ↳ falsch.

d) gas: Δm_{12}

Z_1: $T_1 = 100°C$

$x_D = 0.005$.

$m_{gas} = 5755\,kg$.

$T_2 = 70°C$.

→ m_{ein}: $T_{ein} = 20°C$.

$Q_{R,12} = Q_{aus} = 35000\,kJ$.

Z_2: m_2: $x = 0$. 100% fl.

halboffen (wasser ein).

$m_2 u_2 - m_1 u_1 = \Delta m_{ein} \cdot h_{ein} + Q_{R,12}$.

$\Delta m_{ein} = \dfrac{m_2 u_2 - m_1 u_1 - Q_{R,12}}{h_{ein}}$.

$h_{ein} = 83.96\,kJ/kg$.

$m_2 = (m_1 + \Delta m)$.

$m_1 = 5755\,kg$.

$u_1 = u_f + x(u_g - u_f)$.

$= 424.377\,kJ/kg$

$u_2 = 292.95\,kJ/kg$

$Q_{R12} = 35000\,kJ$

$(m_1 + \Delta m)u_2$

$m_1 u_2 + \Delta m u_2 - m_1 u_1 = \Delta m \cdot h_{ein} + Q_{R,12}$.

$\Delta m (u_2 - h_{ein}) = -m_1 u_2 + m_1 u_1 + Q_{R,12}$.

$\Delta m = \dfrac{-m_1 u_2 + m_1 u_1 + Q_{R12}}{u_2 - h_{ein}}$.

Calc with values on left and formula above.

→ $\Delta m = 3924.29\,kg$

Aufgabe 1.

e) ΔS_{12}.

$\Delta S = m_2 s_2 - m_1 s_1$ ...

$m_2 = \Delta m_{12} + m_1$ $\qquad m_1 = 5755\ kg$

$= 3600\ kg + 5755\ kg$

from sheet. $= \underline{9355\ kg}$.

$s_2 = 0.9544\ \frac{kJ}{kg \cdot K}$

@ 100°C $s_1 = s_f + x(s_g - s_f)$. (p. 005)

$= 1.3069 + 0.005(7.3549 - 1.3069)$.

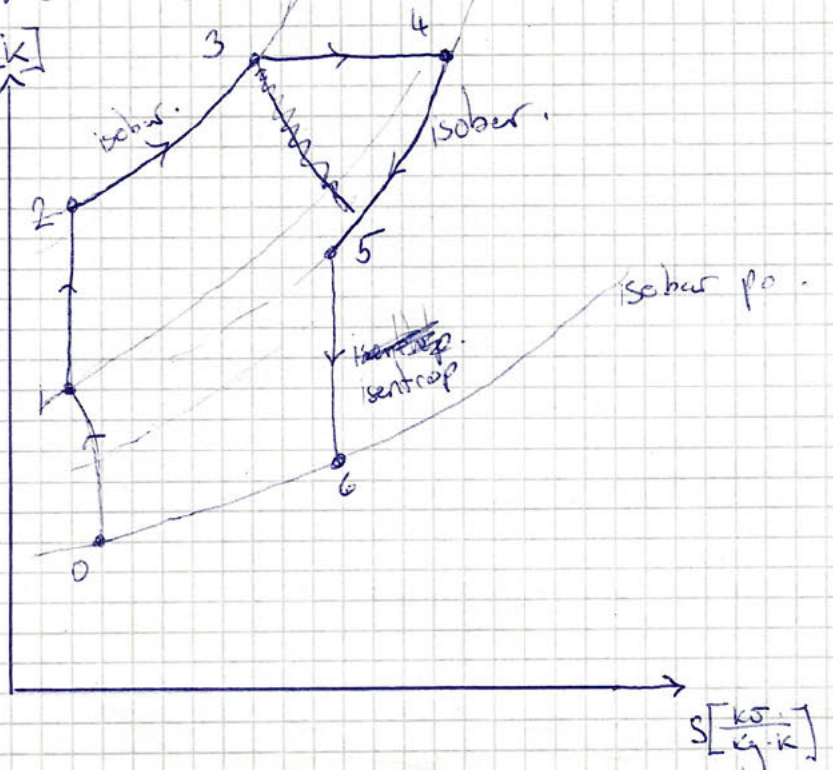
$= 1.33714\ kJ/kg \cdot K$.

$\Delta s = 9355\ kg$ ... Calc. $\qquad 9355\ kg\left(0.9544 \frac{kJ}{kg \cdot K}\right) -$

$= \underline{\underline{1237.849}}\ \frac{kJ}{K}$. $\qquad 5755\ kg\left(1.33714 \frac{kJ}{kg \cdot K}\right) =$

Aufgabe 2.

a)



$\eta_{V,S} = \left(\frac{T_1 - T_{2S}}{T_1 - T_2}\right) < 1.$

$\Rightarrow T_{2S} > T_2.$

b) ω_6. T_6 gas.

$\omega_5 = 220\ m/s$

$p_5 = 0.5\ bar \longrightarrow p_6 = 0.141\ bar.$

$T_5 = 431.9\ K.$

isentrop. $s_5 = s_6.$

$\dot{m}\left(h_5 - h_6 + \frac{(\omega_5)^2 - (\omega_6)^2}{2}\right) = 0.$

$c_L(T_5 - T_6) + \frac{(\omega_5)^2}{2} - \frac{(\omega_6)^2}{2} = 0.$

$\frac{(\omega_6)^2}{2} = \left(1.006\,(T_5 - T_6) + \frac{\omega_5^2}{2}\right) \cdot 2$

$= 24304.85.$

$\omega_6 = 77.95\ m/s$

$= 220.47\ m/s$

$\eta = 1.4.$

polytrop. $T_6 = T_5 \left(\frac{p_6}{p_5}\right)^{\frac{-0.4}{1.4}} = 328.07\ °K$

c) $\dot{m}_{ges}$.

$\Delta e_{x,str} = e_{x,str6} - e_{x,str0}$.

$\Delta e_{x,str} = \left(h_6 - h_0 - T_0(s_6 - s_0) + \Delta ke\right)$

$\Delta ke = \frac{w_6^2}{2} - \frac{w_0^2}{2} =$ ~~$\frac{(220\frac{m}{s})^2 - 200}{2}$~~

$= \frac{(510\frac{m}{s})^2}{2} - \frac{(200\frac{m}{s})^2}{2}$ $\frac{m^2}{s^2}$

$h_6 - h_0 = c_L(T_6 - T_0)$ $= 110050\ J. = 110.1\frac{kJ}{kg}$.

$= 1.005(340k - (273.15 - 30k))$

$= 97\ kJ/kg$.

$T_0(s_6 - s_0) = 243.15\,K \cdot \left(c_L \ln\left(\frac{T_6}{T_0}\right) - R \ln\left(\frac{p_6}{p_0}\right)\right)$ $p_6 = p_0$

$= 82.01\ \frac{kJ}{kg}$.

$\Delta e_{x,str} = (97 - 82.01 + 110.1)\frac{kJ}{kg} = 125.09\frac{kJ}{kg}$

d) $\dot{m}_{ges}\ e_{x,verl}$ $= T_0 \dot{S}_{erz}$

or $= \Delta E_{x,str} + \sum_j \dot{E}_{x,Q_j} - \sum_n \dot{W}_{t,n}$

Aufgabe 3.

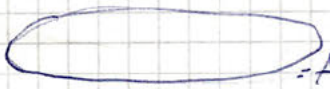
a) $p_{g,1}$ · n_g · ges

$c_v = 0.633 \frac{kJ}{kg\,K}$ $M_g = 50 \frac{kg}{kmol}$.

$T_{g,1} = 500°C = 773.15\,K$

$V_{g,1} = 3.14\,L = 0.00314\,m^3$

$p = \frac{nRT}{V}$ $n =$

p:  $A = \left(\frac{D}{2}\right)^2 \cdot \pi = \left(\frac{0.05m}{2}\right)^2 \cdot \pi = 7.854 \cdot 10^{-3}\,m^2$

$p = \frac{F}{A}$, $p = p_{amb} + \left(32kg \cdot 9.81 \frac{m}{s^2}\right) \cdot \frac{1}{7.354 \cdot 10^{-3}\,m^2}$

$= 100000\,Pa + 39469.\,Pa = \underline{1.3947\,bar}$.

$= p_1$.

$n = \frac{p_1 V_1}{R T_1}$. $R = \frac{\bar{R}}{M} = 0.1663$

$n = \frac{139.47\,kPa \cdot 0.00314\,m^3}{0.1663 \cdot 773.15\,K} = 3.418 \cdot 10^{-3}\,kg$

$= \underline{3.418\,g}$

b) $T_{g,2}$ muss in der nähe von 0°C sein damit Wasser als Feststoff vorliegen muss bei einem Druck von ~~0,611 bar~~. Wobei sich im Glgw einstellt. $T_g \cong T_{EW}$ im thermodynamischen glgw.

c.)

$T_{g_2} = 0.003°C$.

geschlossen:

$\Delta E = Q - ~~W~~_v$ → Q Veränderung.

Ggw: $T_{g_2} = T_{EW_2} = 0.003°3$

$\Delta E = \Delta U = C_v(T_2 - T_1) + W_v = Q$.

$+ W_v$.

$0.683(0.003C - 50°C) = Q$

=

$V_2 = v_2 \cdot m_2$

$m_2 = m_1$.

$v_2 =$

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d) Gleich: $T_{E_2} = 0.003$.

EW: $\Delta U = ~~C_v(T_2 - T_1)~~$.

$m(u_2 - u_1) = Q = 1.5\,kJ$.

m: 0.1 kg.

$u_1 = u_f + x(u_{fl} - u_f)$ @ 1.4 bar.

$= -133.394\ kJ/kg$

$u_2 = u_f + (x)(u_{fl} - u_f)$.

$x = \frac{u_2 - u_f}{u_{fl} - u_f}$ @ 1.4 bar

$= \underline{0.4351} = x$

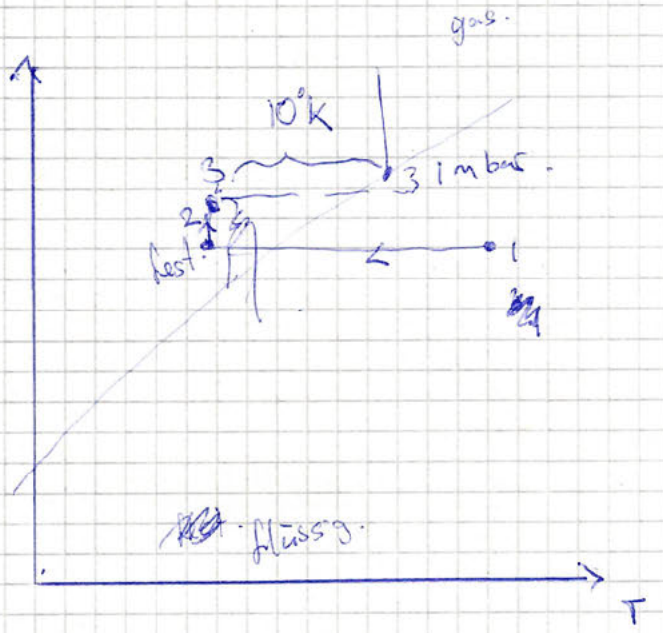
$u_2 = \frac{Q}{m} + u_1$

$= \frac{1.5\,kJ}{0.1\,kg} + -133.394\ kJ/kg$

$u_2 = \underline{-188.394\ kJ/kg}$

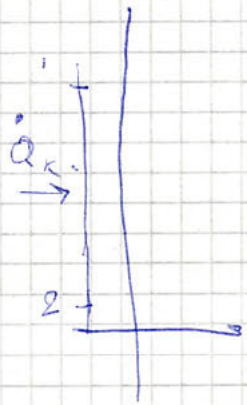
Aufgabe 6.

a)



b) $\dot{m}$ R134a.

$\overline{T_V} =$



$\dot{x}_2 = 1$.

	T	p	h	s
1		//	//	
2		xx		//
3		8bar.		//.
4		8bar.	//	

↑.

d) Leistungszahl

$\epsilon_K = \frac{|\dot{Q}_K|}{|\dot{W}_+|} = \frac{|\dot{Q}_K|}{|\dot{Q}_{ab}| - |\dot{Q}_K|}$