[redacted]

Afg 1 Wasser = realer Fluid

a) Reaktor Wasser:

	p	T			
1		70°C	x = 1		
2		100°C	x = 1		

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

~~$0 = \dot{m}_{Fl}[h_{ein} - h_{aus}] + \dot{Q}$~~

$$0 = \dot{m}_w [h_{ein} - h_{aus}] + \dot{Q}_R - \dot{Q}_{aus}$$

wird negativ eingeführt da es raus geht

$$\dot{Q}_{aus} = \dot{m}_w [h_{ein} - h_{aus}] + \dot{Q}_R$$

$$\underbrace{h_{ein}[70°C, x=1] = 2626.8 \frac{kJ}{kg} \quad h_{aus}(100°C, x=1] = 2676.1 \frac{kJ}{kg}}_{\text{Aus TAB A-2}}$$

$\dot{Q}_{aus} = \underline{\underline{85.2\ kW}}$ (positiv gem. Konvention)

[redacted]

Afg 1

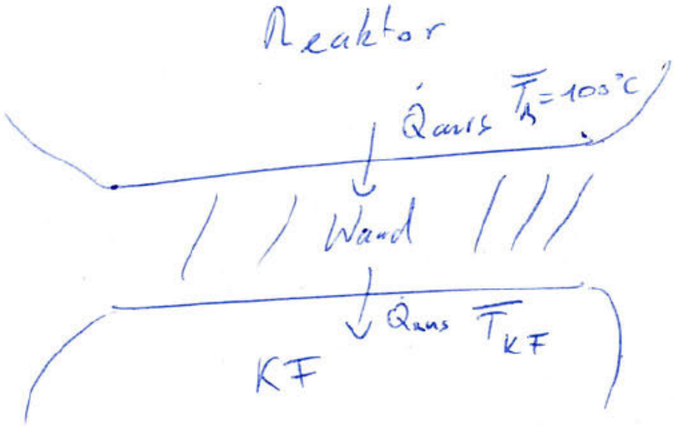
b) $0 = \dot{m}_{KF}\left[s_{KFe} - s_{KFa}\right] + \frac{\dot{Q}_{aus}}{\overline{T}_{KF}} + \cancel{\dot{S}_{erz}}$ 0 da kein Druckverlust

$s_{KFe} - s_{KFa} = c^{if} \cdot \ln\left(\frac{T_{KFe}}{T_{KFa}}\right)$

$\overline{T}_{KF} = \cancel{-\left(m_{KF} \cdot c^{if} \ln\left(\frac{T_{KFe}}{T_{KFa}}\right)\right)} \frac{\dot{Q}_{aus}}{-\dot{m}_{KF} \cdot \underbrace{c^{if}}_{\text{unbekannt?}} \cdot \ln\left(\frac{T_{KFe}}{T_{KFa}}\right)} = \ldots$

c) $\dot{S}_{erz} = -\sum \frac{\dot{Q}}{\overline{T}} = -\frac{\dot{Q}_{aus}}{\overline{T}_{Reaktor}} + \frac{\dot{Q}_{aus}}{\overline{T}_{KF}}$

$\boxed{\dot{S}_{erz} = 0.06049 \frac{kJ}{s \cdot K}}$

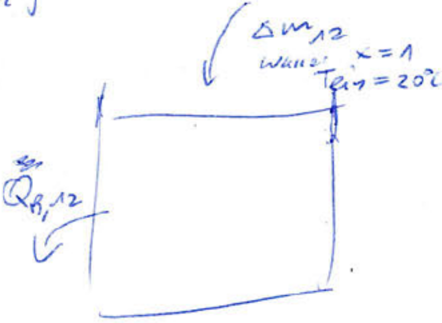


d)

		T	
1		100°C	$x_0 = 0.005$
2		70°C	$x = 1$

$m_1 = 5755\ kg$

$Q_{R,12} = 35\ MJ$



$\underbrace{m_2}_{m_2 = m_1 + \Delta m_{12}} u_2 - m_1 u_1 = \Delta m_{12} h_{ein} + Q_R - \cancel{W_{12}}^{\,0}$

$\Delta m_{12} h_{ein} - \Delta m_{12} \cdot u_2 = m_1 u_2 - m_1 u_1 - Q_R$

$\Delta m_{12} = \frac{m_1(u_2 - u_1) - Q_R}{h_{ein} - u_2}$

$= \underline{\underline{170.9\ t}}$

$h_{ein}[20°C, x = 1] = 2538.1 \frac{kJ}{kg}$ aus $\boxed{\text{TAB A-2}}$

$u_1[100°C, x = 0.005] = u_f + x_0(u_g - u_f)$

$= 429.38 \frac{kJ}{kg}$

$u_2[70°C, x = 1] = 2469.6 \frac{kJ}{kg}$

[redacted]

Afg 1

e) $\Delta S_{12} = m_2 s_2 - m_1 \cdot s_1$

$= 64'855 \frac{kJ}{kg\,K}$

$m_1 = 5755\,kg$

$m_2 = m_1 + \Delta m_{12} = 9355\,kg$

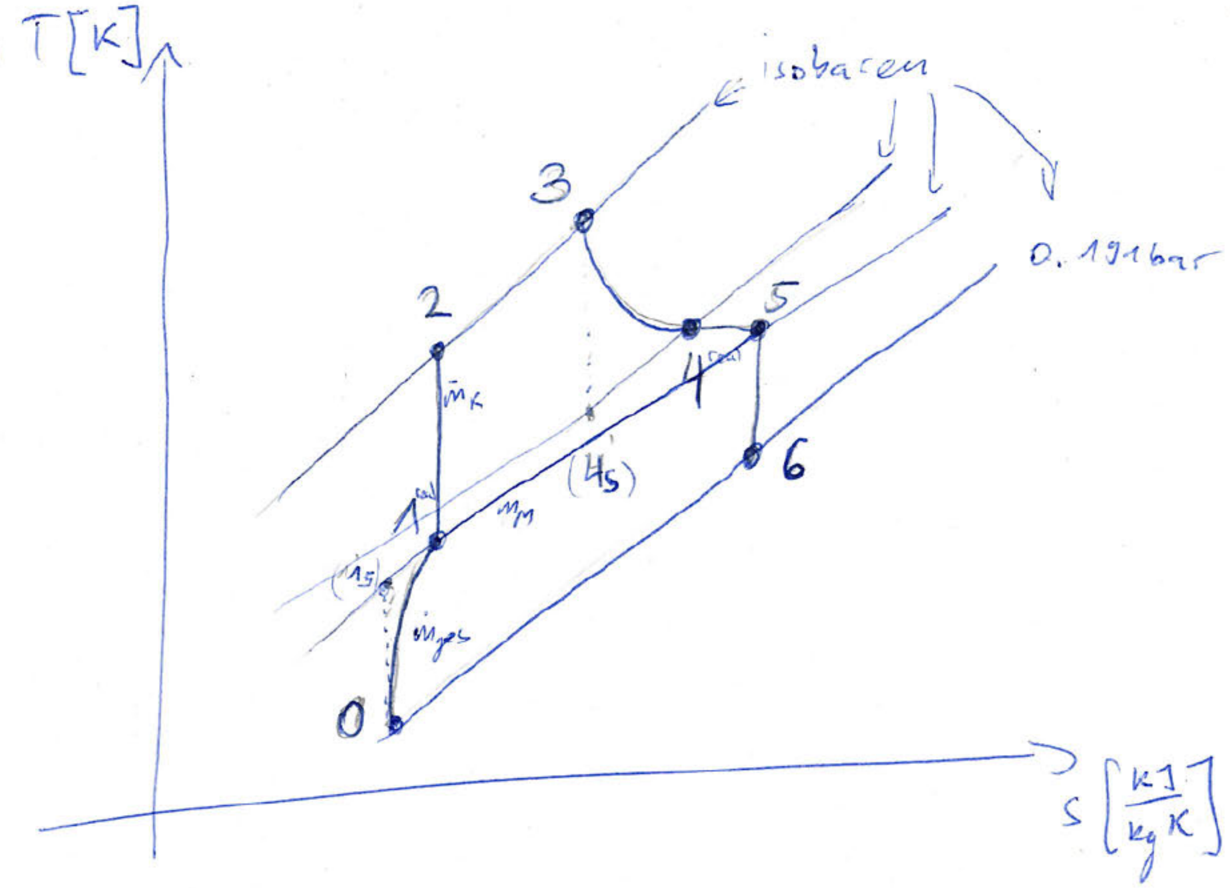
$s_2[70°C, x=1] = 7.7553 \frac{kJ}{kg\,K}$

$s_1[100°C, x=0.005] = \underbrace{s_f + x(s_g - s_f) = 1.33714 \frac{kJ}{kg\,K}}_{\text{Aus TAB A-2}}$

[redacted]

Afg 2

a)



	p	T	w		
0	0.191 bar	= 243.15 K -30°C	200 m/s		$Q_{01} = 0$
1					$\dot{m}_K = \frac{\dot{m}_M}{5.293}$
2	p_2				$q_B = 1195 \frac{kJ}{kg}$
3	$= p_2$				
4					
5	0.5 bar	431.9 K	220 m/s		$\Delta s = 0$
6	0.191 bar				

Afg 2 [redacted]

b) ges w_6 , T_6

$$\frac{T_6}{T_5} = \left(\frac{p_6}{p_5}\right)^{\frac{0.4}{1.4}}$$

$$T_6 = T_5 \left(\frac{p_6}{p_5}\right)^{\frac{0.4}{1.4}} = \underline{\underline{328.07\,K}}$$

$$0 = \dot{m}_{ges}\left[\underbrace{h_5 - h_6}_{= c_p^{ig}(T_5 - T_6)} + \frac{w_5^2 - w_6^2}{2}\right] + \sum \cancelto{0,\ adiabat}{\dot{Q}} - \cancelto{0}{\dot{W}_{t\,56}}$$

$$w_6 = \sqrt{2 c_p (T_5 - T_6) + w_5^2} = \underline{\underline{507.25\ m/s}}$$

c)

$$e_{x\,str\,6} = h_6 - h_0 - T_0 (s_6 - s_0) + \frac{1}{2} w_6^2$$

$$e_{x\,str\,0'} = h_{0'} - h_0 - T_0 (s_{0'} - s_0) + \frac{1}{2} w_{0'}^2$$

$$\Delta e_{x\,str\,06} = e_{x\,str\,6} - e_{x\,str\,0'} = \underbrace{h_6 - h_{0'}}_{= c_p(T_6 - T_0)} \underbrace{- T_0 s_6 + T_0 s_{0'}}_{= -T_0(s_6 - s_{0'}) = -T_0\, c_p \ln\left(\frac{T_6}{T_{0'}}\right) - R_{Luft} \cancelto{0}{\ln\left(\frac{p_6}{p_0}\right)}} + \frac{1}{2} w_6^2 - \frac{1}{2} w_0^2$$

$$\boxed{\Delta e_{x\,str} = c_p (T_6 - T_0) - T_0 \left(c_p \ln\left(\frac{T_6}{T_0}\right)\right) + \frac{w_6^2 - w_0^2}{2}}$$

$$= \underline{\underline{120.8\ \frac{kJ}{kg}}}$$

[redacted]

Afg 2

d) $0 = \dot{m}_{ges}(s_0 - s_6) + \frac{\dot{Q}_B}{T_B} + \dot{S}_{erz} \quad | : \dot{m}_{ges}$

$s_{erz} = s_6 - s_0 - \frac{q_B}{T_B} = c_p \ln\left(\frac{T_6}{T_0}\right) - \frac{q_B}{T_B} = -625.73 \frac{J}{kgK}$ müsste positiv sein!

$e_{x\,verl} = s_{erz} \cdot T_0 = \underline{\underline{-152.146 \frac{kJ}{kg}}}$

[redacted]

Afg 3

perf. Gas:

	p	T	V			
1	1.4 bar	500°C	$0.00314 m^3$			
2	1.4 bar	0°C				

EW: $m_{EW} = 0.1 kg$

	p	T	V		
1	≈ 1.4 bar	0°C	V_1	$x_{Eis} = 0.6$	
2	1.4 bar	0°C	$= V_1$		

$Pa = \frac{N}{m^2}$

$$p_{1gas} = \frac{\overbrace{m_{ges}}^{= m_{Wasser} + m_{Eis}} \cdot g}{\left(\frac{D}{2}\right)^2 \cdot \pi} + p_{amb} = \underline{\underline{1.40 bar}}$$

$$R_{Gas} = \frac{\overline{R}}{M_g} = 0.166 \frac{kJ}{kg K}$$

$$m_g = \frac{p_{1gas} \cdot V_1}{R_{gas} \cdot T_1} = \underline{\underline{3.419 g}}$$

[redacted]

b) Da die ganz Wärme $\dot{Q}_{12}$ in den Prozess vom Eisschmelzen einfließt und am Schluss immernoch Eis übrig ist, gilt das $T_{2,Eis} = 0°C$ ist und somit auch $T_{2,gas} = 0°C$ (da ~~..~~ Therm. Gleichgewicht!). Der Druck bleibt in dieser Konstellation konstant!

$$p_{2g} = p_{1g} = 1.4\ bar$$

c) $$\Delta E = \Delta U + \cancel{KE + PE}^{0} = \cancel{..} Q_{12} \cancel{....} - \cancel{W}_{V12}^{0}$$

$$Q_{12} = c_v (T_2 - T_1) + \cancel{...} \cancel{\frac{R(T_2 - T_1)}{1-n}}$$ $\cancel{n = \kappa = \frac{c_p}{c_v} = \frac{R+c_v}{c_v}}$

$$= -316.5\ kJ$$

d) ges $x_{Eis,2}$ ~~...~~

$m_1 = m_2 = m_{Eis}$

$$\Delta U_{12} = +Q_{12} = m_2 u_2 - m_1 \cdot u_1$$

aus Tab 1.

wird ZR von Afg verwendet $|Q_{12}| = 1.5\ kJ$

$$\frac{Q_{12}}{m_{Eis}} + u_1 = u_2 \quad : \quad u_1[1.4bar, 0°C] = u_{flüssig} + x_{Eis}(u_{Fest} - u_{flüssig})$$

$$= -200.09\ \frac{kJ}{kg}$$

$$u_2 = -185.09\ \frac{kJ}{kg}$$

$$x_{2Eis} = \frac{u_2 - u_{fl}[1.4bar, 0°C]}{(u_{Fest} - u_{fl})[1.4bar, 0°C]} = 0.555$$

[redacted]

Afg 4

b) $0 = \dot{m}_R [h_2 - h_3] + \cancel{\dot{Q}}^{\,0, \text{adiabat}} - \dot{W}_R$

$h_2 [\quad , x = 0]$

$h_3 [8 \text{ bar},$