[redacted]

Aufgabe 1

a) $= \frac{d\cancel{E}}{\cancel{dt}} = 0 = \dot{m}\left[h_e - h_a + \cancel{0}\right] + \sum \dot{Q} - \cancel{\sum \dot{W}}$

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

$\dot{Q}_{aus} = \dot{m}\left[h_{aus} - h_{ein}\right] + 100\,kW$

$h_{aus} = h(100°C) \xrightarrow{\text{Tab-A2}}$ saturated water at 100°C

$\rightarrow h_{aus} = \underline{419.4\,kJ/kg}$

$h_{ein} = h(20°C) \xrightarrow{\text{TAB-A2}} \underline{292.98\,kJ/kg}$

$0.3 \cdot (419.4 - 292.58) + 100 = \boxed{\dot{Q}_{aus} = \underline{\underline{62.074\,kW}}}$

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b) $\rightarrow \tilde{\bar{T}}_{KF} = \frac{\int_e^a T\,ds}{s_a - s_e} \qquad \int T\,ds = q_{rev} = h_a - h_e$

$\tilde{\bar{T}}_{KF} = \frac{h_a - h_e}{s_a - s_e} \rightarrow$ ideales Flüssigkeit!

$\rightarrow$ Der Druck im Kühlmantel ändert sich nicht

$\tilde{\bar{T}}_{KF} = \frac{c_p(T_a - T_e)}{c_p \ln\left(\frac{T_a}{T_e}\right)} \Rightarrow \frac{(T_a - T_e)}{\ln\left(\frac{T_a}{T_e}\right)}$

$T_a = 298.15\,K$

$T_e = 288.15\,K$

$\boxed{\tilde{\bar{T}}_{KF} = \underline{\underline{293.1216\,K}}}$

1. c) $\dot{S}_{erz}$ aus ~~zwischen~~ Wärmeübertragung zwischen Reaktor + Kühlmantel!

$$\dot{S}_{erz} = \cancel{\dot{m}\,(s_{aus} - s_{ein})}^{\to 0} - \frac{\dot{Q}_{aus}}{T_j}$$

$$\dot{S}_{erz} = \frac{-65\,kW}{295\,K}$$ |Werte aus aufgaben a) b)|

$$\boxed{\dot{S}_{erz} = 220.339\,W}$$

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1. d) $\cancel{0 = \dot{m}\,(h_{ein} - h_{aus}) + Q_{R12}}$

$\cancel{\frac{Q_{R12}}{h_{aus} - h_{ein}} = \Delta m_{12}}$

~~$h_{aus} =$~~

Halboffenes System

$$m_2 u_2 - m_1 u_1 = \Delta m_{12}\,(h_{zugefügt}) + Q_{R12} - \cancel{W_n}^{\to 0}$$

$$u_2 = (20°C) \xrightarrow{TAB-A2} 292.95\,kj/kg$$

$$u_1 = (100°C) \xrightarrow{TAB-A2} 418.94\,kj/kg$$

$$h_{zugefügt} = h\,(20°C) \overset{TAB-A2}{=} 83.95\,kj/kg$$

$$m_2 = m_1 + \Delta m_{12}$$

$$m_1 = 5755\,kg$$

$$\Delta m_{12}\,(u_2 - h_{zugefügt}) = m_1 u_1 - m_1 u_2 + Q_{R12}$$

$$\Delta m_{12} = \frac{m_1 u_1 - m_1 u_2 + Q_{R12}}{(u_2 - h_{zugefügt})} =$$

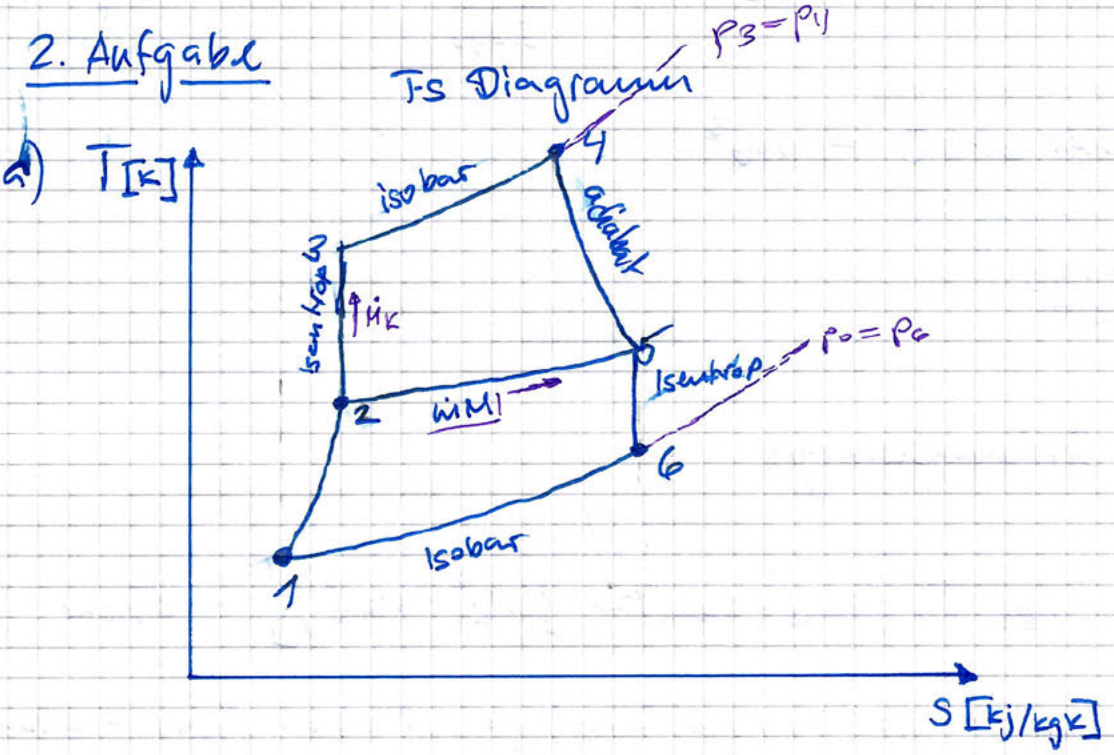
$$\Rightarrow \Delta m_{12} = \frac{5755\,kg\,(418.94 - 292.95)^{kj/kg} + 100\,kjW}{(292.95 - 83.95)} = \boxed{3469.725\,kg = \Delta m_{12}}$$

~~1.~~)

[redacted]

2. Aufgabe

a)



b) w_6 und T_6 bestimmen!

$K = 1.4$

$$T_6 = T_5 \left(\frac{p_6}{p_5}\right)^{\frac{0.4}{1.4}} \quad \boxed{\text{ideales Gas}}$$

$$T_6 = 431.9 \cdot \left(\frac{0.151}{0.5}\right)^{\frac{0.4}{1.4}} = \boxed{328.075\,K = T_6}$$

w_6 bestimmen

$$0 = h_{ein} - h_{aus} + \frac{(w_{ein}^2 - w_{aus}^2)}{2} + 4B \cdot \frac{1}{5.293}$$

Leistung wird ausgestrichen!

$h_{ein} = h(0.151 bar, -30°C) =$

$h_{aus} = h(0.191 bar, 328.075 K) =$

$$h_{ein} - h_{aus} = c_p\,(T_{ein} - T_{aus})$$

$$2\left(c_p\,(T_{aus} - T_{ein}) - \frac{4B}{5.293}\right) = 200^2 - w_6^2$$

$$280.671\,kj = 200^2 - w_6^2$$

$$2\left(1.006\cdot(328.0747 - 243.15) - \frac{1195}{5\cdot 298}\right) = 200^2 - w_6^2$$

$$\sqrt{200^2 - 280'621.273\,J} = w_6^2$$

$$\boxed{w_6 = 490.6\ m/s}$$

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

$$\dot{m}_{ges}\left[h_{aus} - h_{ein} - T_0\,(s_{aus} - s_{ein}) + \frac{1}{2}\left(w_{ein}^2 - w_{aus}^2\right)\right] = \dot{E}x_{str}$$

$$(h_{aus} - h_{ein}) = c_p(T_{aus} - T_{ein}) = 1.006\cdot(340 - 243.15)$$

ideales Gas aus zwischenlösungen

$$\rightarrow \underline{97.4311\,kj}$$

$$-T_0\,(s_{aus} - s_{ein}) = -T_0\left(c_p \ln\left(\frac{T_{aus}}{T_{ein}}\right) - \underbrace{R\ln\left(\frac{p_{aus}}{p_{ein}}\right)}_{0\ p_{aus} = p_{ein}}\right)$$

$$-243.15\left(1.006\,kj/kgK\ \ln\left(\frac{340}{243.15}\right)\right) = \underline{-82.009311\,kj}$$

$$\dot{m}_{ges}\left(97.4311\,kj - 82.009311\,kj + \frac{1}{2}\left(40000 - \underset{\downarrow\ 510^2}{w_6^2}\right)\right) =$$

$$= \cancel{\dot{m}_{ges}}\left|\boxed{(94.628211\,kj) = \Delta ex_{str}}\right|$$

positiv machen

3.) p_{g1} und m_g bestimmen! [redacted]

a) EW $\Rightarrow$ inkompressibel

$$p_{g1} = p_{amb} + \frac{32 \cdot g}{\pi r^2} \qquad r = 0.05$$

$$32\,kg \cdot \underbrace{9.80665\,m/s^2}_{\text{Tabelle erste seite}}$$

$$p_{amb} + \frac{32 \cdot 9.80665}{\pi \cdot (0.05)^2} = 1.399\,bar \rightarrow \boxed{1.4\,bar = p_{g1}}$$

$$m_g = \text{perfektes Gas} \rightarrow \frac{P_g V_g}{R_g T_g} = m_g$$

$$\frac{1.4 \cdot 10^5 \cdot 0.00314\,m^3}{\frac{8314}{50} \cdot 773.15\,K} = 0.00341943\,kg = \boxed{3.42\,g = m_{g1}}$$

---

b) $p_{g2} =$

3. c) Q_{12} = berechnen

Energiebilanz

$$\Delta E = E_2 - E_1 = Q_{12} - \cancel{W_{12}}^{0}$$

$E_2 - E_1$

$\Downarrow$

$$m_g (u_2 - u_1) = Q_{12}$$

$$0.0036 \left(c_v \left(T_2 - T_1 \right) \right) = Q_{12}$$

$$0.0036 \left(0.633 \left(0.003 - 500 \right) \right) = \boxed{Q_{12} = -1.13939\,kJ}$$

3d) $X_2 = \cancel{\dfrac{u_2 - u_f}{u_g - u_f}}$ $\dfrac{u_2 - u_{Flüssig}}{\cancel{u_{Fest} - u_2}\; u_{Fest} - u_{Flüssig}}$

$u_{Flüssig} = 0.033\, kj/kg$ $u_{Fest} = -333.442\, kj/kg$

Aus TAB-1 auf Prüfung

$$u_2 = u_1 + \frac{Q_{12}}{m_{cW}} \rightarrow +15\,kj = q_{12}$$

$$\frac{-333.458 \cdot x + 0.033}{-333.458 + 0.033} = 0.6$$

$$x = 0.5998\overset{3}{2}666$$

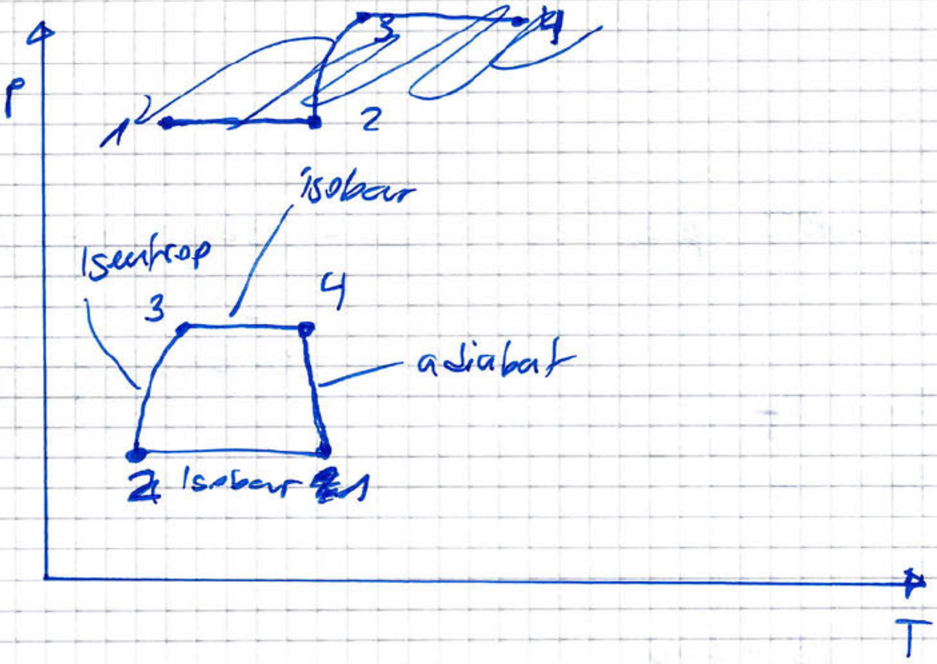
$$x \cdot 333.458 = u_1 = 200.016$$

$$u_2 = -200.016 + 15 = \boxed{185.016\,kj = u_2}$$

$$x_{2\,eis} = \frac{-185.016 + 0.033}{-333.458 + 0.033} = \boxed{0.55501 = x_{2\,eis}}$$

[redacted]

4. a)



b) $\dot{m}_{R134}$ = berechnen

$\dot{W}_K = \dot{m}(h_2 - h_3)$ → aus Energiebilanz für stationärer Fliessprozess → $\dot{Q} = 0$ (adiabat)

$p_1 = p_2$ $\quad p_3 = 8\ bar$

$s_2 = s_3$

$T_2 = 4°C \quad T_1 = 10°C$

$h_2 = h_g(4°C)$ aus TAB – A10 = $\underline{\underline{249.53\ kJ/kg}}$

$h_3 = h_g(8 bar)$ aus TAB – A11 = $264.15\ kJ/kg$

$28 = \dot{m}\,(264.15 - 249.53)\ kJ/kg$

$$\frac{28}{264'150 - 249'530} = \dot{m} = 0.0019151\ kg/s = \boxed{\dot{m} = \underline{\underline{1.915\ g/s}}}$$

4. c)

$x_1 =$

$T_1 - 10°C \quad s_1 = s_4 \to s_4 = (8 bar, x = 0)$

$\downarrow$

0.3459 kJ/kgK

$$x_1 = \frac{s_1 - s_f}{s_g - s_f} =$$

$s_f (10°C)$

Interpolieren $\to$ $\underline{\text{TaB - A10}}$

$$0.2354 + \frac{0.2545 - 0.2354}{4}(2) = 0.24495 = s_f$$

$$s_g = 0.9150 + \frac{0.9132 - 0.9150}{4}(2) = 0.9141$$

$$x_1 = \frac{0.3459 - 0.24495}{0.9141 - 0.24495} = \boxed{0.15086 = x_1}$$

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4. d) $\varepsilon_K = \frac{Q_{zu}}{|W_f|} = \underline{1500 J}$