

AUFGABE 1

$$a) \quad 0 = \dot{m}_{\text{ein}}(h_{\text{ein}} - h_{\text{aus}}) + \dot{Q}_R - \dot{U}_R^0 + \dot{Q}_{\text{aus}}$$

$$h_{\text{ein}} = c_p \cdot T \quad h_{\text{aus}} - h_{\text{ein}} = c_p (T_{\text{aus}} - T_{\text{ein}})$$

$$h(70^\circ\text{C}) = h_{\text{ein}} = 292,98 \frac{\text{kJ}}{\text{kg}} \quad \text{TAB. A-2}$$

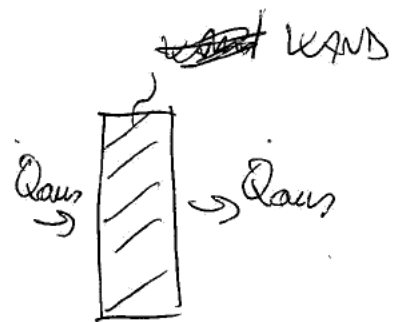
$$h(100^\circ\text{C}) = h_{\text{aus}} = 419,04 \frac{\text{kJ}}{\text{kg}} \quad \text{TAB. A-2}$$

$$\begin{aligned} \dot{Q}_{\text{aus}} &= \dot{m}_{\text{ein}}(h_{\text{aus}} - h_{\text{ein}}) - \dot{Q}_R = 0,3 \cdot (419,04 - 292,98) - 100 = \\ &= -62,18 \text{ kW} \end{aligned}$$

$$b) \quad \text{DZB}$$

$$c) \quad \text{ANNAHME: } \bar{T}_{\text{KF}} = 295 \text{ K}$$

$$0 = \frac{-\dot{Q}_{\text{aus}}}{T_{\text{REKFOR},1}} + \frac{\dot{Q}_{\text{aus}}}{\bar{T}_{\text{KF}}} + \dot{S}_{\text{gen}}$$

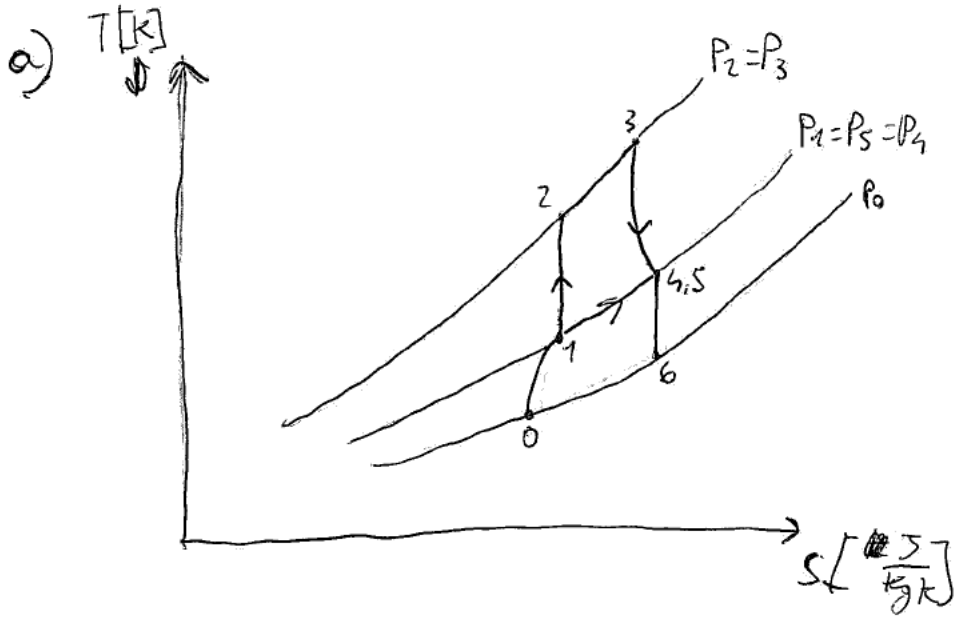


$$\dot{S}_{\text{gen}} = \frac{\dot{Q}_{\text{aus}}}{T_{\text{REKFOR},1}} - \frac{\dot{Q}_{\text{aus}}}{\bar{T}_{\text{KF}}} = \frac{-62,18}{373,15} - \frac{-62,18}{295} = 0,044 \frac{\text{KW}}{\text{K}}$$

$$d) \cancel{N_{12} = Q_{12} - \psi_{12}}$$

$$N_{12} = Dm_{12}(\dot{h}_{\text{aim}_{12}}) + \dot{Q}_{12}^{\circ} - \dot{\psi}_{12}^{\circ}$$

AUFGABE 2



$$0 = \dot{m}_{\text{GES}} (h_0 - h_6 + \frac{w_{\text{LUFT}}^2}{2} - \frac{w_6^2}{2}) + \dot{Q}_{16}^0 - \dot{W}_{16}^0$$

$$\left\{ \begin{aligned} 0 &= \dot{m}_{\text{GES}} (h_s - h_6 + \frac{w_s^2}{2} - \frac{w_6^2}{2}) + \dot{Q}_{s6}^0 - \dot{W}_{s6}^0 \end{aligned} \right. \quad \text{[Schematic of a nozzle/diffuser with inlet s and outlet 6]}$$

c)

$$\Delta e_{\text{XISTR}} = h_6 - h_0 - T_0 (s_6 - s_0) + \frac{w_6^2}{2} - \frac{w_0^2}{2}$$

$$h_6 - h_0 = c_{p, \text{LUFT}} (T_6 - T_0) =$$

$$= 1,006 (340 - 243,15) = 97,43 \frac{\text{kJ}}{\text{kg}}$$

$$s_6 - s_0 = c_{p, \text{LUFT}} \ln\left(\frac{T_6}{T_0}\right) - R \ln\left(\frac{p_6}{p_0}\right) = 1,006 \cdot \ln\left(\frac{340}{243,15}\right) =$$

$$= 0,3373 \frac{\text{kJ}}{\text{kgK}}$$

$$\cancel{D_{ex,STR} = 97,43 - 243,15(0,3373) + \frac{510^2}{2} - \frac{200^2}{2} =}$$

$$\cancel{= 110065,42 \frac{kJ}{kg}}$$

c)

$$D_{ex,STR} = 97430 - 243,15(337,3) + \frac{510^2}{2} - \frac{200^2}{2} =$$

$$= 125468,5 \frac{J}{kg} = 125,47 \frac{kJ}{kg}$$

d)

$$0 = \cancel{D_{ex,STR}} + \left(1 - \frac{T_0}{T_j}\right) \dot{q}_j - \dot{q}_m - \cancel{D_{ex,VERL}}$$

$$D_{ex,VERL} = \cancel{D_{ex,STR}} = \cancel{110065,42} 125,47 \frac{kJ}{kg}$$

AUFGABE 3

a)

$$P_{g,1} \cdot \frac{D^2 \pi}{4} = m_K + P_{AMB} \cdot \frac{D^2 \pi}{4} + m_{ELK}$$

$$P_{g,1} = \frac{m_K + m_{ELK}}{\frac{D^2 \pi}{4}} + P_{AMB} = \frac{32 + 0,1}{\frac{0,1^2 \pi}{4}} + 100000 =$$

$$= 104087,09 \text{ Pa}$$

$$P_{g,1} \cdot V_{g,1} = m_{g,1} \cdot R \cdot T_{g,1}$$

$$R = \frac{\bar{R}}{M_g} = \frac{8,314}{50 \cdot 10^{-3}} = 166,28 \frac{\text{J}}{\text{kgK}}$$

$$m_{g,1} = \frac{P_{g,1} \cdot V_{g,1}}{R \cdot T_{g,1}} = \frac{104087,09 \cdot 314 \cdot 10^{-3}}{166,28 \cdot 773,15} = 2,54228 \cdot 10^{-3} \text{ kg}$$

b)

DER DRUCK DES GASES IST DER SELBE WIE IN ZUSTAND 1 WEIL DIE GLEICHUNG IN PUNKT ~~a~~ ~~a~~ SICH NICHT VERÄNDERT.

DIE TEMPERATUR DES GASES ~~ist~~ IST NIEDRIGER ALS IN ZUSTAND 1 WEIL WÄRME IN DAS EIS-WASSER GEMISCH GEFLASSEN IST

c)

$$\Delta U_{12,g} = Q_{12}$$

$$\Delta U_{12} = m_g (u_{2,g} - u_{1,g}) = m_g \cdot c_v (T_2 - T_{1,g})$$

$$T_2 = T_{EK,1} = 0^\circ \text{C} \quad \text{WEIL } X_2 > 0 \text{ UND THERMISCHES GLEICHGEWICHT}$$

$$Q_{12} = m_g \cdot c_v \cdot (T_{EK,1} - T_{g,1}) = 2,54228 \cdot 10^{-3} \cdot 0,633 \cdot (273,15 - 773,15) = -0,8046 \text{ kJ}$$

IN EK FLIESST $-Q_{12}$ ~~THESE~~ REW

d) $T_{EK,1} = T_{EK,2} \quad \text{WEIL } X_2 > 0$

$$\dot{U}_{12,EK} = \dot{Q} - Q_{12}$$

$$m_{EK} \cdot (u_{2,EK} - u_{1,EK}) = -Q_{12}$$

$$u_{1,EK, \text{flüssig}} = -0,045 \frac{\text{kJ}}{\text{kg}} \quad \text{TAB. 1}$$

$$u_{1,EK, \text{fest}} = -333,458 \frac{\text{kJ}}{\text{kg}}$$

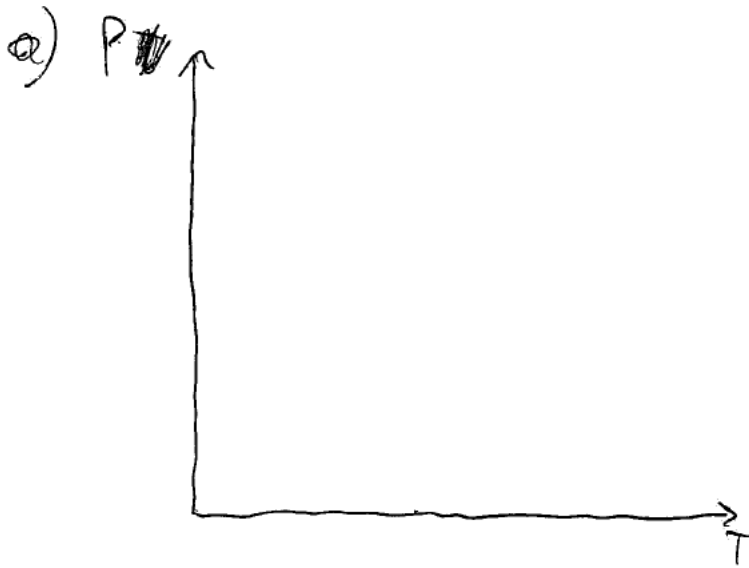
$$u_{1,EK} = u_{1,EK,F} + (1 - X_{EIS,1}) (u_{1,EK,fl} - u_{1,EK,F}) =$$

$$= -333,458 + (1 - 0,6) (-0,045 + 333,458) = -200,093 \frac{\text{kJ}}{\text{kg}}$$

$$u_{2,EK} = \frac{-Q_{12}}{m_{EK}} + u_{1,EK} \cdot \frac{m_{EK}}{m_{EK}} = \frac{0,8046}{0,1} - 200,093 = -192,05 \frac{\text{kJ}}{\text{kg}}$$

$$X_{2,EIS} = - \frac{u_{2,EK} - u_{2,EK,F}}{u_{2,EK,fl} - u_{2,EK,F}} + 1 = - \frac{-192,05 + 333,458}{-0,045 + 333,458} + 1 = 0,5759$$

AUFGABE 4



b)

$$S_2 = S_3$$

~~$S = \dots$~~ ~~$T = \dots$~~

$$0 = \dot{m}_{R134a} (h_2 - h_3) + \dot{Q}_{23} - \dot{W}_{23}$$

$$\dot{W}_{23} = \dot{W}_K = -28 \text{ kW}$$

~~$\dot{m}_{R134a} = 4 \frac{\text{kg}}{\text{s}} = 1,1111 \cdot 10^{-3} \frac{\text{kg}}{\text{s}}$~~

~~$0 = \dot{m}_{R134a} (h_4 - h_1)$~~

$$T_2 = -22^\circ\text{C} = 251,15 \text{ K}$$

$$\underline{S_3 = S_2} = S(T = -22^\circ\text{C}) = - \frac{0,9089 - 0,9102}{-24 - 20} (-24 - 22) + 0,9089 = 0,90955 \frac{\text{kJ}}{\text{kg K}}$$

TAB A-10

$$h_2 = h(T = -22^\circ\text{C}) = -\frac{260,45 - 258,36}{24 - 20} (24 - 22) + 260,45 = 217,57 \frac{\text{kJ}}{\text{kg}}$$

TAB A-10

$$h_3 = -\frac{273,66 - 264,15}{0,9374 - 0,9066} (0,9374 - 0,90955) + 273,66 = 265,06 \frac{\text{kJ}}{\text{kg}} \left. \begin{array}{l} \text{TAB} \\ \text{A-12} \end{array} \right\}$$

$$0 = \dot{m}_{R134a} (h_2 - h_3) + \dot{Q}_{23}^0 - \dot{U}_{23}$$

$$\dot{U}_{23} = \dot{U}_k = -0,028 \text{ kW}$$

$$\dot{m}_{R134a} = \frac{\dot{U}_{23}}{h_2 - h_3} = \frac{-0,028}{217,57 - 265,06} = 5,896 \cdot 10^{-4}$$