

①

$$\dot{Q}_{\text{vien(haus-haus)}} = \dot{Q}_{\text{aus}} + \dot{Q}_R$$

$$\dot{Q}_{\text{vien(haus-haus)}} = \dot{Q}_R = \dot{Q}_{\text{aus}}$$

$$\text{haus}(x=0, 100^\circ) = h_f = 419,04 \text{ kJ/kg}$$

$$\text{hun}(x=0, 70^\circ) = h_f = 292,98 \text{ kJ/kg}$$

TAB A2

$$\dot{Q}_{\text{aus}} = -62,188 \text{ W/kg}$$

b)

$$\frac{T_{KF} - T_1}{S_2 - S_1} = \frac{T_{\text{aus}} - T_{\text{un}}}{S_2 - S_1} = \frac{85,227^\circ\text{C}}{358,377 \text{ K}}$$

$$S_{\text{aus}} = S_2(x=0, 100^\circ) = S_f = 1,3069 \text{ kJ/kg.K}$$

$$S_{\text{un}} = S_1(x=0, 70^\circ) = S_f = 0,9549 \text{ kJ/kg.K}$$

c) $\dot{S}_{\text{ex}} = \dot{m} (S_{\text{aus}} - S_{\text{un}}) - \frac{\dot{Q}_{\text{aus}}}{T_{KF}} = 0,3177 \text{ kJ/s.K}$

$$S_{\text{aus}}(x=0, 100^\circ) = 1,3069 \text{ kJ/kg.K}$$

$$S_{\text{un}}(x=0, 70^\circ) = 0,9549 \text{ kJ/kg.K}$$

b)

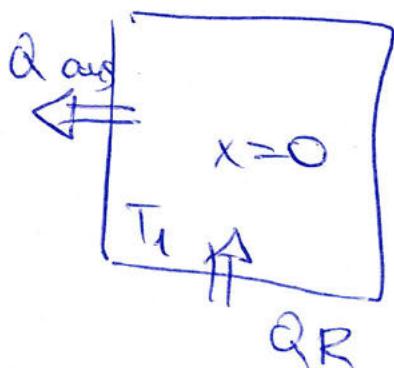
$$\bar{T}_{KF} = \frac{T_{KF,aus} - T_{KF,ein}}{S_{aus} - S_{ein}} = \frac{T_{KF,aus} - T_{KF,ein}}{\ln\left(\frac{T_2}{T_1}\right)} = \underline{\underline{293,12\text{K}}}$$
$$S_{aus} - S_{ein} = \ln\left(\frac{T_2}{T_1}\right) \cdot \cancel{\text{Spur}}$$

Offen
Ober

d)

	TE [°C]
1	
2	70

$$T_{\text{env},12} = 20^\circ\text{C} \quad \Delta m_{12}$$



wetbofrees system

$$T_{\text{env},12} = 20^\circ\text{C}$$

$$\begin{aligned}\Delta E &= m_2 \cdot u_2 - m_1 \cdot u_1 + \cancel{\Delta KE} + \cancel{\Delta PE} \\ &= \Delta m_{12} \cdot h_{12} + \cancel{Q_{aus}} + \cancel{Q_R} - \cancel{W}\end{aligned}$$

$$m_2 \cdot u_2 - m_1 \cdot u_1 = \Delta m_{12} \cdot h_{12}$$

$$(m_1 + \Delta m_{12}) \cdot u_2 - m_1 \cdot u_1 = \Delta m_{12} \cdot h_{12}$$

$$\frac{T_{\text{AB A-2}}}{u_2(x=0, 70^\circ\text{C})} = u_f(70^\circ\text{C}) = 292,95 \text{ kJ/kg}$$

$$u_1 + x \cancel{u_a}(x=0, 100^\circ\text{C}) = u_f(100^\circ\text{C}) + x u_g f(100^\circ\text{C}) = 429,648 \text{ kJ/kg}$$

$$h_{12}(x=0, 20^\circ\text{C}) = h_f(20^\circ\text{C}) = 83,36 \text{ kJ/kg}$$

$$m_1 \cdot u_2 + \Delta m_{12} \cdot u_2 - m_1 \cdot u_1 = \Delta m_{12} \cdot u_{12}$$

$$m_1 \cdot u_2 - m_1 \cdot u_1 = \Delta m_{12} (u_{12} - u_2)$$

$$\Delta m_{12} = 3764,28 \text{ kg}$$

e) $s_1 = s_1 | x=0,005, 100^\circ\text{C} = s_f(100^\circ\text{C}) \cancel{+}$
 $+ x(s_g(100^\circ\text{C}) - s_f(100^\circ\text{C}))$

TAB A-2 $\Delta H = 1,33714 \text{ kJ/kg}\cdot\text{K}$

$$s_2 = s_2(x=0,70^\circ\text{C}) = 0,9549 \text{ kJ/kg}\cdot\text{K}$$

$$\Delta s_{12} = m_2 \cdot s_2 - m_1 \cdot s_1 \cancel{+}$$

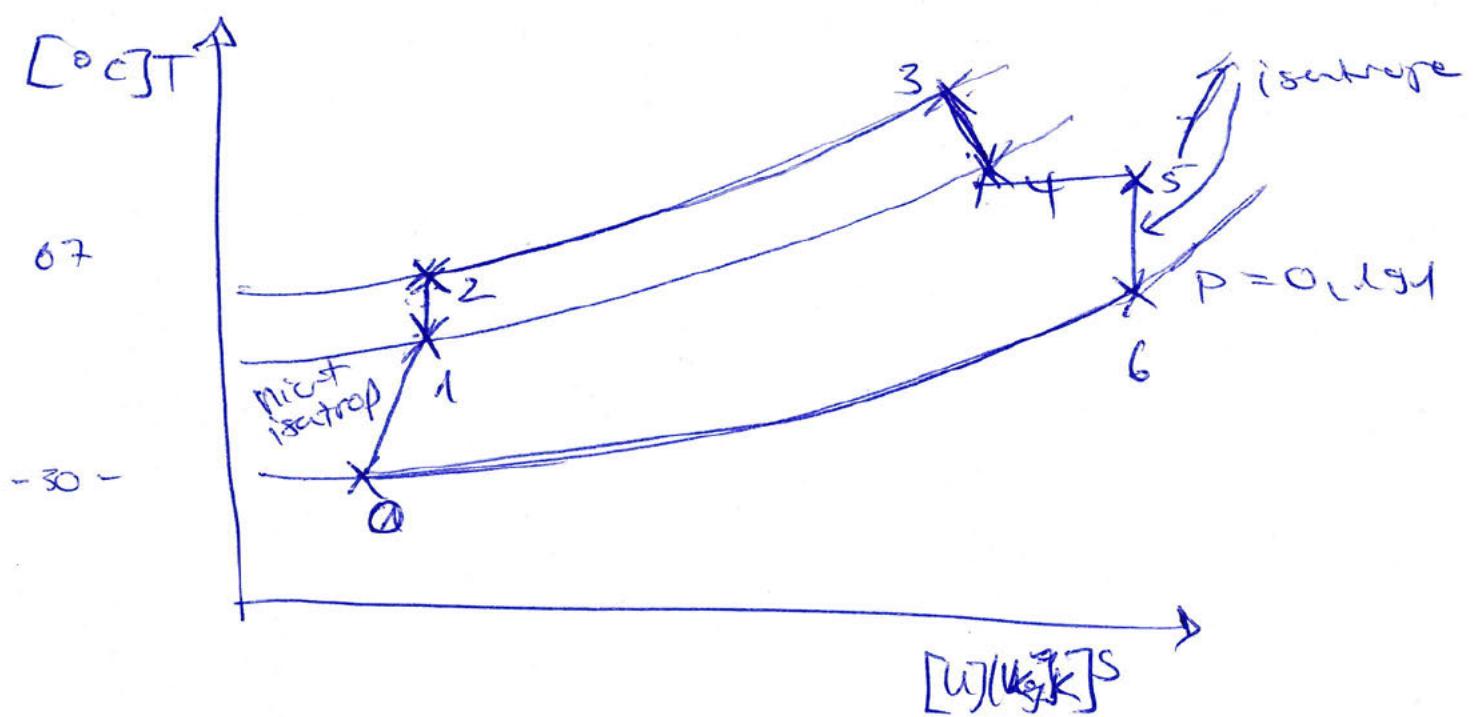
$$= (\Delta m_{12} + m_1) \cdot s_2 - m_1 \cdot s_1 = 1394,7198 \text{ kJ/K}$$

(2)

	P [Pa]	T [K]	S	
0	0,191	-30°C		
1			ss	200 m/s
2		"	"	
3		"		
4		"		
5	0,5	431,9 K	"	
6	0,191	2340	"	

$w_s = 280 \text{ m/s}$

a)



$$b) \quad \left(\begin{array}{l} p_5 = p_6 \\ s(T_5 = 431,9K) = \end{array} \right)$$

$$S_6 - S_5 = 0 = S^\circ(T_6) - S^\circ(T_5) - R \cdot \ln\left(\frac{p_6}{p_5}\right)$$

$$S^\circ(T_6) = S^\circ(T_5) + \frac{R}{M} \cdot \ln\left(\frac{p_6}{p_5}\right)$$

$$S^\circ(T_5) = 431,9K = 2,0653377 \frac{kJ}{kg \cdot K} \frac{440 - 430}{440 - 430} \cdot (431,9 - 430)K$$

$$= 2,06977 \frac{kJ}{kg \cdot K}$$

$\Delta T_6(S^\circ(T_5))$

$$\begin{aligned} S^\circ(T_6) &= 2,06977 \frac{kJ}{kg \cdot K} + \frac{8,314 \frac{W}{mol \cdot K}}{28,97 \frac{kg}{kmol}} \cdot \ln\left(\frac{0,191}{0,15}\right) \\ &= 1,7936 \frac{kJ}{kg \cdot K} \end{aligned}$$

$$\begin{aligned} \Delta T_6(S^\circ(T_6)) &= 325K + \frac{(330 - 325)K}{(1,79783 - 1,78249) \frac{kJ}{kg \cdot K}} \cdot \frac{(1,7936 - 1,78249)}{0,01 \frac{kJ}{kg \cdot K}} \\ &= 328,62K \end{aligned}$$

$$0 = \dot{m} \left(h_6 - h_5 + \frac{(w_6^2 - w_5^2)}{2} \right) = \dot{Q} + \dot{W}$$

$$\dot{W} = \frac{R \cdot (T_6 - T_5)}{1 - k} = \underline{74,077 \text{ uJ/kg}}$$

$$R = \frac{8,314 \text{ J/(mol K)}}{28,97 \text{ kg/kgmol}} = 0,2863 \text{ uJ/kg.K}$$

~~$\frac{w_6^2}{2}$~~
 ~~$w_5^2/2$~~

Mach w_6 umstellen,

$$c) \omega_6 = 510 \frac{\text{rad}}{\text{s}}$$

wages

$$\Delta e_{x,\text{st}} = e_{x,\text{str},6} - e_{x,\text{str},0}$$

$$= h_6 - h_0 - T_0(s_6 - s_0) + \Delta k_e$$

$243,15$

$$h_0(T=288\text{K}) = 240,02 \frac{\text{kJ}}{\text{kg}} + \frac{(250,05 - 240,2)\text{kJ/kg}}{(250 - 240)\text{K}}$$

$$+ (243,15 - 240,2) \frac{\text{kJ/kg}}{\text{K}}$$

$$= 242,906 \frac{\text{kJ}}{\text{kg}}$$

$h_6(T=328,62\text{K})$

TAB A-22

$$= 325,31 \frac{\text{kJ}}{\text{kg}} + \cancel{+ \frac{330,34 - 3}{(330 - 325)\text{K}}}$$

$$+ \frac{330,34 - 325,31}{(330 - 325)\text{K}} (328,62 - 325)\text{K}$$

$$= \underline{328,9517 \frac{\text{kJ}}{\text{kg}}}$$

$$\Delta_{\text{ex,st}} = h_6 - h_0 - T_0 (s^\circ(T_6) - s^\circ(T_0)) + \frac{1}{2} (\omega_6^2 - \omega_0^2)$$

$$s_6 - s_0 = s^\circ(T_6) - s^\circ(T_0)$$

$$s^\circ(T_6) = 2,06977 \text{ kJ/kg.K}$$

$$s^\circ(T_0) = 1,47844 + \frac{1,51917 - 1,47844}{250 - 240} (243,15 - 240)$$

$$= 1,4911 \text{ kJ/kg.K}$$

TAB A-22

$$\Delta_{\text{ex,st}} = 109,995 \text{ kJ/kg}$$

d) $\dot{Q}_{\text{ex,vert}} = T_0 \cdot \frac{\dot{S}_{\text{ex,vert}}}{m}$

$$\dot{S}_{\text{ex,vert}} = s_6 - s_0 + \alpha - \frac{\Delta Q}{T_0}$$

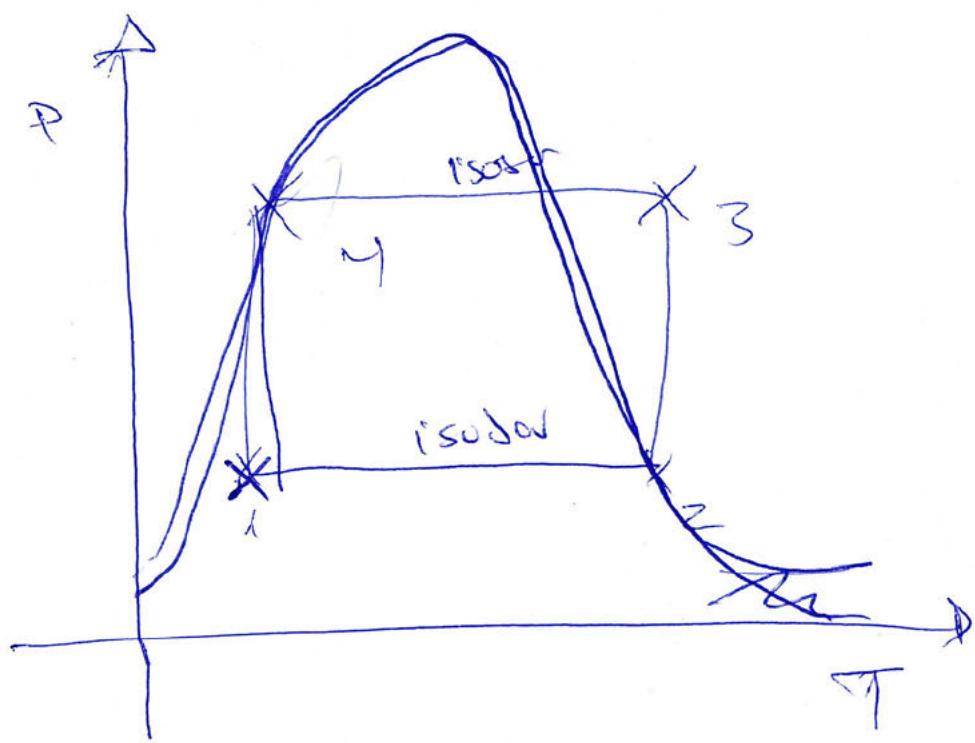
$$= s_6^\circ - s_0^\circ = 0,57867 \text{ kJ/kg.K}$$

$$\dot{Q}_{\text{ex,vert}} = 140,70 \text{ W/kg}$$

(4)

	P	T	S	h
$x_1 = 1$	2,268	-6		262118 93,42
$x_2 = 1$	2	2,268		
	3	8		
$x_3 = 0$	4	8		262118 93,42

a)



$$5) \quad T_i = 0^\circ\text{C}$$

$$T_i - 6K = T_1 = 267,115 \text{ K} \\ = -6^\circ\text{C}$$

$$h_1 = h_f(885) = 93,42 \text{ kJ/kg} \quad \text{TAB A-11}$$

$$h_4 = h_1 \quad \text{dL}$$

x_{D}

$$x_1 = \frac{h_1 - h_f}{h_g - h_f} = 0,273$$

TAB A-10 @ -6°C

$$h_f(-6^\circ\text{C}) = 36,935 \text{ kJ/kg}$$

$$h_g(-6^\circ\text{C}) = 243,72 \text{ kJ/kg} \quad \text{interpoliert}$$

$$P_A = \cancel{2,5274} + x \cdot (2,5274 - 2,1704) \text{ bar} \\ = 2,1704 \text{ bar}$$

$$= \underline{\underline{2,268 \text{ bar}}}$$

$$P_1 = P_2$$

$$h_g(2,268 \text{ bar}) = h_2 = 243,169 \text{ kJ/kg IP TAB A-11}$$

$$\dot{m}(h_2 - h_3) = \dot{m}_w$$

$$\dot{m} = \frac{\dot{m}_w}{h_2 - h_3}$$

$$s_2 f(2,268 \text{ bar}) = s_g = 0,9232 \text{ kJ/kg.K}$$

$$s_2 = s_3$$

$$h_3 f \text{ at } 85^\circ \text{ C, } 0,9232 \text{ kJ/kg.K}$$

$$= 264,15 + \frac{273,66 - 264,15}{0,9374 - 0,9066} (0,9232 - 0,9066)$$

$$= 269,276 \text{ kJ/kg}$$

$$\dot{m} = 0,6736 \text{ kg/s} = 3,186 \text{ kg/h}$$

6) x_1 in aufgabe b berechnet

$$x_1 = 0,273$$

d) $E_K = \frac{\dot{Q}_{zu}}{\dot{m} f} = \frac{578}{28} = 20,64$

$$\dot{Q}_{zu} = \dot{m}(h_2 - h_1) = 0,578 \text{ kJ/s}$$

$$h_2 = 243,169 \text{ kJ/kg}$$

$$h_1 = 93,42 \text{ kJ/kg}$$

(3)

a)

5)

c) $Q_{12} = m g \cdot (T_{g,2} - T_{g,1})$
 $= -1,7999 \text{ kJ}$

d)