3)

$$R = \frac{8.314 \frac{kJ}{kmol \cdot K}}{50 \frac{kg}{kmol}} = 0.166 \frac{kJ}{kg \cdot K}$$

a) $p_{g,1}$, m_g $\quad A = \pi \cdot \left(\frac{D}{2}\right)^2$

$\downarrow m_K \cdot g \quad \downarrow p_{amb} \cdot A$

$\uparrow p_{EW,1} \cdot A$

$$\rightarrow p_{EW,1} = \frac{m_K \cdot g}{A} + p_{Amb}$$

$\downarrow p_{EW,1} \cdot A$

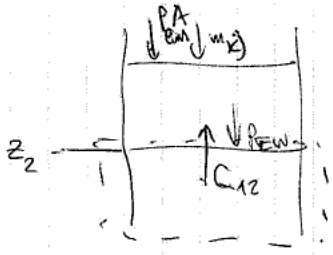
$\uparrow p_{g,1}$

$$p_{g,1} = p_{EW,1} = \frac{m_K \cdot g}{A} + p_{Amb} = \frac{32kg \cdot 9.81 \frac{m}{s^2}}{\pi \left(\frac{0.2m}{2}\right)^2} + 1 \cdot 10^5 \frac{N}{m^2} = 1.40 bar$$

$pV = mRT$, $T_{g,1} = 773.15 K$

$$m_g = \frac{p_{g,1} V_{g,1}}{R T_{g,1}} = \frac{1.40 \cdot 10^5 \frac{N}{m^2} \cdot 3.14 \cdot 10^{-3} m^3}{0.166 \cdot 10^3 \frac{J}{kg \cdot K} \cdot 773.15 K} = 3.48 g$$

c) $T_{g,2} = 0.005°C$



$$\frac{dE}{dt} = -\dot{Q} - \dot{W}_V = \frac{dU}{dt} \qquad T_{2g} = 273.153 K$$

$$\Delta U = -Q_{12} - W_V = m_g (u_2 - u_1) = -1.085 kJ$$

$$W_V = -p_{amb} (V_{g_2} - V_{g_1}) - mg (z_2 - z_1)$$

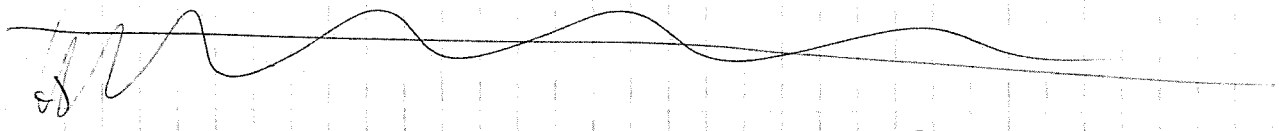
($z_2 - z_1$: Höhenunterschied)

$$u_2 - u_1 = c_V^{Pg} (T_{2g} - T_{1g}) = 0.633 \frac{kJ}{kg K} (273.153 - 773.15) K = -316.498 \frac{kJ}{kg}$$

$$p V_{g,2} = m_g R T_{g,2} \rightarrow V_{g,2} = \frac{m_g R T_{g,2}}{p}$$

d) $|Q_{12}| = 1500\,J$

$V_{1EW} = V_{2EW} \rightarrow v_{1EW} = v_{2EW}$



e)

TAB A-6 $v_{1EW} = 0.6 \cdot v_g(0°C) + (1-0.6)\, v_g(0°C) = 125.78 \frac{m^3}{kg}$

$x_2 = \frac{v_2 - v_f}{v_g - v_f} = \frac{u_2 - u_f}{u_g - u_f}$

$1EW_a$: $\Delta U = \dot{Q}_{12} - \cancel{W_{V12}}^{0}$

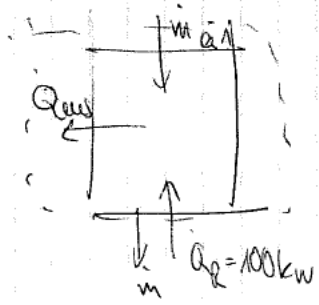
$\Delta U = m(u_2 - u_1)$

$u_2 - u_1 = c^{if}(T_2 - T_1)$

1)

	T [°C]
ein	70
aus	100
Reaktor	100°C

a)



stationär

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

$$\dot{Q}_{aus} = \dot{m}(h_{ein} - h_{aus}) + \dot{Q}_R = 0.3\frac{kg}{s}\left(304.65\frac{kJ}{kg} - 430.34\frac{kJ}{kg}\right) + 100kW$$

$$= \underline{\underline{62.29\ kW}}$$

TABA2: $h_{ein} = x_0 h_g(70°C) + (1-x_0) h_f(70°C) = 304.65\frac{kJ}{kg}$

$$h_{aus} = x_0 h_g(100°C) + (1-x_0) h_f(100°C) = 430.34\frac{kJ}{kg}$$

b) $$\bar{T}_{KF} = \frac{T_{aus,KF} - T_{ein,KF}}{\ln\left(\frac{T_{aus,KF}}{T_{ein,KF}}\right)} = \frac{373.15 - 343.15}{\ln\left(\frac{373.15}{343.15}\right)} K = \frac{298.1J - 288.1J}{\ln\left(\frac{298.1J}{288.1J}\right)}$$

Druck ändert sich nicht!

$$= \underline{\underline{293.12K}}$$

c) $$0 = \dot{m}(s_{ein} - s_{aus}) + \frac{\dot{Q}_R - \dot{Q}_{aus}}{\bar{T}_{KF}} + \dot{S}_{erz}$$

$$\dot{S}_{erz} = \dot{m}(s_{aus} - s_{ein}) + \frac{\dot{Q}_{aus} - \dot{Q}_R}{\bar{T}_{KF}} = 0.3kg/s\left(1.337 - 7.755\right)\frac{kJ}{kgK} + \frac{67.29 - 100kW}{293.12K} =$$

$$= \underline{\underline{-204\frac{kJ}{kgK}}}$$

(kann negativ sein weil System nicht geschlossen?)

TABA2: $s_{aus} = x_0 s_g(100°C) + (1-x_0) s_f(100°C) = 1.337\frac{kJ}{kgK}$

$$s_{ein} = x_0 s_g(70°C) + (1-x_0) s_f(70°C) = 7.755\frac{kJ}{kgK}$$

d) ~~$\Delta U = \dots$~~

$$\Delta U = \Delta m_{12} h_{ein} - Q_{R12} = m_2 u_2 - m_1 u_1$$

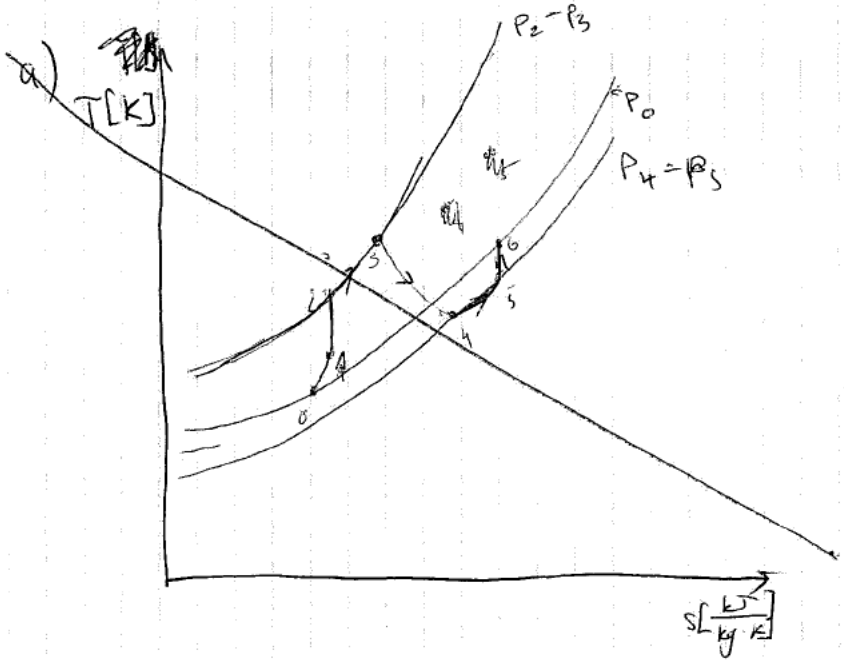
$$\Delta m_{12} = \frac{m_2 u_2 - m_1 u_1 + Q_{R12}}{h_{ein}}$$

TAB A-2 $h_{ein} = h(20\,^\circ C) = h_f(20\,^\circ C) = 83.96 \frac{kJ}{kg}$

$u_2 =$

e) $\Delta S_{12} = \Delta m_{12} s_{ein} + \frac{Q_j}{T} + S_{erz}$

		T [K]	p [bar]
2)	isentrop (, 1		
	(, 2		p_2
	(, 3		p_2
	4		
	isentrop (, 5	431.9	0.5
	isentrop (, 6		0.191



b)

$$\frac{T_6}{T_5} = \left(\frac{p_6}{p_5}\right)^{\frac{n-1}{n}}$$

$$T_6 = T_5\left(\frac{0.191}{0.5}\right)^{\frac{0.4}{1.4}} = 328.07\,K$$

$T_5 = 431.9\,K$

0, stationär

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

$$\dot{m}_{Ges}(h_5 - h_6) = \left(\frac{w_6^2}{2} - \frac{w_5^2}{2}\right)\dot{m}_{Ges}$$

$$w_6^2 = 2(h_5 - h_6) + w_5^2$$

$\frac{J}{kg} = \frac{Nm}{kg} =$

$$h_5 - h_6 = \int_{T_0}^{T_5} c_p \, dT = c_p (T_5 - T_6) = 1.006 \frac{kJ}{kgK} (431.9K - 328.07K) = \underline{104.45 \frac{kJ}{kg}}$$

$$w_6 = \sqrt{2(h_5 - h_6) + w_5^2} = \sqrt{2 \cdot 104.45 \cdot 10^3 \frac{J}{kg} + \left(200 \frac{m}{s}\right)^2} = \underline{498.90 \frac{m}{s}}$$

c) $e_{x,ist,6} - e_{x,ist,0} = h_6 - h_0 - T_0 (s_6 - s_0) + ke_6 - ke_0$

$$h_6 - h_0 = c_p (T_6 - T_0) = 1.006 \frac{kJ}{kgK} (328.07 - 243.15) K = 85.43 \frac{kJ}{kg}$$

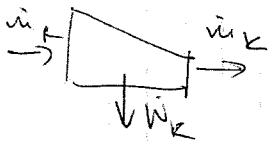
$$s_6 - s_0 = c_p \ln\left(\frac{T_6}{T_0}\right) - R \ln\left(\frac{p_6}{p_0}\right) = 1.006 \frac{kJ}{kgK} \cdot \ln\left(\frac{328.07}{243.15}\right) - 0.30 \frac{kJ}{kgK}$$

$ke_0 = \frac{1}{2} w_{Luft}^2$

$$\Delta e_{x,ist} = 85.43 \frac{kJ}{kg} - 243.15 \, 15K \left(0.3 \frac{kJ}{kgK}\right) + \frac{\left(498.90 \frac{m}{s}\right)^2 - \left(200 \frac{m}{s}\right)^2}{2}$$

$$= \underline{116.63 \frac{kJ}{kg}}$$

d) $\dot{m}_M = 5.299 \cdot \dot{m}_K$



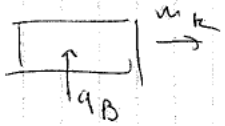
$\dot{W}_K = \dot{m}_{Verdichter}$

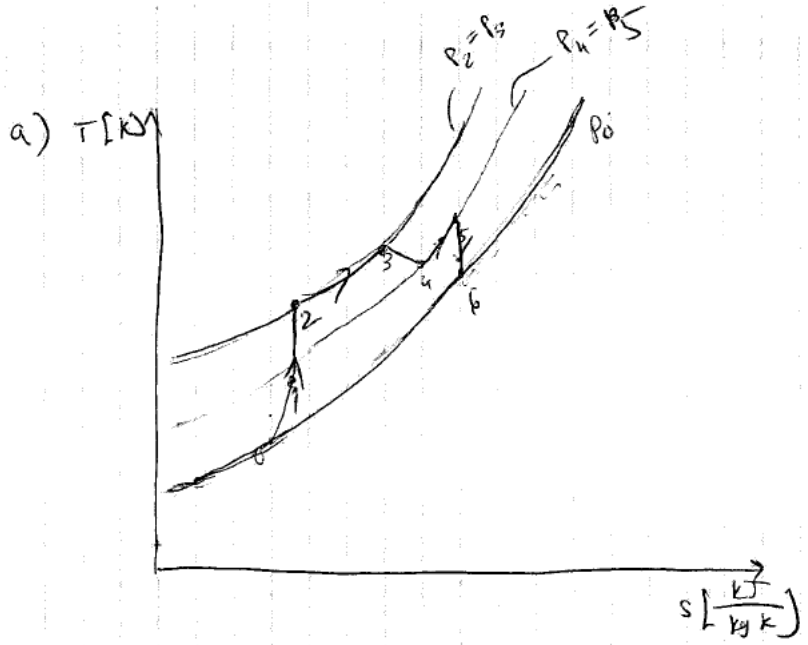
$\dot{m}_{Ges} = \dot{m}_M + \dot{m}_K$

$0 = \dot{m}_K (s_1 - s_2) + \dot{m}$

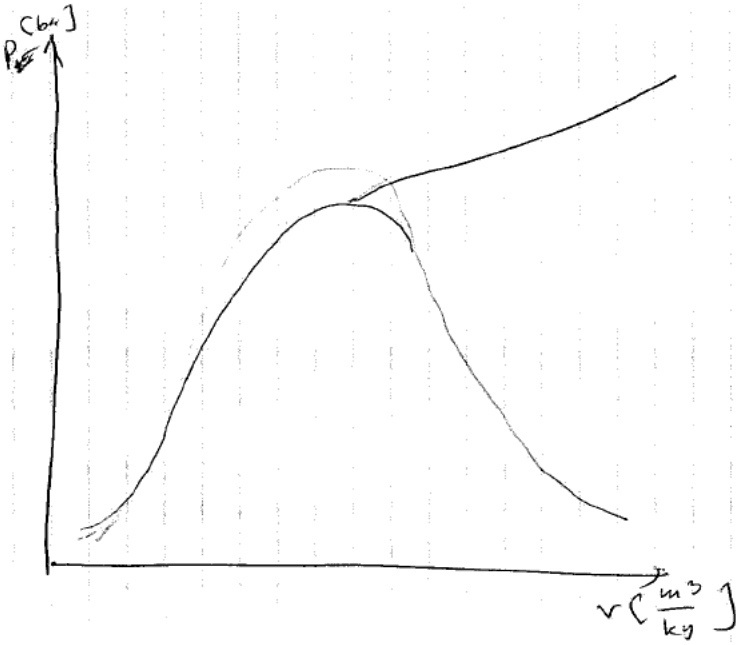
$e_{x,Verl} = \frac{T_0 \dot{S}_{erz}}{\dot{m}_{ges}}$

$\dot{S}_{erz}$ in Brennkammer, Turbine, Mischkammer, Verdichter

d) 

a) 

4) a)



c)