[redacted]

1.a) Q_{aus} : 1. HS : $0 = \dot{m}(h_{ein} - h_{aus}) + \dot{Q}_{aus} + \dot{Q}_{12}$

TAB A-2 { h_{ein}(70°C, siedend) = 292.98kJ/kg
h_{aus}(100°C, siedend) = 419.04kJ/kg
h_{ein}(70°C, gesättigt) = 292.98kJ/kg
h_{aus}(100°C, gesättigt) = 419.04kJ/kg

$$Q_{aus} = -\dot{m}(h_{aus} - h_{ein}) + \dot{Q}_{12}$$
$$= 62.182kW$$

b) $$\bar{T}_{KF} = \frac{\int_e^a T\,ds}{s_a - s_e} = \frac{1}{s_a - s_e} \cdot \left(\frac{T_a^2}{2} - \frac{T_e^2}{2}\right)$$

$$s_a - s_e = c^{it} \ln\left(\frac{T_2}{T_1}\right) =$$

c) $$\dot{S}_{erz} = \dot{m}[s_a - s_e] - \frac{\dot{Q}_{aus}}{\bar{T}_{KF}} =$$

d) $$Q_{R,12} = Q_{aus,12} = 35MJ$$

$$0 = \dot{m}_{ges,1}($$

[redacted]

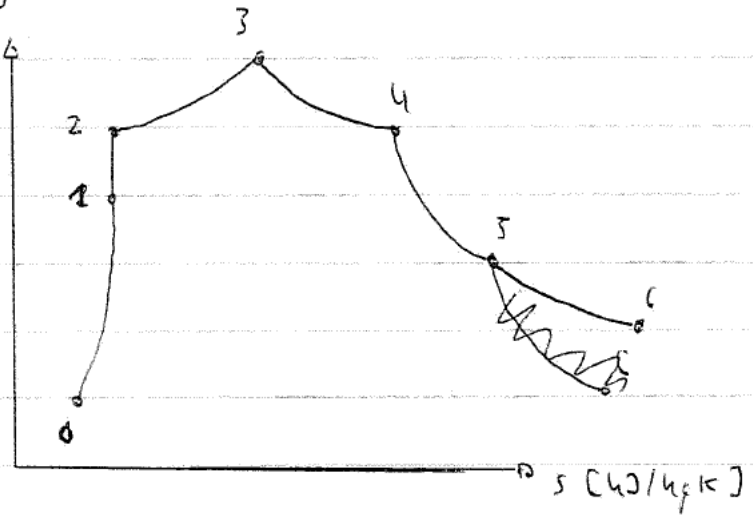
2.

	[°C] T	[bar] p	
0	243.15 −30	0.191	
1			isentrop / $\eta_{V,isC,1}$, mit
2			isobar
3			$q_B = 1195\,kJ/kg$, $\bar{T}_B = 1289\,K$
4		0.5	isobar
5	K 471.9	0.5	$w_5 = 220\,m/s$
6	328.075	0.191	isentrop

$w_{Luft} = 200\,m/s$

Verdichter

a) T [K]



b) w_6 & T_6:

$$T_6 = \left(\frac{p_2}{p_1}\right)^{\frac{n-1}{n}} T_5 = 328.075\,K$$

→ isentrop

$$w_6 = \frac{V_6}{V_5} \cdot w_5 = 437.427\,m/s$$

$$V_5 = \frac{RT_5}{p_5} = 0.0024\,\frac{m^3}{kg}$$

$$R = c_p - c_v = 0.2874$$

$$\kappa = \frac{c_p}{c_v} \rightarrow c_v = \frac{c_p}{\kappa} = 0.719$$

$$V_6 = \frac{RT_6}{p_6} = 0.0049\,kg/m^3$$

c) $\Delta e_{x,str} = e_{x,str,6} - e_{x,str,0}$

$\Delta e_{x,str,6} = w_i [h_a - h_c - T_0 (s_a - s_c) + \Delta h_{ec}] = 87.829\,kJ/kg$

$h_a - h_c = c_p (T_6 - T_0) = 85.434\,kJ/kg$

$T_0 = 243.15K$

$s_a - s_c = c_p \ln\left(\frac{T_6}{T_0}\right) - R \ln\left(\frac{p_6}{p_0}\right)^{\to 0} = 0.30136\,kJ/kg\,K$

$\Delta h_{ec} = \frac{w_6^2}{2} - \frac{w_0^2}{2} = 75'671.19\,J = 75.671\,kJ/kg$

d) $e_{x,verl}$ auf w_{is} bezogen

$\dot{E}_{xverl} = T_0 \dot{s}_{erz} \xrightarrow{/\dot{m}_{is}} e_{x,verl} = T_0 s_{erz}$

$T_0 = 243.15K$

$s_{erz} = (s_a - s_c) + \frac{q_j}{T_j} = (s_6 - s_0) + \frac{q_B}{T_B} = 1.2284$

$s_6 - s_0 = c_p \ln\left(\frac{T_6}{T_0}\right) = 0.30136\,kJ/kg\,K$

$\frac{q_B}{T_B} = 0.922\,kJ/kg\,K$

$e_{x,verl} = T_0 s_{erz} = 298.69\,kJ/kg$ //

3. a) $p_{g,1}$ & m_g:

$$p_{G1} = p_{ams} + \left(\frac{32kg}{A_{Zyl.}}g\right)\cdot 10^{-5} + \left(\frac{0.1kg}{A_{Zyl.}}g\right)\cdot 10^{-5} = 1.4015\,bar$$

$$A_{Zylinder} = 0.05m^2 \cdot \pi = 0.00785\,m^2$$

m_g: $n = \frac{p_1 V_1}{\bar{R} T_1} = 0.0684\,mol$

$$V_1 = 3.14 \cdot 10^{-3}\,m^3$$

$$M_G = 50g/mol$$

$$m_G = n \cdot M_G = 3.4194\,g$$

b) $p_{G2} = p_{G1} \Rightarrow$ Masse steigt nicht, somit bleibt der Druck konstant $p_{g,2} = 1.4015\,bar$

c) $\Delta U m_G = Q_{12} = -1082.23\,kJ$

$\Delta u = u(T_2) - u(T_1) = c_v(T_2 - T_1) = -316.4984\,kJ/kg$

mit $T_2 = 0.003°C$

d) $u_1 = u_{Flüssig} + x_{ein}(u_{Fest} - u_{Flüssig}) = -200.0928\,kJ/kg$

$u_{Fest}(0°C) = -333.458\,kJ/kg$

$u_{Flüssig}(0°C) = -0.045\,kJ/kg$ $\quad U_1 = u_1 m = -20.009\,kJ$

$U_1 = -20.009284$ kJ

$U_1 + Q_{12} = -21091.51$ J

$u_2 = \frac{U_1 + Q_{12}}{m} = -210.9151431$ kJ/kg

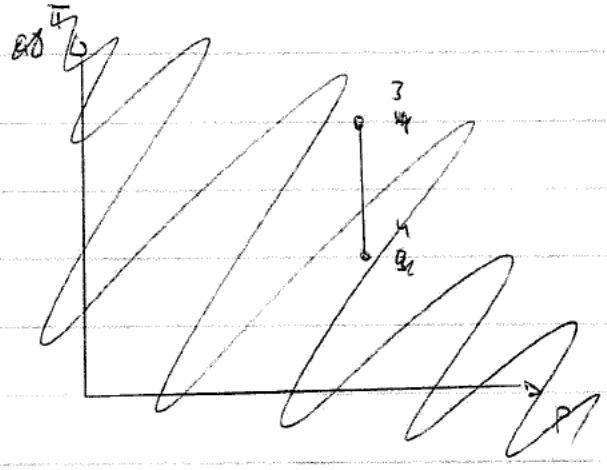
$x_{2,Eis} = \frac{u_2 - u_{2Fluessig}}{u_{2Fest} - u_{2Fluessig}} = 0.63250 = 0.633$

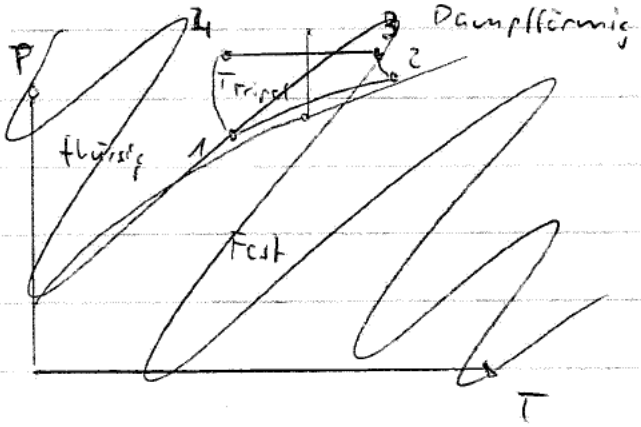
$u_{2Fest} = -333.442$ kJ/kg

$u_{2Fluessig} = -0.033$ kJ/kg

4.

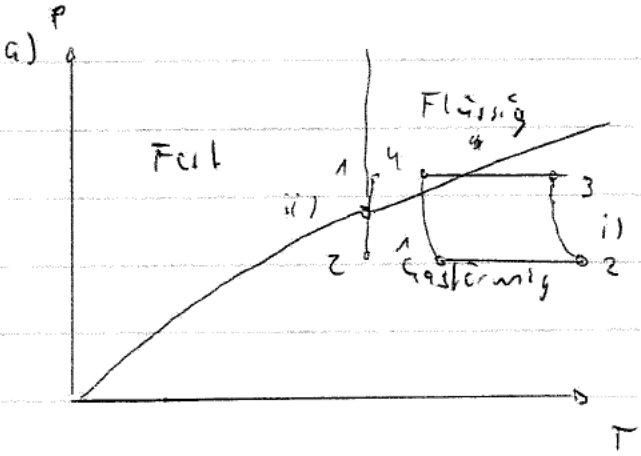
	[K] zu T_i	p [bar]	x	
1	-C			→ -GK zu T_i ← $\dot{Q}_K$
2			1	isentrop $s = const$
3		8		← $\dot{W}_K = 28\,kW$
4		8	0	isobar → $\dot{Q}_{Aff}$





5)

a)



b) $\dot{m}_{R,134a}$ → 2 → 3 isentrop → s = const

2 → gesättigter Kältemitteldampf

4 → 1 ~~isentrop~~ isenthalp

1. HS über 2 → 3 $\quad 0 = \dot{m}(h_2 - h_3) - \dot{W}_K$

b) $T_2 = -10°C - 6K = -16°C$

$0 =$

$s_2 = 0.9525\ kJ/kg\ K = s_3$

$s_3 \rightarrow$ in TAB A-9

zwischen 30 / 35 °C

$$\text{Lin int}: T_3 = 30 + \frac{0.9525 - 0.9414}{0.9574 - 0.9414}(35-30) = 30°C$$