[redacted]

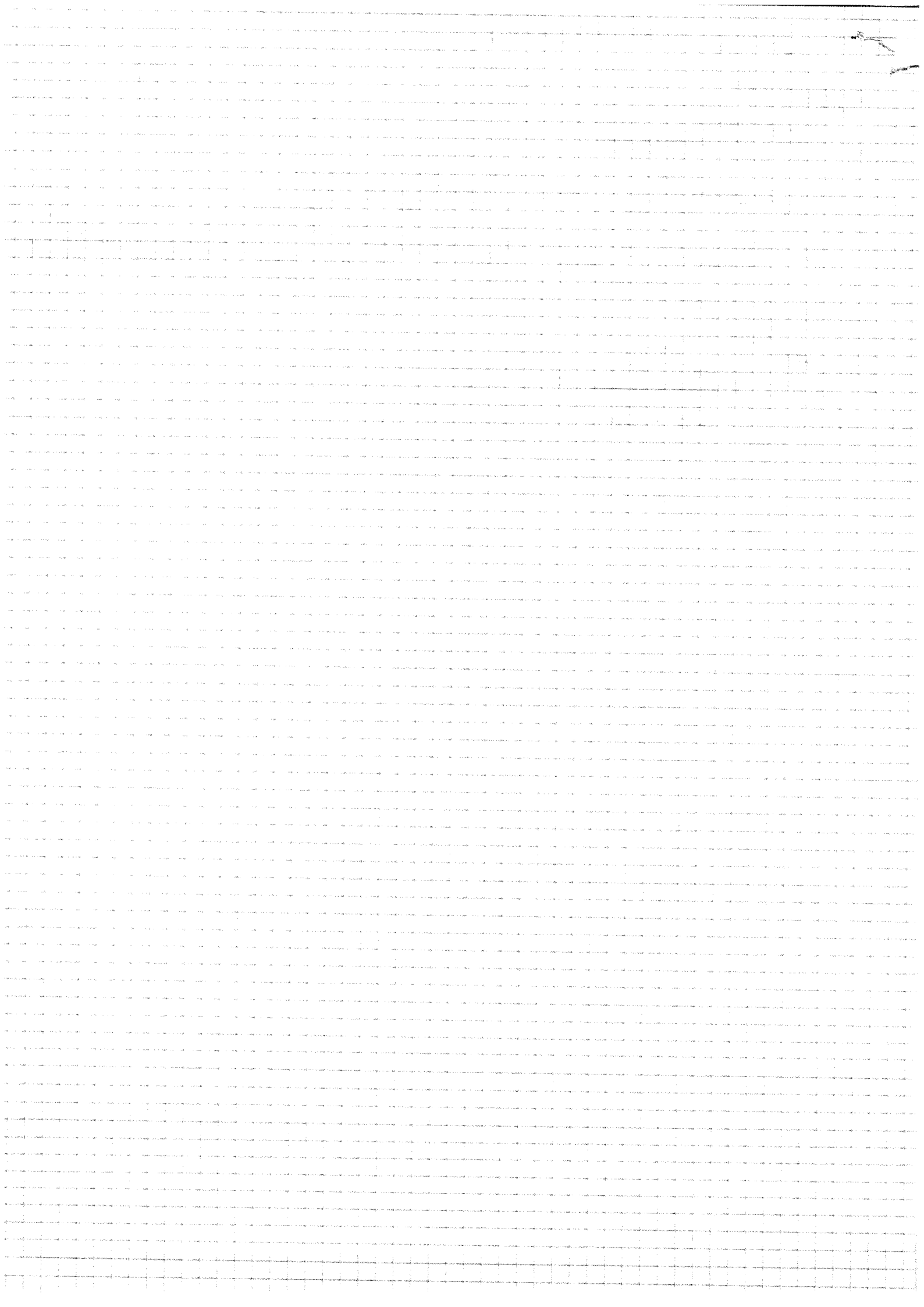
Aufgabe 1:

a) EB (fliessprozess):

$$0 = \dot{m}\,[h_{ein} - h_{aus}] + \dot{Q}_{aus}$$

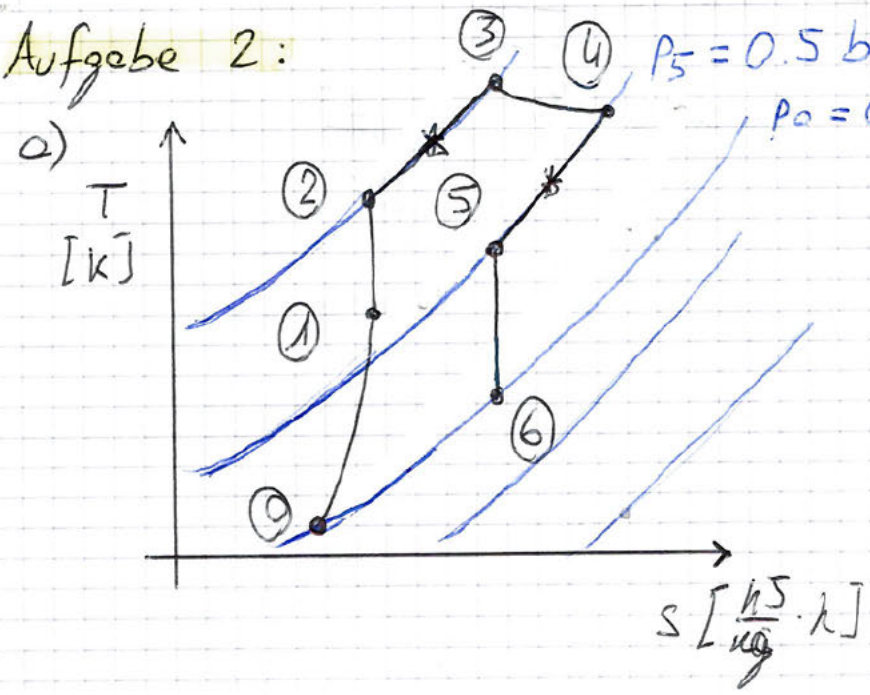
$$\hookrightarrow \dot{Q}_{aus} = \dot{m}\,[h_{aus} - h_{ein}] = \dot{m}\, c^{if}\,(T_{KF,as} - T_{KF,ein}) + \cancel{v^{if}\,(p_2 - p_1)}^{\,0}$$

b) $$\overline{T}_{KF} = \frac{\int_e^a T\,ds}{s_a - s_e} =$$



Aufgabe 2:

a)



$p_5 = 0.5$ bar

$p_a = 0.191$ bar

* = isobar

b) EB (fliessprozess 5-6):

$$0 = \dot{m}_{ges} \left[h_5 - h_6 + \frac{(w_5^2)}{2} - \frac{(w_6^2)}{2} \right]$$

$$\frac{w_6^2}{2} = c_p^{ig} (T_5 - T_6) + \frac{w_5^2}{2}$$

$$\rightarrow T_6 = T_5 \left(\frac{p_6}{p_5} \right)^{\frac{k-1}{k}} = 328.07 \text{ K}$$

$$\rightarrow w_6 = \sqrt{\left(c_p^{ig} (T_5 - T_6) + \frac{w_5^2}{2} \right) \cdot 2} = 507.25 \frac{m}{s}$$

c) $\Delta e_{x,stk} = e_{x,stk,a} - e_{x,stk,e} =$

$$= h_a - h_e - T_0 (s_a - s_e) + \Delta ke$$

↳ $\Delta ke = \frac{w_6^2}{2} - \frac{w_0^2}{2} = 108.651 \text{ J} = 108.651 \frac{kJ}{kg}$

↳ $h_a - h_e = c_p^{ig} (T_6 - T_0) = 85.430 \frac{kJ}{kg}$

↳ $s_a - s_e = c_p^{ig} \ln \left(\frac{T_6}{T_0} \right) - R \ln \left(\frac{p_6}{p_a} \right) = 0.301 \frac{kJ}{kg} \cdot K$

↳ $R = c_p^{ig} - c_v^{ig} = c_p^{ig} - \frac{c_p^{ig}}{k} = 0.2874 \frac{kJ}{kg K}$

$\Rightarrow \Delta e_{x,stk} = 120.89 \frac{kJ}{kg}$

d) $e_{x,Q} = \left(1 - \frac{T_0}{T}\right) q_B = 969.58 \frac{kJ}{kg}$

$\Rightarrow e_{x,verl} = -\Delta e_{x,stk} + e_{x,Q} = 848.69 \frac{kJ}{kg}$

Aufgabe 3:

a) $p_{g1} = p_{amb} + p_K + p_{EW}$

$\Rightarrow p_{amb} = 1\ bar$

$\Rightarrow p_K = \frac{m_K \cdot g}{\left(\frac{D}{2}\right)^2 \pi} = \frac{32\,kg \cdot 9.81\,ms^{-1}}{\left(\frac{0.10m}{2}\right)^2 \pi} = 39969\ Pa = 0.400\ bar$

$\Rightarrow p_{EW} = \frac{m_{EW} \cdot g}{\left(\frac{D}{2}\right)^2 \pi} = 124.9\ Pa = 1.25 \cdot 10^{-3}\ bar$

$\Rightarrow p_{g1} = 1.401\ bar$

$\Rightarrow m_g = \frac{p_{g1} V_1}{R T_1} = 3,42 \cdot 10^{-3}\ kg = 3.42\ g$

$\& R = \frac{\bar{R}\ \frac{J}{mol\,K}}{50\ \frac{kg}{kmol}} = 166.28\ \frac{J}{kg}$

b)

c) EB (Geschlossenes System):

$$m_2 u_2 - m_1 u_1 = Q_{12} - W_{12}$$

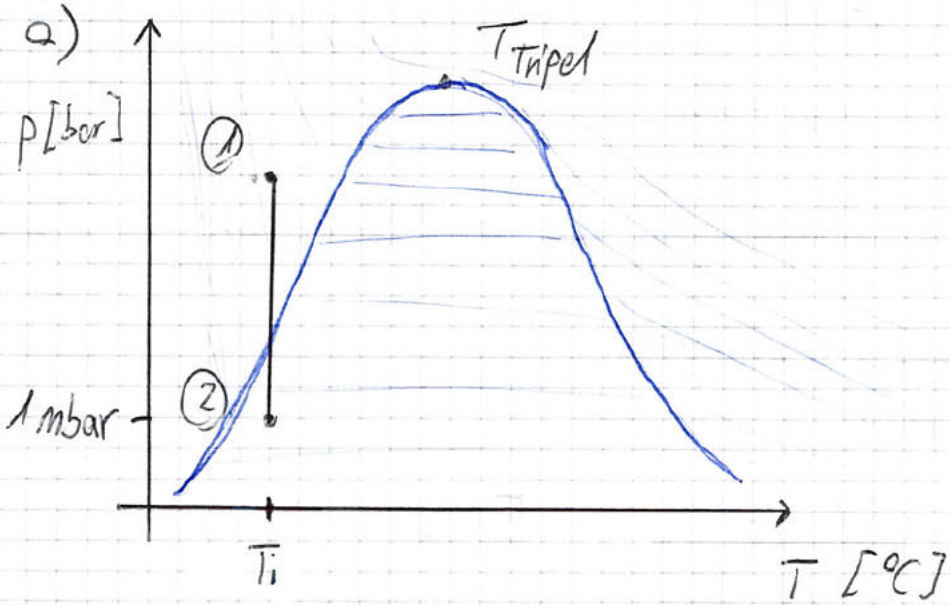
$$m_{TOT}\left(u^1_{EW} + u^1_{Gas} - u^2_{EW} - u^1_{Gas}\right) = Q_{12} - W_{12}$$

$$m_{TOT}\left(c_v \left(T_2 - T_1\right) + \right.$$

$$W_{12} = m \int_1^2 (\rho_0 + \rho_k)\, dv = m\,(\rho_0 + \rho_n)\cdot(v_2 - v_1)$$

Aufgabe 4:

a)



b) $T_2 = -10°C = 263.15\ K$

(von Graph)

$$h_2 = h_g(-10°) = \frac{h(-8) - h(-12)}{-8+12}(-10+12) + h(-12) =$$

↓ tab A-10

$$= 241.345\ \frac{kJ}{kg}$$

Isentrop

$s_2 \overset{\uparrow}{=} s_3$ tab A-10

$$\hookrightarrow s_2 = s_g(-10) \overset{\uparrow}{=} \frac{s(-8) - s(-12)}{-8+12}(-10+12) + h(-12) =$$

$$= 0.9253\ \frac{kJ}{kg}\cdot K$$

$$\hookrightarrow h_3(8\ bar, s_2) = \frac{h(40) - h(31.33)}{s(40) - s(31.33)}(s_2 - s(31.33)) + h(31.33) =$$

$$= 269.92\ \frac{kJ}{kg}$$

$\Rightarrow$ EB (Fließprozess):

$$\dot{m}_{R134A} = -W_{23} \cdot \frac{1}{h_2 - h_3} = 9.798 \cdot 10^{-4}\ \frac{kg}{s} = 3.52\ \frac{kg}{h}$$

c) $h_4(8\,bar) = h_f(8\,bar) = 93.42\ \frac{kJ}{kg}$

↓

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↳ Drossel Adiabat: $h_4 = h_1$

↳ $p_2 = p_1(-10°) = \frac{p(-12)+p(-8)}{2} = 2.0122\,bar \approx 2\,bar$

↳ $x_1 = \frac{h_4 - h_f(p_2)}{h_g(p_2) - h_f(p_2)} = 0.277$

d) $\varepsilon_K = \frac{\dot{Q}_{zu}}{\dot{W}_K} = \frac{146.42\ W}{28\ W} = 5.23$

EB (fließprozess):

$0 = \dot{m}[h_1 - h_2] + \dot{Q}_K$

↳ $\dot{Q}_K = \dot{m}[h_2 - h_1] = 146.42\ W$

e) Die Temperatur steigt