1) a) ges $\dot{Q}_{aus}$

~~KF:~~ ~~$U_2 - U_1 = \dot{Q}_{aus}$~~

$$0 = \dot{m}_{ein}(h_1 - h_2) + \dot{Q}_R + \dot{Q}_{aus}$$

$$\hookrightarrow \dot{Q}_{aus} = -\dot{Q}_R + \dot{m}_{ein}(h_2 - h_1) = \underline{-62\,kW}$$

① $T_1 = 70°C$ $h_1 = h_f \overset{A2}{=} 292.98\ kJ/kg$

② $T_2 = 100°C$ $h_2 = h_f \overset{A2}{=} 419.04\ kJ/kg$

b) $\bar{T}_{KF} = \dfrac{\int_1^2 T\,ds}{s_2 - s_1} = \dfrac{\int_1^2 T\,ds}{\int_{T_1}^{T_2} c_{if}\,dT} = \dfrac{\int_1^2 T\,ds}{c_{if}\left(\ln\left(\frac{T_2}{T_1}\right)\right)}$

$h_2 - h_1 = c_{if}(T_2 - T_1)$

$c_{if} = const.$

$$= \frac{T_2 - T_1}{\ln\left(\frac{T_2}{T_1}\right)} = \underline{293.12\,K}$$

c) $\dot{S}_{ers} = \dot{S}_{KF,ers} + \dot{S}_{Reaktor,ers}$

$$\dot{S}_{KF,ers} = s_2 - s_1 - \frac{\dot{Q}}{\bar{T}_{KF}}$$

$$\dot{S}_{Reaktor,ers} = -\frac{\dot{Q}}{\bar{T}} + \dot{m}(s_2 - s_1) = \underline{4.25\ W/K}$$

$s_1 \overset{A2}{=} s_f = 0.9549\ kJ/kgK$

$s_2 \overset{A2}{=} s_f = 1.3069\ kJ/kgK$

$\bar{T} = T_{Reaktor} = 100°C$

$\dot{Q} = \dot{Q}_R + \dot{Q}_{aus}$

d) $T_{Reaktor,2} = 70°C$

$$\underbrace{m_2 u_2}_{(\Delta m_{12} + m_1)} - m_1 u_1 = \Delta m_{12}(h_{ein}) + \dot{Q}_{aus,12}$$

$$\Rightarrow \Delta m_{12} = \frac{1}{u_2 - h_{ein}} \left(\dot{Q}_{aus,12} + m_1 u_1 - m_1 u_2 \right) = 4121.50\,kg$$

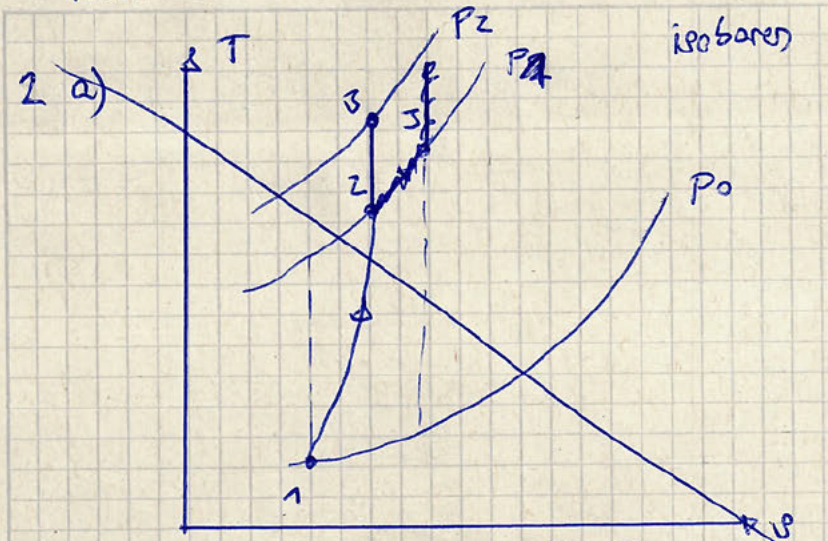
$$h_{ein} \overset{AZ}{=} h_f(20°C) = 83.96\,kJ/kg$$

$$T_1 = 100°C \quad u_1 \overset{AZ}{=} u_f + x(u_g - u_f) = 429.577\,kJ/kg$$

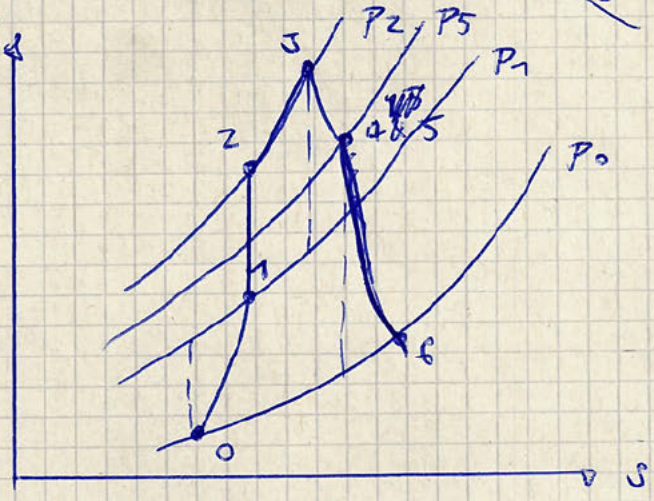
$$u_2 \overset{AZ}{=} u_f(70°C) = 292.95\,kJ/kg$$

e) 

2 a)



2) a)



b) w_6, T_6

$$0 = \dot{m}\left(h_5 - h_6 + \frac{w_5^2 - w_6^2}{2}\right) - \dot{W}_{56}$$

unit

$$\frac{\dot{W}_{56}}{\dot{m}} = -\int_5^6 v\,dp + \Delta p_e$$

isobar

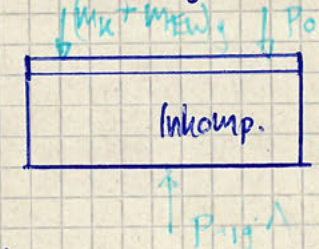
↳ $$h_5 - h_6 + \frac{w_5^2 - w_6^2}{2} = 0$$

↳ $$w_6 = \sqrt{2\cdot(h_6 - h_5) + w_5^2} = \sqrt{2 c_p (T_6 - T_5) + w_5^2}$$

$$= \underline{507.25 \ \frac{m}{s}}$$

$$T_6 = T_5 \cdot \left(\frac{P_6}{P_5}\right)^{\frac{n-1}{n}} = \underline{328.07\ K}$$

3) a) p_{g1}, m_g



$$(m_K + m_{EW})g + p_0 A = p_{1g} \cdot A \quad (1)$$

mit $A = \left(\frac{D}{2}\right)^2 \cdot \pi = \frac{\pi}{400}$

(1) $\rightarrow$ $p_{1g} = p_0 + \frac{(m_K + m_{EW})g}{A} = \underline{1.401\ \text{bar}}$

$$p_{1g} \cdot V_{g1} = m_g \cdot R \cdot T_{g1}$$

mit $R = \frac{\bar{R}}{M_g} = \frac{166.28}{[illegible]}\ \text{J/kgK}$

$\rightarrow$ $m_g = \frac{p_{1g} V_{1g}}{R \cdot T_{g1}} = \underline{3.4217\ \text{g}}$

b) $x_{Eis,2} > 0$

ges $T_{g,2}$, $p_{g,2}$

$p_{g,2} = p_{g,1}$ da das Wasser inkompressibel ist und das Eis beim Schmelzen zu keiner Volumenänderung führt. Das EW ist also isochor und die Gleichung (1) aus a) ist die selbe für b).

~~$p_{2g} \cdot V_{g,2} = m_g R T_{g,2}$~~

$\rightarrow$ $\frac{T_{g,2}}{T_{g1}} = [illegible] = \left(\frac{V_1}{V_2}\right)^{n-1}$

$\rightarrow$ $T_{g,2} = T_{g,1} \cdot [illegible] \cdot \left(\frac{V_1}{V_2}\right)^{n-1}$ (2)

$$p_{2,g} \cdot V_{g,2} = m_g \cdot R \cdot T_{g,2} \rightarrow V_{g,2} = \frac{m_g R \cdot T_{g,2}}{p_{2,g}} \quad (3)$$

(3) $\rightarrow$ (2): $T_{g,2} = T_{g,1} \cdot \frac{m_g \cdot R \cdot T_{g,2}}{p_{2,g} \cdot V_1}$

$T_{g,2} = 0.005\,°C$

c) ges Q_{12}

g: $U_2 - U_1 = Q_{12}$

↳ $Q_{12} = m_g \cdot c_v (T_2 - T_1) = \underline{-1.0830\,kJ}$

d) ges $x_{Eis,2}$

$T_{EW,2} = 0.005\,°C$

EW: $U_2 - U_1 = -Q_{12}$

↳ $U_2 = U_1 - Q_{12}$

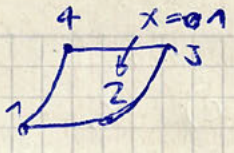
$U_2 = U_1 - \frac{Q_{12}}{m_{EW}}$

mit $x_1 = 0.6,\ T_{EW,1} = 0°$

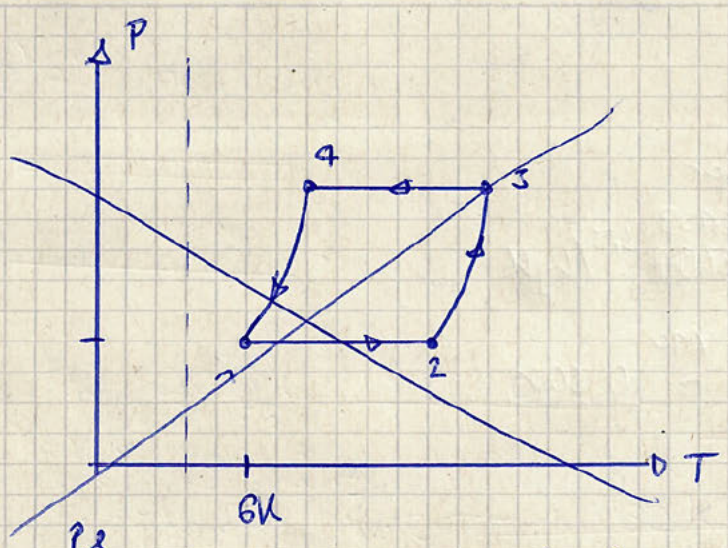
Tab1: $U_1 = U_f + x \cdot (U_g - U_f) = -133.41\ kJ/kg$

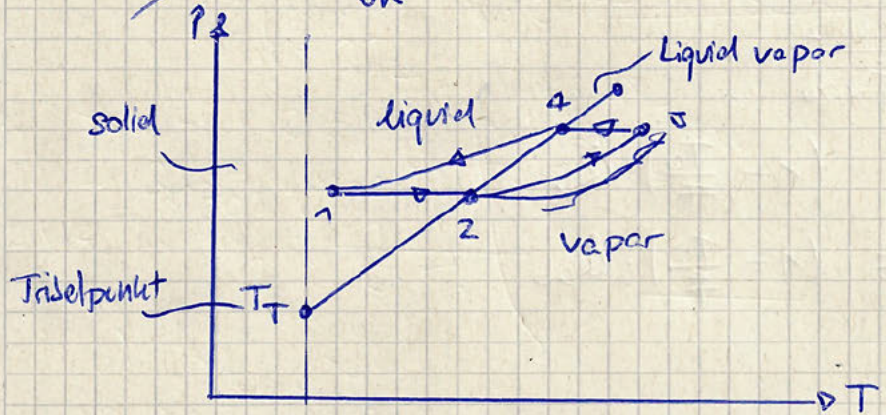
↳ $U_2 = U_1 - \frac{Q_{12}}{m_{EW}} = -122.5805\,kJ/kg$

Tab1: $x_2 = \frac{U_2 - U_f}{U_g - U_f} = \underline{0.9989}$ ~



4) a)





5) gas $\dot{m}_{R134a}$

2S: $0 = \dot{m}(h_2 - h_3) - \dot{W}_K$

↳ $\dot{m} = \dfrac{\dot{W}_K}{h_2 - h_3} = \underline{0.7437\ kg/s}$

② ~~p~~ $s_2 = s_3$, $p_1 = p_2$, $x = 1$

① $s_1 = s_4$

③ $p_3 = 8bar$

④ $x = 0$, $p_4 = 8bar$

mit $T_2 = -22°C$ aus Lösung

↳ $h_2 \overset{A10}{=} h_g = \underline{234.08\ kJ/kg}$

$s_3 \overset{A10}{=} s_2 = 0.8351\ kJ/kgK$

↳ $h_3 \overset{A12}{=} \dfrac{h(40°C, 8bar) - h(Sat., 8bar)}{s(40°C, 8bar) - s(Sat, 8bar)} (s_3 - s(Sat, 8bar)) + h(Sat, 8bar)$ interp.

$= \underline{271.72\ kJ/kg}$

c) x_1

$p_1 = p_2 \overset{A10}{=} 1.2192 \text{ bar}$

$s_1 = s_4 \overset{A10}{=} s_f = 0.3459 \text{ kJ/kgK}$

↳ $x_1 = \frac{s_4 - s_f}{s_g - s_f} \overset{A10}{=} \underline{0.3031}$

d) ε_K

$\varepsilon_K = \frac{\dot{E}_{x,Nutz}}{\dot{E}_{x,zu}}$

↳ $\dot{E}_{x,zu} = \left(1 - \frac{T_0}{T}\right) \cdot \dot{Q}_K$

$\dot{E}_{x,Nutz} = \left(1 - \frac{T_0}{T}\right) \cdot \dot{Q}_{ab}$

e) Wenn nicht isotherm würde der Druck immer steigen.