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

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

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

- $h_{ein} = h_f(70°C) = 292.98 \frac{kJ}{kg}$ A2
- $h_{aus} = h_f(100°C) = 419.04 \frac{kJ}{kg}$ A2
- $\dot{Q}_{aus} = \underline{62.182\ kW}$

1b) $$\overline{T}_{kf} = \frac{\int_e^a T\, ds}{s_a - s_e} = \frac{T_{kf,aus} - T_{kF,ein}}{s_{aus} - s_{ein}}$$

$s_{aus} = s_f(15°C) = 0.2245 \frac{kJ}{kg\,K}$ A2

$s_{ein} = s_f(25°C) = 0.3674 \frac{kJ}{kg\,K}$ A2

$$T_{kf} = \frac{T_{kF\,ein} - T_{kF\,aus}}{s_{aus} - s_{ein}} = \underline{70°C}$$

1.c) $0 = \dot{m}_{ein}(s_e - s_a) + \frac{\dot{Q}_{aus}}{T_{kF}} + \dot{S}_{erz}$

$$\dot{S}_{erz} = \dot{m}_{ein}(s_a - s_e) - \frac{\dot{Q}_{aus}}{T_{kF}}$$

$s_a = s_f(100°C) = 1.3069 \frac{kJ}{kg\,K}$

$s_e = s_f(70°C) = 0.9549 \frac{kJ}{kg\,K}$

$$\dot{S}_{erz} = -0.105 \frac{kJ}{K}$$

1d) Δm_{12}

$$\Delta m_{12}(u_2 - u_1) = \Delta m_{12}(h_1 - h_2) - Q_{aus}$$

$$\Delta m_{12}(u_2 - u_1 + h_2 - h_1) = -Q_{aus}$$

$$\Delta m_{12} = \frac{-Q_{aus_{12}}}{u_2 - u_1 + h_2 - h_1} = 83.7\,kg$$

$h_1 = h_f(20°C) = 83.96 \frac{kJ}{kg}$ A2

$h_2 = h_f(70°C) = 292.98 \frac{kJ}{kg}$ A2

$u_1 = u_f(20°C) = 83.96 \frac{kJ}{kg}$ A2

$u_2 = u_f(70°C) = 292.95 \frac{kJ}{kg}$ A2

1e) $\Delta S_{12} =$ ~~$m(s_2 - s_1)$~~

$$\Delta S_{12} = \Delta m_{12}(s_2 - s_1) + \frac{Q_{ans,12}}{\overline{T}}$$

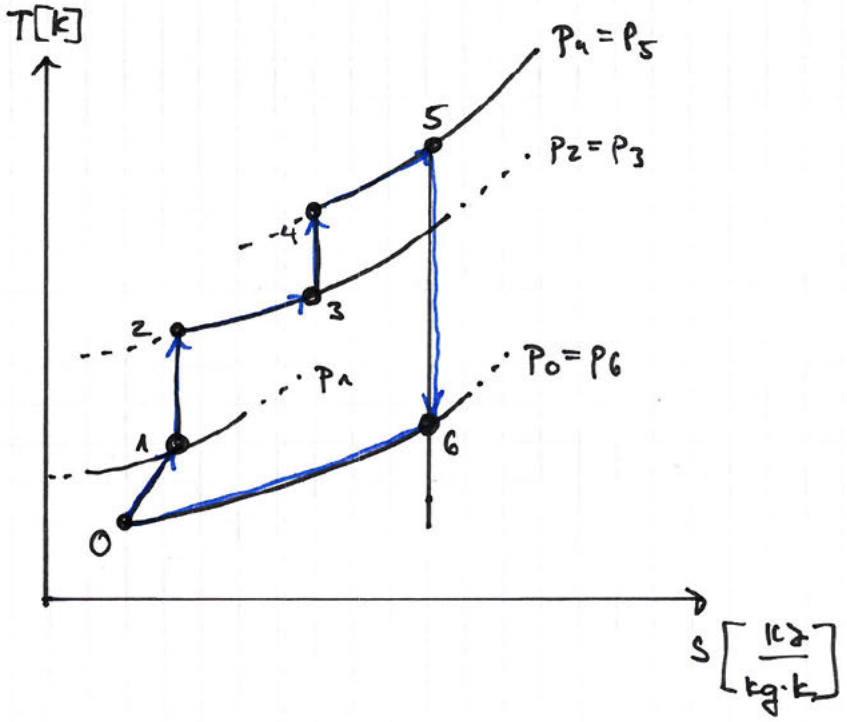
$s_1 = s_f(20°C) = 0.2966 \ \frac{kJ}{kg\,K}$ A2

$s_2 = s_f(70°C) = 0.9549 \ \frac{kJ}{kg\,K}$ A2

$\overline{T} = 295\,K$

$\Delta S_{12} = 2.5 \ \frac{MJ}{kg \cdot K}$

2a)



2b) w_6 , T_6

- $T_6 = T_5 \left(\frac{p_0}{p_5}\right)^{\frac{n-1}{n}} = \underline{328\ K}$

$n = 1.4$

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

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

$$w_6 = \sqrt{2 \cdot \left(h_5 - h_6 + \frac{w_5^2}{2} \right)}$$

$$w_6 = \sqrt{2 \cdot \left(c_p (T_5 - T_6) + \frac{w_5^2}{2} \right)} = \underline{507.4\ \frac{m}{s}}$$

2c) $\Delta_{exstr} = e_{x_{str\,6}} - e_{x_{str\,0}}$

$$\dot{E}_{x_{str}} = \dot{m}\left(h - h_0 - T_0(S - S_0) + p_0(v - V_0)\right)$$

$$\Delta_{exstr} = \dot{m}\left(h_6 - h_0 - T_0(S_6 - S_0) + p_0(V_6 - V_0)\right)$$

$V_6 \approx V_0$

$$h_6 - h_0 = C_p(T_6 - T_0)$$

$$S_6 - S_0 = C_p \ln\left(\frac{T_6}{T_0}\right)$$

$$\Delta_{exstr.} = \dot{m}\left(C_p(T_6 - T_0) - T_0\left(C_p \ln\left(\frac{T_6}{T_0}\right)\right) + p_0(V_6 - V_0)\right)$$

3a) p_{g1} , m_g

$$p_{g1} = p_0 + \frac{(m_k + m_{EW}) \cdot g}{\pi (\frac{d}{2})^2} = \underline{1.4 \text{ bar}}$$

$$m_g = \frac{p_{g1} \cdot V_{g1}}{R \cdot T_{g1}} = \underline{5.29 \text{ g}}$$

$$R = \frac{\overline{R}}{M_g} = 166.29 \; \frac{J}{kg \cdot K}$$

~~3b)~~ p_{g2} & T_{g2} werden sich beide linear verringern, da gemäss Annahme das Wasser inkompressibel ist.

~~V_{12}~~

3b) $p_{g2} \stackrel{!}{=} p_{g1}$, da die Masse, die auf den Zylinder wirkt immernoch die selbe ist.

~~$V_{g2} = \frac{V_{g1}}{m_g} = 0.5934 \frac{m^3}{kg}$~~

T_{g2} wird sich gegen 0°C abkühlen, da durch die Membran ein Wärmeaustausch stattfindet.

3c) Q_{12}

$$\Delta E = m_g(u_2 - u_1) = -Q_{12}$$

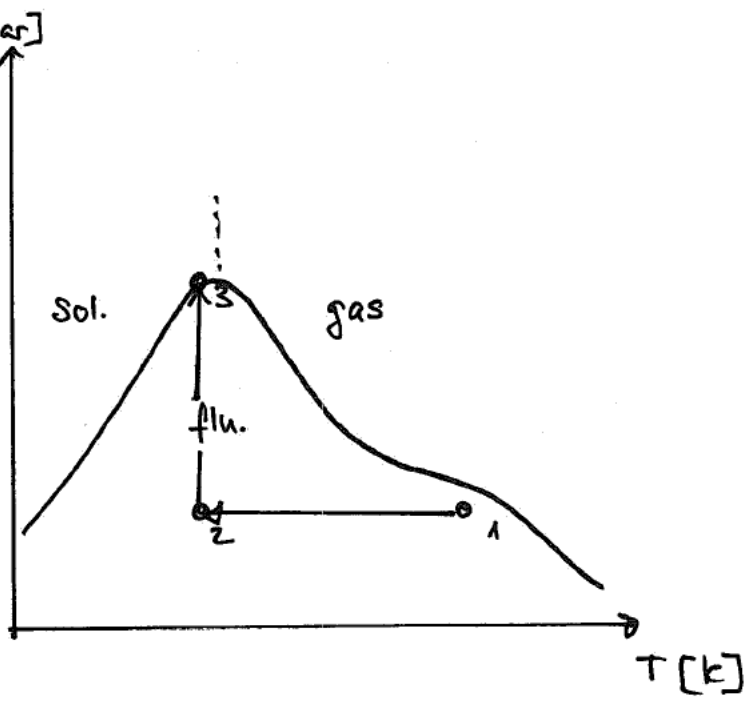
$$= m_g(c_v(T_2 - T_1)) = -Q_{12}$$

$$Q_{12} = -m_g\, c_v (T_2 - T_1) = \underline{1674.3\ J}$$

($T_2 = 0.003°C$)

~~3d~~

4a)



4b) $$\dot{m}_R = \frac{\dot{W}_K}{W_{rev}^{23}}$$

$$W_{rev}^{23} = -\left(\int_1^2 p\, dv\right)$$

4c) $$s_4 = s_1$$

$$s_4\,(8\,bar)_g = 0.9066\ \frac{kJ}{kg\,K}$$

$$x_1 = \frac{s_4 - s_f\ (\text{[redacted]})}{s_g - s_f}$$

4d) $$\varepsilon_k = \frac{|\dot{Q}_{zu}|}{|\dot{w}_+|}$$

$$\varepsilon_k = \frac{|\dot{Q}_k|}{|\dot{w}_k|}$$