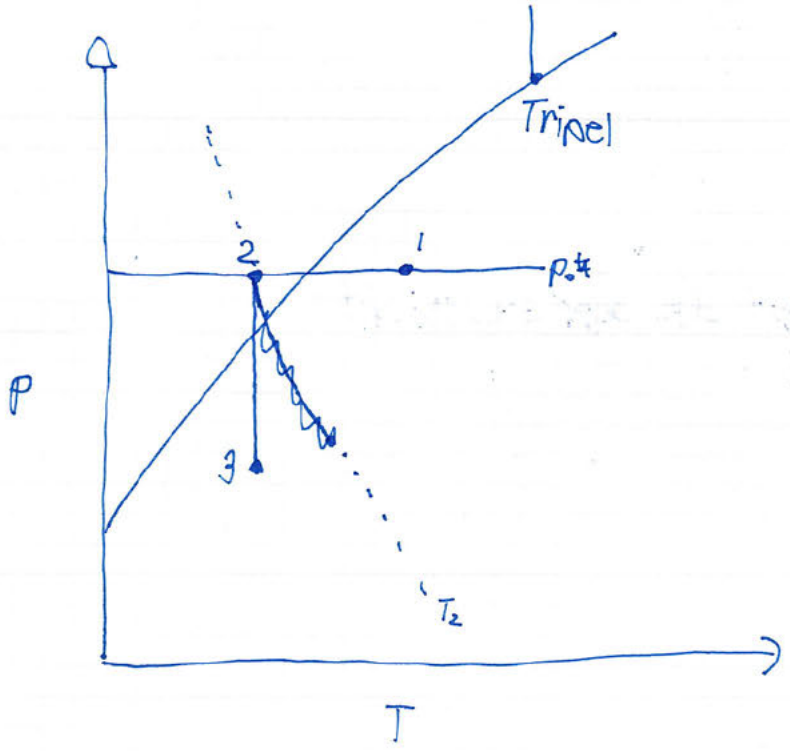
4a)



b)

$$0 = \dot{m}(h) + \dot{Q} - \cancel{\dot{W}}^{0}$$

$$0 = \dot{m}(h) + \cancel{\dot{Q}}^{0} - W$$

$$W = \dot{m}(h_2 - h_3)$$

$$\dot{m} = \frac{W}{h_2 - h_3} =$$

$h_2 = h_g(T = -6) =$

isentrop: $s_3 = s_2$

$$\left(\frac{p_3}{p_2}\right)^{\frac{n-1}{n}} = \frac{T_3}{T_2} \Rightarrow T_2 = T_3\left(\frac{p_2}{p_3}\right)^{\frac{n-1}{n}}$$

d)

$$\varepsilon = \frac{Q_{2k}}{W_t} = \frac{\dot{Q}_K}{\dot{W}_K} =$$

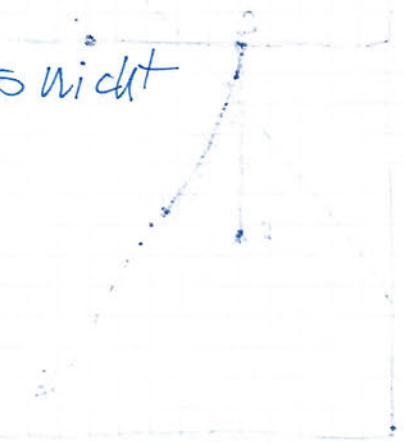
TA

5) $s_4 = s_1$ ✗

$s_4 = s_f$ ✓

$$x = \frac{s_4 - s_f}{s_g - s_f}$$

e) der Kreislauf wird gestoppt da es nicht mehr verdichtet wird



1a) ~~0~~ $0 = \dot{m}(h) + \dot{Q} - \cancel{\dot{W}^{0}}$ isobar

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

~~$\dot{Q} = \dot{m}\, c_p (T_{ein} - T_{aus})$~~

hein $\dot{Q} = \dot{m}\, c_p (T_{aus} - T_{ein})$

cp

$\dot{Q}_{1,TA-2} = \dot{m}(h_{ein} - h_{aus}) = 14.82\,kW$

$h_{ein} = h_{g}(T=20°C) = 2626.8\,kJ/kg$

$h_{aus} = h_{g}(T=100°C) = 2676.2\,kJ/kg$

$\Rightarrow \dot{Q}_{aus} = \dot{Q}_R + \dot{Q}_1 = 100 - 14.82 = 85.18\,kW$

b) $T_k = \frac{T_2 - T_1}{\ln(\frac{T_2}{T_1})} = 156.28\,K$

QA $\dot{Q} = \dot{m}(s) + \frac{\dot{Q}}{T} + \dot{S}_{erz}^{0}$

$T = -\frac{\dot{m}(s)}{\dot{Q}} =$

65kW

c) $\dot{S}_{erz} = -\dot{m}(s) - \frac{\dot{Q}}{T} = -m(s_1 - s_2) - \frac{\dot{Q}_R}{T} + \frac{\dot{Q}_{aus}}{T}$

$T = 295$

$= -0.238$

$s_{1g} = 7.7553$

$s_{2g} = 7.3549$

d) QAM

$\Delta E = \dot{m}(h) + \dot{Q} - \cancel{\dot{W}^{0}}$

$m_2 u_2 - m_1 u_1 = \Delta m_{21}(h_{ein}) + \dot{Q}$

$m_2 = m_1 + \Delta m_{12}$

$u_2 = u_g(70°C) = 2469.6$

$u_1 = 2402.9$

$h_{ein} = 2538.1$

$\dot{Q} = 35\,MJ$

~~$\Delta m_{21} = \frac{1}{h_{ein}}(m_2 u_2$~~

~~$\Delta m_{21}(h_{ein} - m_2) = m_1 u_1$~~

$m_1(u_2 - u_1) = \Delta m_{21}(h_{ein} - u_2) + \dot{Q} \Rightarrow \Delta m_{21} = \frac{m_1(u_2 - u_1) - \dot{Q}}{h_{ein} - u_2}$

$= 5092.8\,kg$

e) $\Delta S_{12} = m_2 s_2 - m_1 s_1$

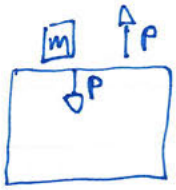
$\Delta m_{12} = 3600 kg =$

$m_2 = 9355$

3a) perfektes gas:

$pV = mRT \Rightarrow m = \frac{pV_{vol}}{RT} = 3.42\,kg$

$R = \frac{\bar{R}}{M} = 0.16628$



$F_g + p_0 A = p_G A$

$p_G = \frac{F_g}{A} + p_0 = 1.46\,bar$

$F_g = 9.81 \cdot (m_K + m_{Ew}) = 314.901\,N$

$A = 0.00785\,m^2$

b) $V_1 = V_2 \Rightarrow V_1 = \frac{V}{m} = 0.0314$

$\frac{T_2}{T_1}$

$x = \frac{V_1 - V_f(T_2)}{V_g(T_2) - V_f(T_2)} =$

$\Delta U = Q$

$\Rightarrow m(u_2 - u_1) = mc_p(T_2 - T_1)$

c) inkompressibel

$\Delta E = \dot{m}(h) + \dot{Q} - \dot{W}$

$Q_{12} = m c_v (T_2 - T_1) = 1899\,J$

$c_p = R + c_v = 0.29928$

d) $\Delta E = \dot{Q} \Rightarrow m_2 u_2 - m_1 u_1 = \dot{Q}$

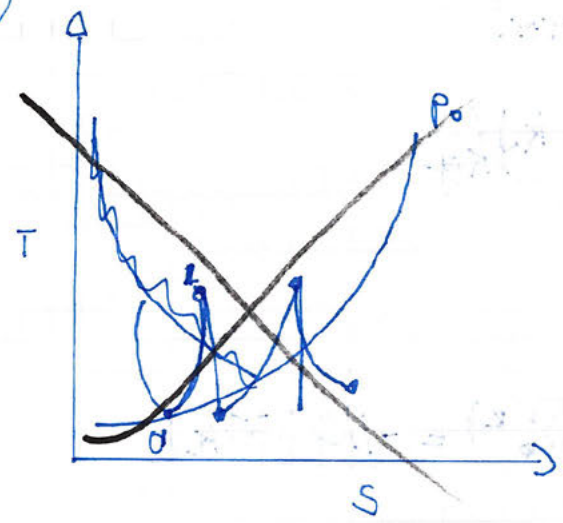
$u_2 = u_f + x(u_g - u_f)$

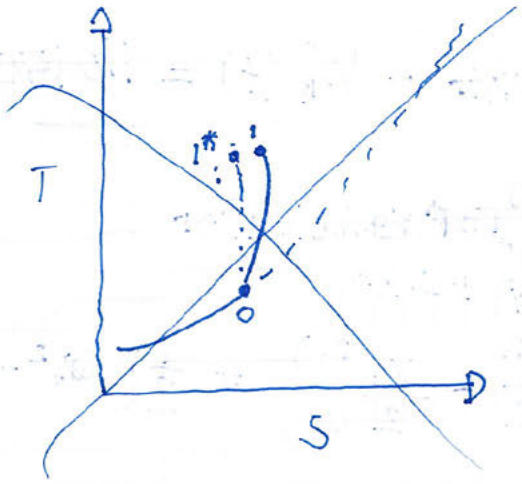
$\Rightarrow m_2(u_f + x(u_g - u_f)) = m_1 u_1 + \dot{Q}$

$\Rightarrow x = \frac{1}{m_2(u_g - u_f)}\left(m_1 u_1 + \dot{Q}\right) - u_f$

$u_g =$

2a)





b)

$0 = \dot{m}(h) + \cancel{\dot{Q}} - \cancel{\dot{W}}$ isobar

$\cancel{\dot{Q}}^{0} = -\dot{m}\left(h_0 - h_6 + \frac{w_0^2}{2} - \frac{w_6^2}{2}\right) \Rightarrow -\dot{m}\left(c_p^{ig}(T_0 - T_6) + \frac{w_0^2}{2} - \frac{w_0^2}{2}\right)$

$\frac{w_1^2}{2} - \frac{w_0^2}{2} = -c_p^{ig}(T_0 - T_6)$

$w_1 = \sqrt{w_0^2 - 2c_p(T_0 - T_6)}$

$= 200.48\ m/s$

$mRT = p \cdot V$

$\frac{m_1 R T_1}{p_1 V_1} = \frac{m_2 R T_2}{p_2 V_2}$ (*)

isochor / polytrop.:

$\frac{T_6}{T_0} = \left(\frac{p_6}{p_0}\right)^{\frac{n-1}{n}} \Rightarrow T_0 = T_6 = 340$

c) $e_{xstr} = (h_6 - h_0 - T_0(s_6 - s_0) + kc)$ isobar

$= c_p(T_6 - T_0) - T_0\left(c_p \ln\left(\frac{T_6}{T_0}\right) - R \ln\left(\frac{p_6}{p_0}\right)\right) + \frac{w_6^2}{2} - \frac{w_0^2}{2}$

$= \ldots$

d) $0 = \dot{e}_{xstr} + \dot{e}_{xq} - W_n(t) - \dot{E}_{xverl}$

$\dot{e}_{xverl} = \dot{e}_{xstr} - W_n(t) = 110150\ kJ/kg$

~~$W_n(t) = P_{voor verdichter}$~~

$W_n = -\int_2^0 v\,dp + \Delta ke$

$= -\left(\frac{\omega_6^2}{\omega_2} + \frac{\omega_0^2}{2}\right) = \frac{1}{2}(\omega_0^2 - \omega_6^2) = -110050\ kJ$

b)

$\ast\ \frac{T_6}{T_5} = \left(\frac{P_6}{P_5}\right)^{\frac{n-1}{n}} \Rightarrow T_6 = T_5\left(\frac{P_6}{P_5}\right)^{\frac{n-1}{n}}$

$= 328.07\ K$

$\ast\ 0 = \dot{m}(h) + \dot{Q} - W$

$W = \dot{m}(h_5 - h_6) + \frac{\omega_5^2}{2} - \frac{\omega_6^2}{2}$

$c_p(T_5 - T_6) = \frac{\omega_6^2}{2} - \frac{\omega_5^2}{2} \Rightarrow \omega_6 = \sqrt{2c_p(T_5 - T_6) + \omega_5^2} = 220.47\ m/s$

$\Rightarrow \omega_6 = \omega_5 = 220\ m/s$

adiabat & reversibel : isentrop $\Rightarrow S_6 = S_5$

$0 = \int_{T_5}^{T_6} \ln\left(\frac{T_6}{T_5}\right) c_p - R\ln\left(\frac{P_6}{P_5}\right)$

$\Rightarrow T_5 = T_6$

2a)