Aufgabe 1:

a)

$\dot{m} = 0,3 \; kg/s$

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

Tabelle A2:

$h_{ein} = h_f (70°C) = 292,98 \; \frac{kJ}{kg}$

$h_{aus} = h_f (100°C) = 419,04 \; \frac{kJ}{kg}$

$\dot{Q}_{aus} = -62,181 \; kW$

b)

$$\overline{T} = \frac{\int_e^a T \, ds}{s_a - s_e} = \frac{c_{pF} (T_a - T_e)}{c_{pF} \ln\left(\frac{T_a}{T_e}\right)} = 293,12 \; K$$

$T_a = \# T_{kF,aus} = 298,15 \; K$

$T_e = T_{kF,ein} = 288,15 \; K$

Aufgabe 1:

c)

$$0 = \dot{m}_{ein}\,(s_e - s_a) + \frac{\dot{Q}_{aus}}{\bar{T}_{kF}} + \frac{\dot{Q}_R}{\bar{T}_R} + S_{erz}$$

$$S_{erz} = \dot{m}_{ein}(s_a - s_e) - \frac{\dot{Q}_{aus}}{\bar{T}_{kF}} \quad \frac{\dot{Q}_R}{\bar{T}_R}$$

$$S_{erz} = -\frac{\dot{Q}_{aus}}{\bar{T}_{kF}} = 0{,}212\ \frac{kJ}{kg}\,K$$

d)

$$m_2 u_2 - m_1 u_1 = \circ m_{12}\, h_{ein}$$

Tabelle A-2 für u_{1f}, u_{1g}, $u_f(70°C)$, h_{ein}

$$u_{1f} = 418{,}94\ \frac{kJ}{kg} \qquad u_{1g} = 2506{,}4\ \frac{kJ}{kg}$$

$$u_1 = u_{1f} + x_0\,(u_{1g} - u_{1f}) = 429{,}38\ \frac{kJ}{kg}$$

$$u_2 = u_f\,(70°C) = 292.95 \qquad h_{ein} = 83{,}96\ \frac{kJ}{kg}$$

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

$$\circ m_{12} u_2 + m_1(u_2 - u_1) = \circ m_{12}\, h_{ein}$$

$$\frac{m_1 (u_2 - u_1)}{h_{ein} - u_2} = \circ m_{12}$$

$$\circ m_{12} = 3756{,}9\ kg$$

Aufgabe 1:

e)

$$\Delta s_{12} = s_2 - s_1$$

Tabelle A-2:

$$s(100°C)_f = 1,3069 \frac{kJ}{kg} K \quad s(100°C)_g = 7,3545 \frac{kJ}{kg} K$$

$$s(70°C)_f = 0,955 \frac{kJ}{kg} K$$

$$s_1 = s_f + x_0 (s_g - s_f) = 1,337 \frac{kJ}{kg} K$$

$$s_2 = 0,955 \frac{kJ}{kg} K$$

$$\Delta s_{12} = s_2 - s_1 = -0,382 \frac{kJ}{kg} K$$

Aufgabe 3

c)

$T_{G1} = 500°C \qquad T_{G2} = 0,003°C$

$\dot{m}\, c_w\, (T_2 - T_1) = Q_k$

$Q_k = 0,85\ kJ$

d)

$u_{1\,Ew} = u(0°C, \ldots)$

$u_{1\,Ew} = u_{flüssig} + x_{Eis}\,(u_{fest} - u_{flüssig})$

$u_{1\,Ew} = -200,0928$

$m_w\,(u_{2\,Ew} - u_{1\,Ew}) = Q_k$

$u_{2\,Ew} = \frac{Q_k}{m_w} + u_{1\,Ew}$

$u_{2\,Ew} = -191,6$

$-191,6 = -0,033 + x_{Eis}\,(-333,442 + 0,033)$

$x_{Eis_2} = \underline{0,575}$

Aufgabe 3:

a)

$$A_{Zylinder} = 0{,}1\,m^2 \cdot \pi = 0{,}0314\,m^2$$

$$p = \frac{N}{m^2}$$

$$F_{aussen} = 10^5\,Pa \cdot 0{,}0314\,m^2 + 32\,kg \cdot 9{,}81\,m/s^2$$
$$= 3455{,}5\,N$$

$$p_{innen} \cdot A_{Zylinde} = 3455{,}5\,N$$

Pinnen $p_{G1} = \underline{1{,}1\,bar}$

$$M = 50\,\frac{kg}{kmol} \qquad R = \frac{\bar{R}}{M} = 166{,}28\,\frac{J}{kg\,K}$$

$$\frac{p\,V}{R\,T} = m_{g1} = \underline{2{,}687\,g}$$

b)

$$E_1 = E_2$$

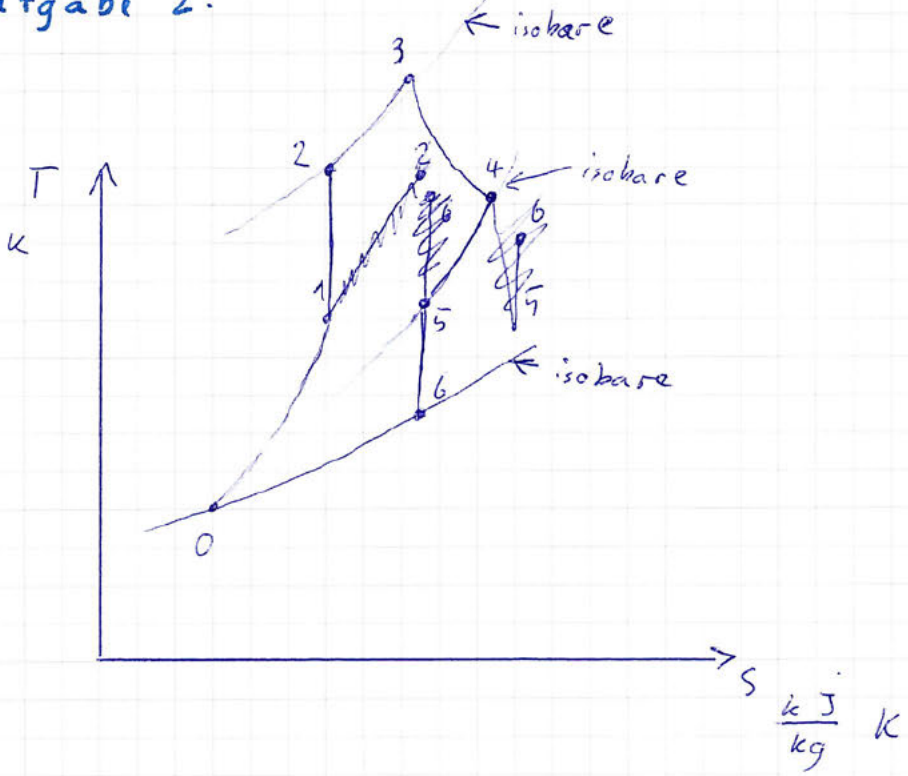
$$\Delta E_{12\,g} = \Delta E_{12\,w}$$

$$m_G\,c_v\,(T_2 - T_1) = \Delta E_{12\,w} = m_w\,(u_2 - u_1)$$

[redacted]

Aufgabe 2:

a)



b) $w_5 = 220\ m/s$

$p_5 = 0{,}5\ bar$ $\quad p_6 = 0{,}191\ bar$

$T_5 = 431{,}9\ K$

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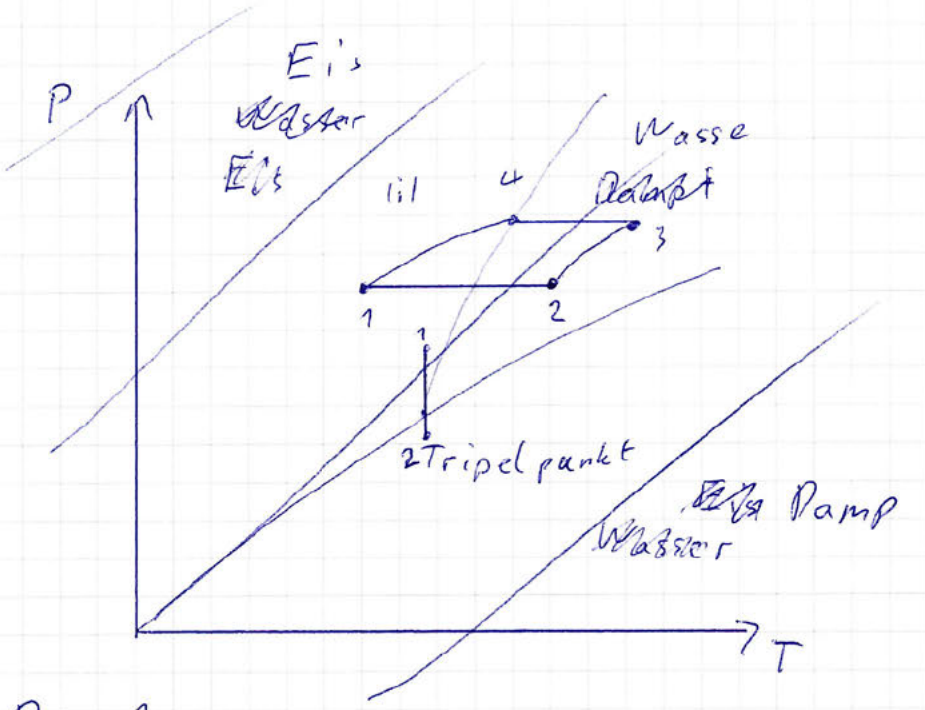
$$\frac{T_6}{T_5} = \left(\frac{p_6}{p_5}\right)^{\frac{1{,}4-1}{1{,}4}}$$

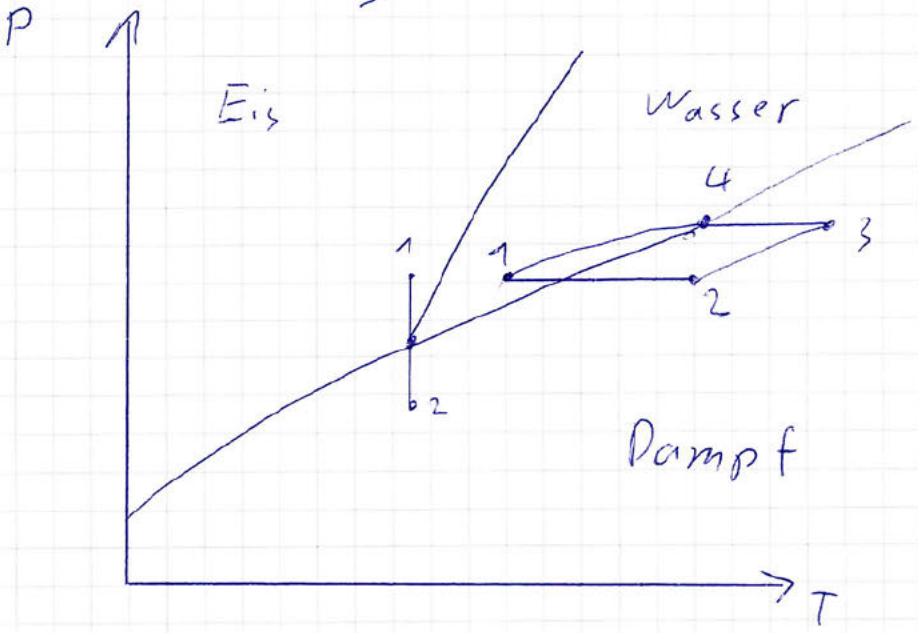
$$T_6 = 328{,}075\ K$$

[redacted]

Aufgabe 4:

a)





b)

$T_i = -10°C$

~~$T_{Wi} = 16K$~~ $T_V = -16K$

[redacted]