1.

a) $\dot{Q}_{aus}$? $\quad 0 = \dot{m}_{ein}(h_{ein} - h_{aus} + \cancel{h_{KF,ein}} - \cancel{h_{KF,aus}}) + \dot{Q}_R - \dot{Q}_{aus}$

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

A-2: $h_{ein}(70°C) = 292.98 \cdot 10^3$

A-2: $h_{aus}(100°C) = 419.04 \cdot 10^3$

$\Rightarrow \dot{Q}_{aus} = 0.3 \frac{kg}{s}(h_{ein} - h_{aus}) + 100\,kW$

$= \underline{62'182\,W}$

b) $\bar{T}_{KF} = \cancel{\frac{T(s_{aus} - s_{ein})}{s_{aus} - s_{ein}}}$

$\bar{T}_{KF} = (T_{KF,ein} + T_{KF,aus}) \frac{1}{2} = \underline{293.15\,K}$

c) $\dot{S}_{erz}$? $\quad 0 = \dot{m}(s_e - s_a) + \frac{\dot{Q}_{aus}}{\bar{T}} + \dot{S}_{erz}$

$\dot{S}_{erz} = -\dot{m}(s_e - s_a) - \frac{\dot{Q}_{aus}}{\bar{T}_{KF}}$

~~$s_e = s(293.15\,K)$~~

$s_e - s_a = c_p \cancel{(T_e - T_a)} \ln\left(\frac{T_e}{T_a}\right) = c_p \ln\left(\frac{293.15\,K}{298.15\,K}\right) = -0.03411 \cdot c_p$

$\dot{S}_{erz} = -\dot{m}_{ein}(-0.03411\,c_p) - \frac{62'182\,W}{293.15\,K} = \underline{0.010233\,c_p - 212.116}$

d) Δm_{12} ? $\quad T_{Reaktor,2} = 70°C$

$0 = \Delta m_{12}(h_2 - h_1) + \dot{Q}_R - \dot{Q}_{aus}$

$\frac{\dot{Q}_{aus} - \dot{Q}_R}{h_2 - h_1} = \Delta m_{12}$

A-2: $h_1(100°C) = \uparrow \; \cancel{292.98 \cdot 10^3} \; 83.96 \cdot 10^3$

A-2: $h_2(\cancel{70°C}) = 419.04 \cdot 10^3 \downarrow$

$\Rightarrow \Delta m_{12} = \frac{-35\,000\,000}{\cancel{62'182\,W - 100\,000\,W}} = \frac{\cancel{0.3\,kg}}{\cancel{292.98 \cdot 10^3} - 419.04 \cdot 10^3 \; 83.96 \cdot 10^3} = \underline{104.45\,kg}$

e) $\Delta s_{12} = s_2 - s_1 = m_{Di2}(s_2 - s_1) = m_{Di2} \ln\left(\frac{T_2}{T_1}\right) = \underline{130.851\,\frac{J}{kgK}}$

$T_2 = 70°C \quad T_1 = 20°C$

2.

η_{Visc} (0 : $p_0 = 0.191\ 6\,bar$ $T_0 = -30°C$ $\omega_{Luft} = 200\ \frac{m}{s}$ $\dot{m}_{ges}$ $s_0 = s_1$

1 : $s_0 = s_1 \rightarrow \dot{m}_M$ & $\dot{m}_K$ $\dot{m}_M/\dot{m}_K = 5.293$

2 :

3 : $p_2 = p_3$

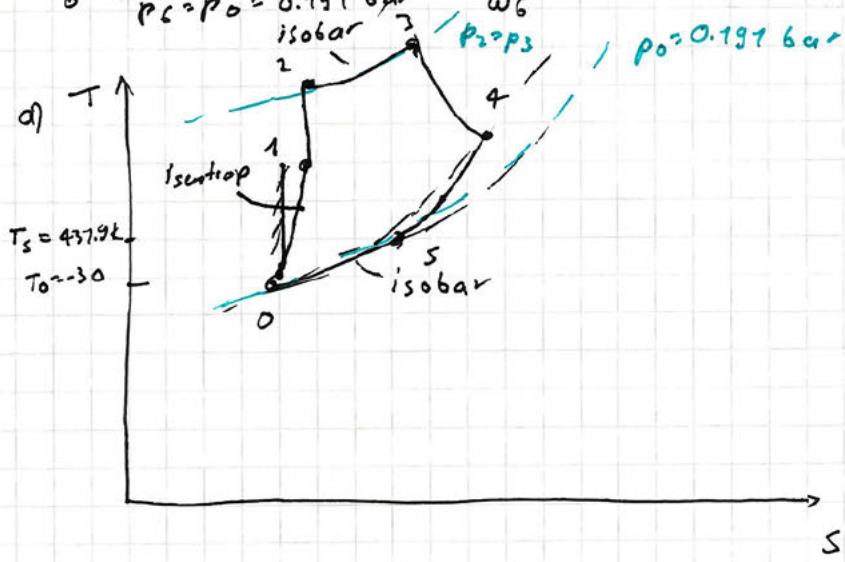
4 :

5 : $T_5 = 431.9\,K$ $p_5 = 0.5\,6\,bar$ $\omega_5 = 220\ \frac{m}{s}$

6 : $p_6 = p_0 = 0.191\ 6\,bar$ ω_6

$c_{p\,Luft} = 1.006 \cdot 10^3\ \frac{J}{kgK}$

$n = K = 1.4$



b) ω_6? T_6? $p_6 = 0.191\ 6\,bar$

$$0 = \dot{m}_{ges}\left(h_5 - h_6 + \frac{1}{2}m\omega_6^2 + \frac{1}{2}m\omega_5^2\right)$$

$\dot{m}_{ges} \rightarrow \quad 0 = \dot{m}_{ges}($

$h_5 = h(431.9\,K, 0.5\,6\,bar) =$ A-22 : $A = 430$ $C = 431.43 \cdot 10^3$ $B = 440$ $D = 441.61 \cdot 10^3$

$$\Rightarrow C + \frac{431.9k - A}{B - A}(D - C) = 433'364.2 = \underline{433.369 \cdot 10^3\ \frac{J}{kg}}$$

$h_6 = h(0.191\ 6\,bar, 328.07K) =$

$$\frac{T_6}{T_5} = \left(\frac{p_6}{p_5}\right)^{\frac{n-1}{n}} \Rightarrow T_6 = \left(\frac{0.191}{0.5}\right)^{\frac{0.4}{1.4}} \cdot T_5 = \underline{328.07\ K}$$

A-22:

$A = 325$ $C = 325.31 \cdot 10^3$

$B = 330$ $D = 330.34 \cdot 10^3$ $\Rightarrow C + \frac{328.07 - 325}{330 - 325}(D - C) = 328'398.92$

$= \underline{328.398 \cdot 10^3\ \frac{J}{kg}}$

$$\Rightarrow \frac{1}{2}m\omega_6^2 = h_5 - h_6 + \frac{1}{2}m\omega_5^2 \rightarrow \omega_6^2 = \frac{2(h_5 - h_6)}{m} + \omega_5^2$$

$$\Rightarrow \omega_6 = \sqrt{\frac{2}{m}(h_5 - h_6) + \omega_5^2} = (m \doteq 1) = \underline{508.26\ \frac{m}{s}}$$

c) $\Delta e_{x,str} = e_{x,str,6} - e_{x,str,0}$

$\Delta e_{x,str,0-6} = \dot{m}/\dot{q}_{es} \left(h_0 - h_6 - T_0 (s_0 - s_6) + \frac{1}{2} m w_0^2 - \frac{1}{2} m w_6^2 \right)$

$h_0 \left(0.1916\,bar, 243.15K (-30°C) \right) =$ A-22: A = 240 B = 250 C = 240.02 D = 250.05·10³

$\rightarrow h_0 = C + \frac{243.15 - 240}{250 - 240} (D - C) = 243'179.45 = 243.179.10^3 \frac{J}{kg}$

$h_6 = 328.398 \cdot 10^3 \frac{J}{kg}$

s_0: A = 240 C = 1.47828; B = 250 D = 1.47917 $\rightarrow C + \frac{243.15 - 240}{250 - 240}(D - C) =$

$s_0 = 1491.13 = 1.49113 \cdot 10^3$

$\Rightarrow h_0 - h_6 - T_0 (s_0 - s_6) + \frac{1}{2} m w_0^2 - \frac{1}{2} m w_6^2 =$

s_6: A = 325 C = 1.78249; B = 330 D = 1.79783 $\rightarrow C + \frac{328.07K - 325}{330 - 325} (D - C)$

$s_1 = 1791.91 = 1.79191 \cdot 10^3$

$\Rightarrow e_{x,str} = 137'079.77 \frac{J}{kg}$

d) $e_{x,rel} = T_0 \dot{s}_{irr}$

3. $x_{Eis} = 0.6$
$m_{EW} = 0.1\,kg$
$T_{EW,1} = 0°C$

$p_{EW}\ V_{EW}$

a) $p_{g,1}$! m_g ? $\quad p_1 V_1 = m_1 R T_1$

b) $p_{g,1} = 1.5$ bar $\quad m_g = 3.6\,g \quad T_{g,2}$? $\quad p_{g,2}$?

$\frac{T_2}{T_1} = \left(\frac{p_2}{p_1}\right)^{\frac{n-1}{n}}$

~~x_{Eis}~~ p_g

c) Q_{12} ? $\quad T_{g,2} = 0.003°C$ $\quad q_{12} = c_p (T_2 - T_1)$

Q_{12} : $\quad 0 = \dot{m}(h_1 - h_2) + \dot{Q}_{12}$

$\Rightarrow \dot{Q}_{12} = -\dot{m}(h_1 - h_2) \rightarrow Q_{12} = c_p (T_2 - T_1)$

~~$h = f(s)$~~ $\Rightarrow c_p - c_v = \frac{R}{M} \Rightarrow c_p = \frac{R}{M} + c_v$

$c_p = \frac{8.314}{50} + 0.633 \cdot 10^3 = 0.79928\ \frac{kJ}{kg\,K}$

$Q_{12} = c_p (T_2 - T_1) = 0.79928\,(0.003°C - 500°C) = -399.6376\,W$

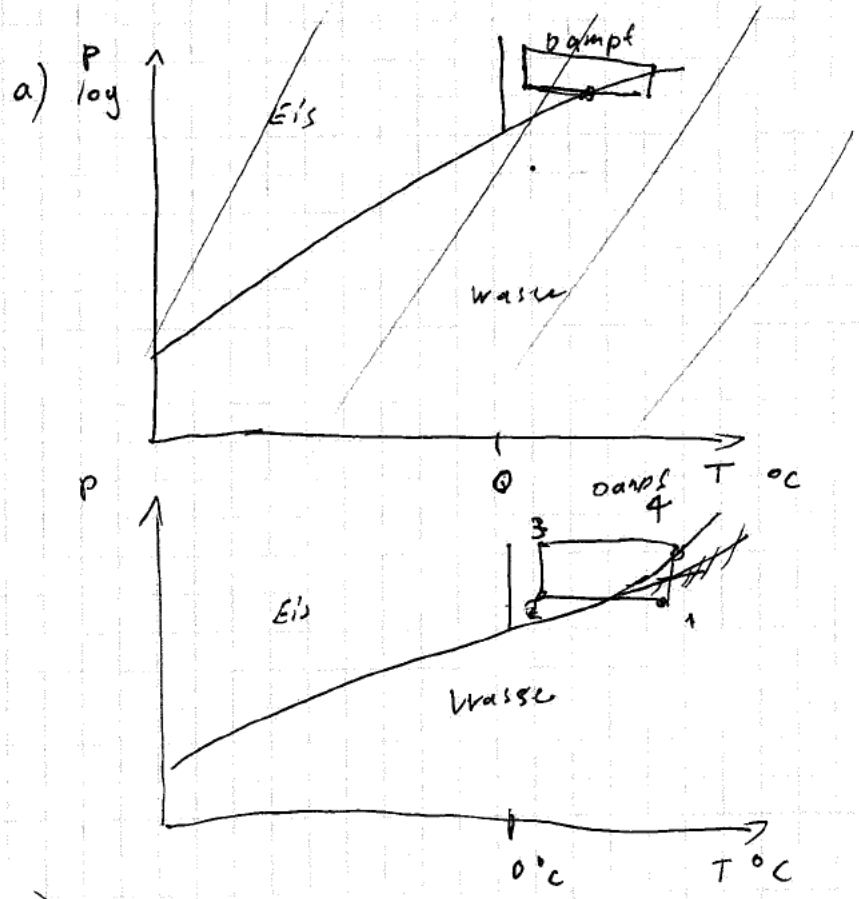
d) $x_{Eis,2}$?

$x_{Eis} = \frac{u_2 - u_f}{u_g - u_f}$

$u_2 = u(0.003°C$
$u_f = -0.033 \cdot 10^3\ \frac{J}{kg}$
$u_g = -333.492 \cdot 10^3\ J/kg$

4. $\dot{Q}_K$ +
1: $T_1 = T_i - 6\,K$ $h_1 = h_4$ $p_1 = p_2$
2: $x_2 = 1$ (Dampf) T_2 $p_1 = p_2$ $p_i =$
$+\dot{W}_K$
3: $p_3 = 8\,bar$
4: $p_3 = p_4 = 8\,bar$ $x_4 = 0$ $h_4 = h_1$
1: $h_4 = h_1$

a)



b) $\dot{m}_{R134a}$

$0 = \dot{m}_{R134a}\,(h_2 - h_3) - \dot{W}_K$ $\dot{W}_K = 28\,W$

$h_2 \hat{=} h_g =$

c) x_1? $\dot{m}_{R134a} = 4\,\frac{kg}{h}$ $T_2 = -22°C$

$x_1 = \frac{h_1 - h_{f,1}}{h_{g,1} - h_{f,1}}$ $T_i \doteq 0 \rightarrow T_1 = -6°C = 267.15\,K$

A-10: $h_{f,1}$ = A: -9°C C: $39.54 \cdot 10^3$ D: $44.75 \cdot 10^3$ $h_{f,1} = C + \frac{-6+4°C}{-8+4°C}(D - C)$
B: -6°C

A-10: $h_{f,1} = 42145\,\frac{J}{kg}$ A: -4°C C: 244.9 D: 242.54 $h_{g,1} = C + \frac{-6+4°C}{-8+4°C}(242.54 - 244.9)$
$h_{g,1}$ = B: -6°C

$= 243720\,\frac{J}{kg}$

d) $\varepsilon_K = \frac{|\dot{Q}_{ab}|}{|\dot{W}_t|} = \frac{|\dot{Q}_K|}{|\dot{W}_K|} =$ $T_1 \approx -6°$ $T_2 \approx -22°$

$= c_p (T_1 - T_2)$ A-19: $\Rightarrow c_p = 1.434 \cdot 10^3$

$\dot{Q}_K \Rightarrow \quad 0 = \dot{m}_{R134a} (\tilde{h_1 - h_2}) + \dot{Q}_K$

$h_1(-6°)$ $\Rightarrow \quad \dot{Q}_K = -\dot{m}_{134a} (T_1 - T_2)\, c_p = -91'776\ W$

$h_2(-22°)$

$\Rightarrow \varepsilon_K = \frac{-91'776\,W}{28\,W} = -3277.7$

e)