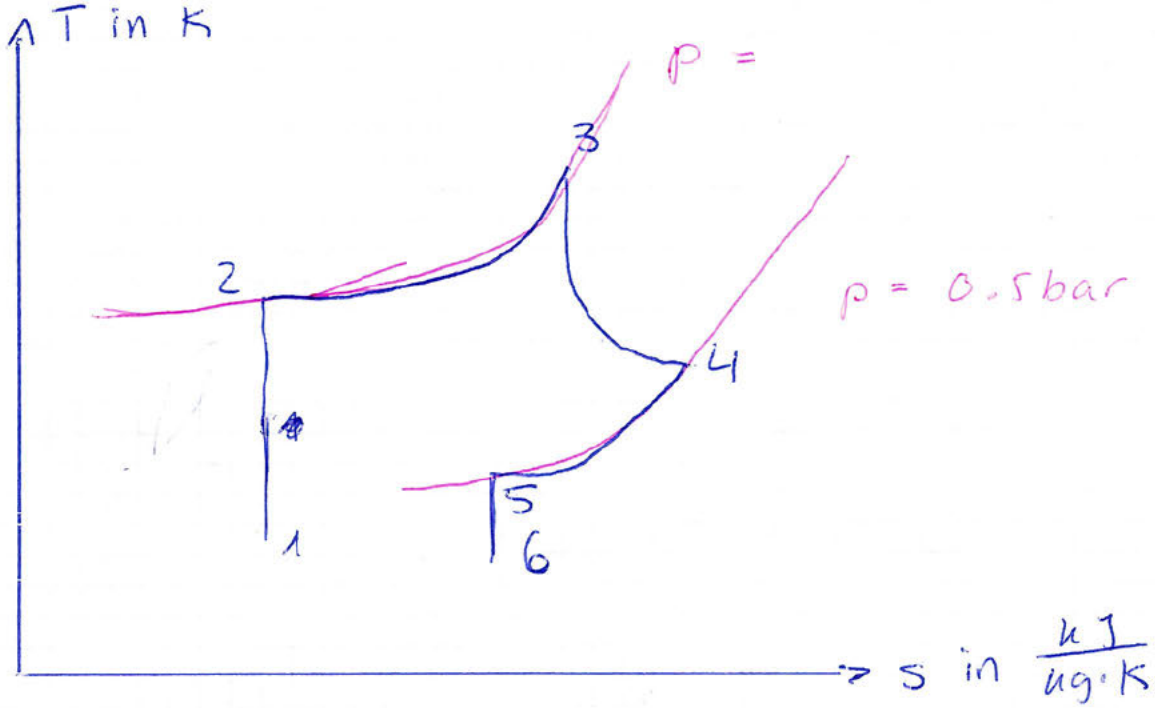
2 a)



b) ~~$\dot{m}(h_e + \frac{w_e^2}{2}) = \dot{m}(h_a + \frac{w_6^2}{2})$~~

Tabelle A-22

$h_e =$

$\dot{m}\left(h_e - h_a + \frac{w_e^2 - w_a^2}{2}\right) = 0$

$h_e - h_a =$

$c_p(T_2 - T_1) = 1.006\ (526.918 - 431.9) = 95.58 \frac{kJ}{kg}$

$T_1 = 431.9\ K$

T_2 :

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

$T_2 = T_1 \circ 1.22$

$= 526.918\ K = T_6$

$\dot{m}\ 95.58 \frac{kJ}{kg} + \frac{220 \frac{m}{s}^2}{2} - \frac{w_a^2}{2} = 0$

$\frac{w_a^2}{2} = 95580 \frac{J}{kg} + 24200 \frac{J}{kg}$

~~$\frac{w_a^2}{2} = 119780 \frac{J}{kg}$~~

~~$w_a^2 = 239560 \frac{J}{kg}$~~

~~$w_a = 489.449 \frac{m}{s}$~~

c) ~~$ex_{str6} = h - h_0$~~

526.918 K = altes Ergebnis für T_6

$ex_{str6} - ex_{str0} =$

$h_e - h_a - T_0 (s_e - s_a) + \Delta ke$

$c_p(T_0 - T_6) - T_0 \left(c_p \ln\left(\frac{T_0}{T_6}\right) - R \ln\left(\frac{p_0}{p_6}\right)\right) + \Delta ke$

$1.006(243.15 - 526.918) - 243.15\left(1.006 \cdot \ln\left(\frac{526.918}{243.15}\right) - R \ln\left(\frac{p_6}{p_0}\right)\right) + \Delta ke$

$R = 0.287 \frac{kJ}{kg \cdot K}$

altes Ergebnis für w_e

$285.47 \frac{kJ}{kg} - T_0 \left(0.778 \frac{kJ}{kg \cdot K}\right) + \frac{(489.449)^2}{2} - \frac{(200)^2}{2}$

$96.299 \frac{kJ}{kg} + 99780.16 \; J$

$\Delta ex_{str} = 196079.16 \; J$

d)

[redacted]

4) b) $\dot{m}(h_2 - h_3) = 28\ W$

Tabelle A-14

$h_4 = h^f(8\ bar) = 263.95\ \frac{kJ}{kg}$

Drosselventil

$h_4 = h_1$

4b) $\dot{Q}_{ab} = \dot{m}(u_2 - u_1) - \dot{W}_k$

$T_2 = -22°C$

Tabelle A 11

$u_2 = 234.08\ \frac{kJ}{kg}$ u_g bei $-22°C$

Tabelle A 11

$u_3 = 93.42\ \frac{kJ}{kg}$ h_f bei 8 bar

$\dot{m}\left(234.08\ \frac{kJ}{kg} - 93.42\ \frac{kg}{kg}\right) = 28\ W$

$= 0.000199\ \frac{kg}{s}$

Tabelle A-11

c) $h_4 = h_1 = h^f(8\ bar) = 93.42\ \frac{kJ}{kg}$

$p_1 = p_2$ bei Annahme, dass $T_2 = -22°C$

$= 1.2192$ bar

Tabelle A-10

$x_1 = \frac{h_1 - h_{1f}}{h_{g1} - h_{1f}} = \frac{93.42 - 21.77}{234.08 - 21.77}$

$= 0.337$

d) $\varepsilon_K = \frac{\dot{Q}_{zu}}{\dot{W}_t} =$

[redacted]

2b) $\frac{T_6}{T_5} = \left(\frac{P_6}{P_5}\right)^{\frac{n-1}{n}}$

$\frac{T_6}{T_5} = \left(\frac{0.191}{0.5}\right)^{\frac{0.4}{1.4}}$

$T_6 = T_5 \cdot 0.759$

$T_6 = 327.81\ K$

~~$h_e - h_a + \frac{w_e^2 - w_a^2}{2}$~~

$h_e - h_a + \frac{we^2 - wa^2}{2} = 0$

$h_e - h_a = 104.71$

$\frac{wa^2}{2} = 104710\ \frac{J}{kg} + 4200\ \frac{J}{kg}$

$\frac{wa^2}{2} = 128910\ J/kg$

$wa^2 = 257820\ J/kg$

$wa = 507.76\ \frac{m}{s}$

[redacted]

1a) $\dot{m}\,(h_{aus} - h_{ein}) = \dot{Q}_{aus}$

~~haus~~ hein

Aus Tabelle A2

$h^f(70°C) = 292.98 \frac{kJ}{kg}$

~~hein~~: haus:

$h^f(100°C) = 419.04 \frac{kJ}{kg}$

$\dot{Q}_{aus} = 0.3 \frac{kg}{s} (419.04 - 292.98)$

$= 37.818\ kW$

5) $\bar{T}_{KF}$ = Der Druck im Kühlmantel nimmt nicht ab => $\dot{s}_{erz} = 0$

$\bar{T} = \frac{T_2 - T_1}{\ln(\frac{T_2}{T_1})} = 293.12\ K$

c) $s_{erz} = \frac{\dot{Q}}{\bar{T}} = \frac{37.818}{293.12} = 0.129 \frac{kJ}{kg\,K}$

d) $m_2 u_2 - m_1 u_1 = \Delta m \cdot u_{ein} + Q_t$

$m_2 = m_1 - \Delta m$

Aus Tabelle A-2

$u_1 = 419.04 + 0.005(2676.1 - 419.04)$

$= 430.33 \frac{kJ}{kg}$

$u_2 = 292.98 + \frac{m_D + m_{ein}}{m_{ges}} (2626.8 - 292.98$

$(m_D + m_{ein}) \cdot (292.98 + \frac{m_D + m_{ein}}{m_{ges}} (233382)$

$u_{ein} = h^f(20°C)$ Tabelle A-2

$= m_{ein} \cdot 83.96 \frac{kJ}{kg} + 2765.49 \frac{kJ}{kg} - 35MJ$

e) $m_2 s_2 - m_1 s_1 = \Delta m_{sein} + \frac{Q}{T} + s_{erz}$

$s_{erz} = m_2 s_2 - m_1 s_1 - \Delta m_{sein} - \frac{Q}{T}$

mit zwischenergebnis $m_D = 28.775\,kg$

$m_2 = 5755\,kg + 3600\,kg = 9355\,kg$

$m_1 = 5755\,kg$

$s_2 =$

Tabelle A-2

$s_2 = 0.954\,\frac{kJ}{kg} + \frac{28.775\,kg}{9355\,kg}\,(7.7553 - 0.954\,\frac{kJ}{kg})$

$= 0.976\,\frac{kJ}{kg \cdot K}$

Tabelle A-2

$s_1 = 1.306\,\frac{kJ}{kg} + \frac{28.775\,kg}{5755\,kg}\,(7.354\,\frac{kJ}{kg} - 1.306\,\frac{kJ}{kg})$

$= 1.337\,\frac{kJ}{kg \cdot K}$

$s_{ein} =$ Tabelle A-2

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

$s_{erz} = 9355 \cdot 0.976 - 5755 \cdot 1.337 - 3600 \cdot 0.2966 + \frac{35000\,kJ}{293.12\,K} = 487.69\,\frac{kJ}{kg \cdot K}$

3a) ~~pV = mRT~~

$$p_1 = p_0 + \frac{32\,kg \cdot 9.81}{(0.1)^2 \cdot \pi} + \frac{0.1 \cdot 9.81}{(0.1)^2 \cdot \pi}$$

$p_1 =$ ~~109992.38 Pa~~ $110023.6\ Pa = 1.1\ bar$

m_1:

$pV = mRT$

~~p =~~

$R = 0.16628$

$p \cdot 0.00314\ m^3 = m \cdot 0.16628 \cdot$ ~~50~~ 773.15

$$\frac{p \cdot 0.00314}{128.56} = m$$

$m = 0.0000268\ kg = 0.0269\ g$

b) $m_{ges\,1} = 0.1\ kg \quad m_{eis\,1} = 0.06\ kg$

$m_{eis\,2} > 0.1\ kg$