

$$1. a) 0 = \dot{m}(h_e - h_a) + \dot{q}_R - \dot{q}_{aus}$$

$$h_e = 292.98 \frac{\text{kJ}}{\text{kg}} \quad \text{TAB A-2}$$

$$h_a = 419.04 \frac{\text{kJ}}{\text{kg}} \quad \text{TAB A-2}$$

$$\dot{q}_{aus} = \dot{m}(h_e - h_a) + \dot{q}_R = \underline{\underline{62.18 \text{ kW}}}$$

$$b) \bar{T} = \frac{\int_a^b T ds}{s_a - s_e} \quad T ds = dh - \underbrace{v dp}_P \text{ konstant}$$

$$= \frac{h_a - h_e}{s_a - s_e}$$

$$s_a - s_e = \int_{T_e}^{T_a} \frac{c_{if}}{\bar{T}} dT = c_{if} \ln\left(\frac{T_a}{T_e}\right)$$

$$h_a - h_e = \int_{T_e}^{T_a} c_{if} dT = c_{if} (T_a - T_e)$$

$$\bar{T} = \frac{T_a - T_e}{\ln\left(\frac{T_a}{T_e}\right)} = \underline{\underline{293.12 \text{ K}}}$$

$$c) 0 = \dot{m}(s_e^w - s_a^w) + \frac{\dot{q}_{aus}}{\bar{T}} + \dot{s}_{erz}$$

$$0 \neq \dot{m}(h_e - h_a) + \dot{q}_{aus}$$

$$\dot{q}_{aus} = \dot{m}(h_a - h_e) = \dot{m}$$

$$s_e^w = 0.9599 \frac{\text{kJ}}{\text{kg K}} \quad \text{TAB A-2}$$

$$s_a^w = 1.3069 \frac{\text{kJ}}{\text{kg K}} \quad \text{TAB A-2}$$

$$\dot{s}_{erz} = \dot{m}(s_a^w - s_e^w) - \frac{\dot{q}_{aus}}{\bar{T}} = \underline{\underline{0.3178 \frac{\text{kJ}}{\text{K}}}}$$

$$d) m_2 u_2 - m_1 u_1 = \Delta m_2 h_2 + 35 \text{ MJ} - 35 \text{ MJ}$$

$$u_1 = x_D \cdot 2506.5 + (1-x) \cdot 418.04 \quad \text{TAB A-2}$$

$$= 429.38 \frac{\text{kJ}}{\text{kg}}$$

$$u_2 = 292.95 \frac{\text{kJ}}{\text{kg}} \quad \text{TAB A-2}$$

$$m_1 = 5755 \text{ kg}$$

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

$$h_{12} = 83.96 \frac{\text{kJ}}{\text{kg}} \quad \text{TAB A-2}$$

$$(m_1 + \Delta m_{12}) u_2 - m_1 u_1 = \Delta m_{12} h_{12}$$

$$d) m_1 u_2 + \Delta m_{12} u_2 - m_1 u_1 = \Delta m_{12} h_{12}$$

$$\Delta m_{12} (u_2 - h_{12}) = m_1 u_1 - m_1 u_2$$

$$\Delta m_{12} = 3756.9 \text{ kg}$$

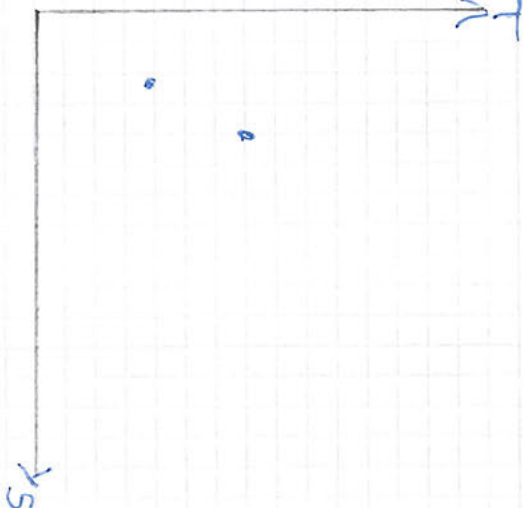
$$e) \Delta S_{12} = m_2 s_2 - m_1 s_1$$

$$s_1 = x_D \cdot 7.3549 + (1 - x_D) \cdot 1.3069 \quad \text{TAB A-2} \\ = 1.33714 \frac{\text{kJ}}{\text{kg K}}$$

$$s_2 = 0.9549$$

$$\Delta S_{12} = (m_1 + \Delta m_{12}) \cdot s_2 - m_1 s_1 \\ = 1387.7 \frac{\text{kJ}}{\text{K}}$$

2) π



	P	T	w
0	0.1971	293.15	200
1			
isentr.			
2			
isob.	11		
3			
adiab.			
4	0.5		
isob.	11		
5	0.5	431.9	220
isentr.			
6	0.1971	328.07	

$$b) C = m(h_s - h_6 + \frac{u_s^2 - u_6^2}{2})$$

$$\text{isentrop} \Rightarrow n = k = 1.4$$

$$T_6 = T_s \left(\frac{P_6}{P_s} \right)^{\frac{n-1}{n}} = 328.07 \text{ K}$$

$$C = \int_6^s c_{pL} dT + \frac{u_s^2 - u_6^2}{2} = c_{pL}(T_s - T_6) + \frac{u_s^2 - u_6^2}{2}$$

$$u_6^2 = 2c_{pL}(T_s - T_6) + 2u_s^2$$

$$u_6 = 311.46 \frac{\text{m}}{\text{s}}$$

$$c) \Delta h_{\text{isentr}} = h_6 - h_0 - T_0(s_6 - s_0) + k e_6 - k e_0$$

$$h_6 - h_0 = c_{pL}(T_6 - T_0) = 85.43 \frac{\text{kJ}}{\text{kg}}$$

$$s_6 - s_0 = c_{pL} \ln \left(\frac{T_6}{T_0} \right) - R \ln \left(\frac{P_6}{P_0} \right) \quad R = c_{pL} - \frac{c_{pL}}{k} = 0.3013 \frac{\text{kJ}}{\text{kg K}}$$

$$2)c) \Delta_{\text{exstr}} = h_6 - h_0 - T_0(s_6 - s_0) + \frac{1}{2}u_6^2 - \frac{1}{2}u_0^2$$

$$= 40.673 \frac{\text{kJ}}{\text{kg}}$$

$$d) \dot{E}_{\text{verlust}} = T_0 \dot{S}_{\text{erz}}$$

$$\dot{S}_{\text{erz}} = \dot{m}_{\text{ges}}(s_9 - s_e)$$

$$\dot{E}_{\text{verlust}} = T_0(s_6 - s_0)$$

$$= 73.26 \frac{\text{kJ}}{\text{kg}}$$

$$3) p) P_{g1} = \frac{m_g}{A} + p_0 \quad A = \left(\frac{D}{2}\right)^2 \pi = 7.85 \cdot 10^{-3} \text{ m}^2$$

$$m = m_k + m_{EW} = 32.1 \text{ kg}$$

$$P_{g1} = -1 + 0.1 \text{ kPa} = \underline{1.40 \text{ bar}}$$

$$R = \frac{8.314}{M_g} = 0.16628 \frac{\text{kJ}}{\text{kg K}}$$

$$P_{m1} V_{g1} = m_g R T_{g1} \Rightarrow \underline{m_g = 3.419 \cdot 10^{-3} \text{ kg}}$$

b)

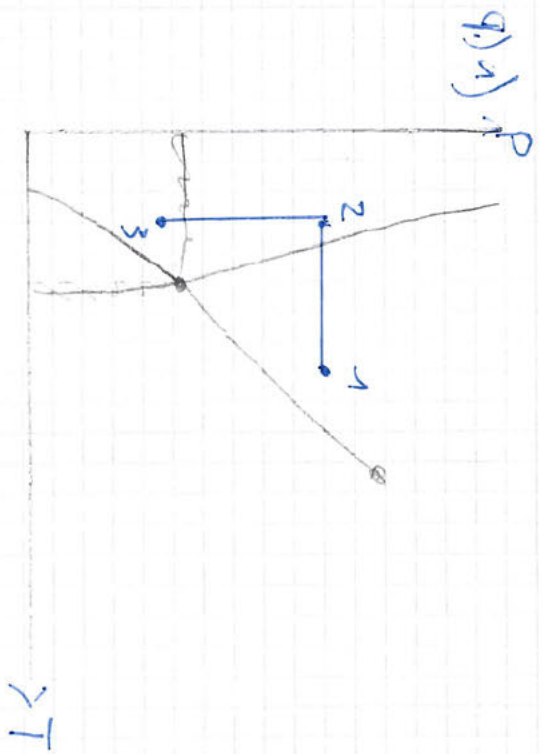
T_{EW}	λ
0	0.6

$$u_{g1} = 0.633 \cdot m_g \cdot T_1 = 1.673 \text{ kJ}$$

$$u_{m1} = (x_1 \cdot (-333.458) + (1-x_1) \cdot (-0.045)) m_m T_{g1} - 1$$

$$= -20.009 \text{ kJ}$$

$$u_{\text{end}} = \frac{u_{g1} + u_{m1}}{2} = -9.168 \text{ kJ}$$



	P	T	x	w
1				
isob	11	$T_f - 6K$		
2			1	25W
isent.	8			
3	11			
isob	8			
4			0	
adiab				

b) $w_k = m_{KH}(h_2 - h_3) \quad s_2 = s_3$

$P_1 = 1 \text{ mbar}, \quad T_1 = -10^\circ\text{C}$

$T_2 = -22^\circ\text{C}$

$h_2 = 234.08 \frac{\text{kJ}}{\text{kg}}, \quad s_2 = 0.9351 \frac{\text{kJ}}{\text{kgK}} \quad \text{TAB A-10}$

$h_3 = 267.15 + (273.66 - 267.15) \frac{s_2 - 0.9066}{0.9374 - 0.9066}$
 $= 272.95 \frac{\text{kJ}}{\text{kg}} \quad \text{TAB A-12}$

$m_{KH} = 0.371 \frac{\text{kg}}{\text{h}}$

c)

