

1a) ges: \dot{Q}_{aus}

$$0 = \dot{m} (h_e - h_a) + \sum \dot{Q} - \dot{W}$$

$$h_{ein} = h_f(70^\circ C) = 292,98$$

$$h_{aus} = h_f(100^\circ C) = 419,04$$

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

$$0,3 \frac{\text{kg}}{\text{s}} \cdot (292,98 - 419,04) + 100 \text{ kW} = \underline{\underline{62,182 \text{ kW}}}$$

b)

$$\cancel{0 = \dot{m} (s_a - s_e) + \int}$$

$$\bar{T} = \frac{\int_e^a T ds}{s_a - s_e}$$

$$s_a = 7,3069$$

$$s_e = 0,9549$$

$$\int_e^a T ds = \cancel{T_e \cdot (s_a - s_e)}$$

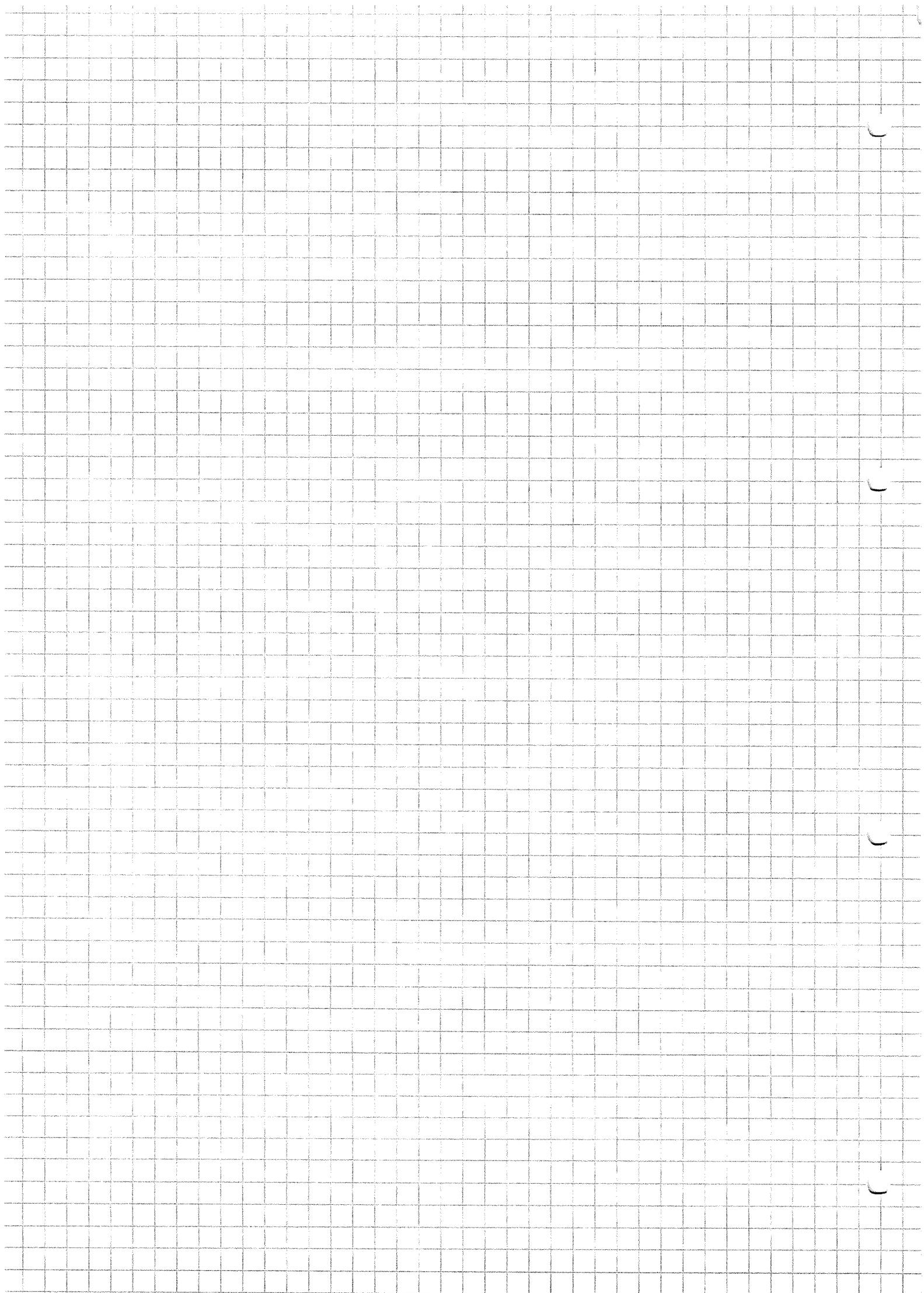
$$T_a \cdot s_a - T_e \cdot s_e = -343,75 \cdot \cancel{7,3069} + 373,75 \cdot 0,9549$$

$$= 487,6697 - 227,679$$

$$s_a - s_e = 0,352$$

$$\bar{T} = \frac{159,996}{0,352} =$$

$$= 159,996$$

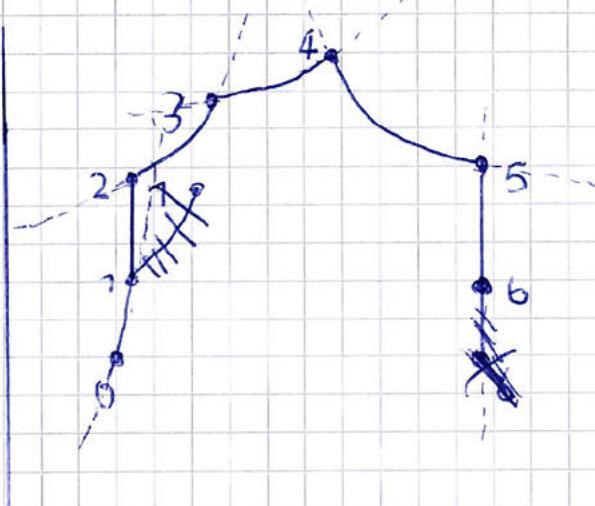


2

a)

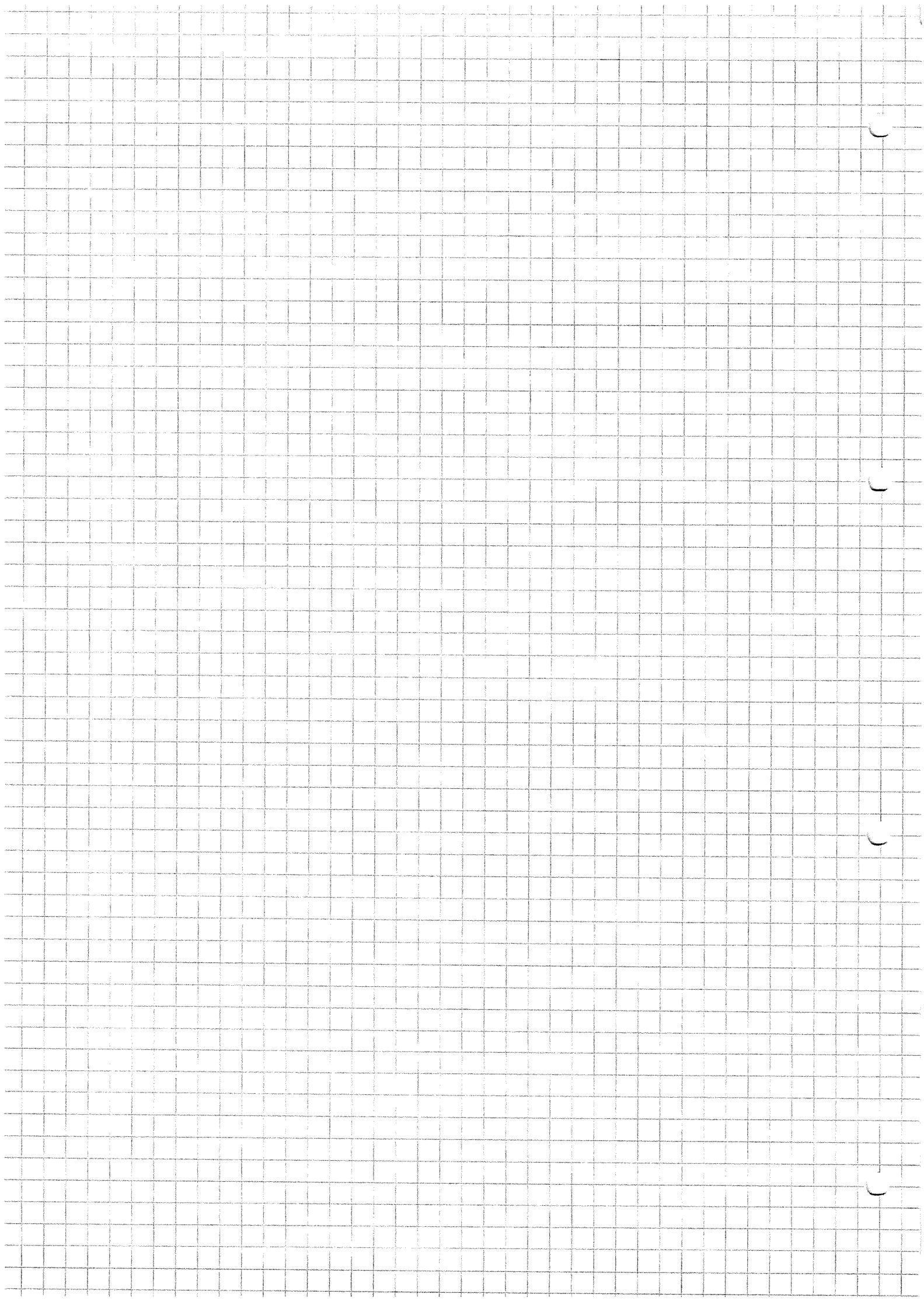
T

K



$$\frac{kJ}{\log K}$$

S



3

a) ges: p_g , m_g

$$p = p_{\text{amb}} + \underbrace{\frac{m_k \cdot g}{A} + \frac{m_{\text{EW}} \cdot g}{A}}_{= 1 \text{ bar}} = p_{\text{amb}} + \frac{(m_k + m_{\text{EW}}) \cdot g}{A}$$

$$= 1 \text{ bar} + \frac{(32 \text{ kg} + 0,7 \text{ kg}) \cdot 9,81}{\pi \cdot r^2} = \frac{314,907 \text{ N}}{\pi \cdot 0,05^2 \text{ m}^2} = 40094,44 \text{ Pa}$$

$$= 0,401 \text{ bar} \Rightarrow \underline{P_g = 1,407 \text{ bar}}$$

$$m_g \Rightarrow p \cdot V = m \cdot R \cdot T \quad R = \frac{\bar{R}}{M} = \frac{8314 \text{ J/Kmol}}{50} = 0,16629 \text{ J/Kg}$$

$$\underline{m_g = \frac{p \cdot V}{R \cdot T} = \frac{1,407 \text{ bar} \cdot 3,14 \text{ L}}{0,16629 \cdot 273,15 \text{ K}} = 3,42 \text{ g}}$$

b)

$$p \cdot V = m \cdot R \cdot T \Rightarrow T:$$

EW besteht aus Eis & Wasser $\Rightarrow T_{\text{EW}} = 0^\circ\text{C}$

Es findet keine Wärme austausch mehr statt

$$\rightarrow \underline{T_{g2} = 0^\circ\text{C} = 273,15 \text{ K}}$$

 ~~$P_{2,g}$~~ $P_{2,g} = P_{1,g}$ da Pamb gleich bleibt

und die Masse des Gewichts und des EW konst.

bleiben $\rightarrow P_{2,g} = 1,407 \text{ bar}$

B.C)

$$\frac{dE}{dt} = \sum Q - \sum W_v$$

$$V_2 = \frac{m \cdot R \cdot T}{P} = \frac{0,00342 \cdot 273,15}{101325} \cdot 10^5$$

$$= \frac{3,42 \cdot 273,15 \cdot 0,101325}{101325} \cdot 10^5$$

$$\Delta E = Q_{72} - W_v$$

$$= 7,109 \text{ kJ}$$

$$W = \int_1^2 P \, dv = P(V_2 - V_1)$$

$$= 1,401 \cdot (3,74L - 1,709L) = 284,54 \text{ kJ}$$

~~ΔE = m · C_v · ΔT~~

$$\Delta E = m \cdot (C_v \cdot (T_2 - T_1)) = 3,42g \cdot 0,633 \cdot (500K) = 7,08 \text{ kJ}$$

$$W = m \cdot g = 284,54 \cdot 0,00342 = 0,97 \text{ kJ}$$

$$Q = \Delta E + W = 7,08 + 0,97 = 2,056 \text{ kJ}$$

d) ~~P · t · EW = 7 \text{ bar} \cdot 32 \cdot 9,31~~ $\Rightarrow P \cdot t \cdot EW = 7 \text{ bar} \cdot \frac{32 \cdot 9,31}{\pi \cdot 5 \text{ cm}^2} = 7 + 0,4 \text{ bar} = 7,4 \text{ bar}$ ~~für feste f → flüssig~~

$$\Delta E = \sum Q - \sum W_v$$

$$m \cdot (U_2^f - U_1^f) = Q_{72}$$

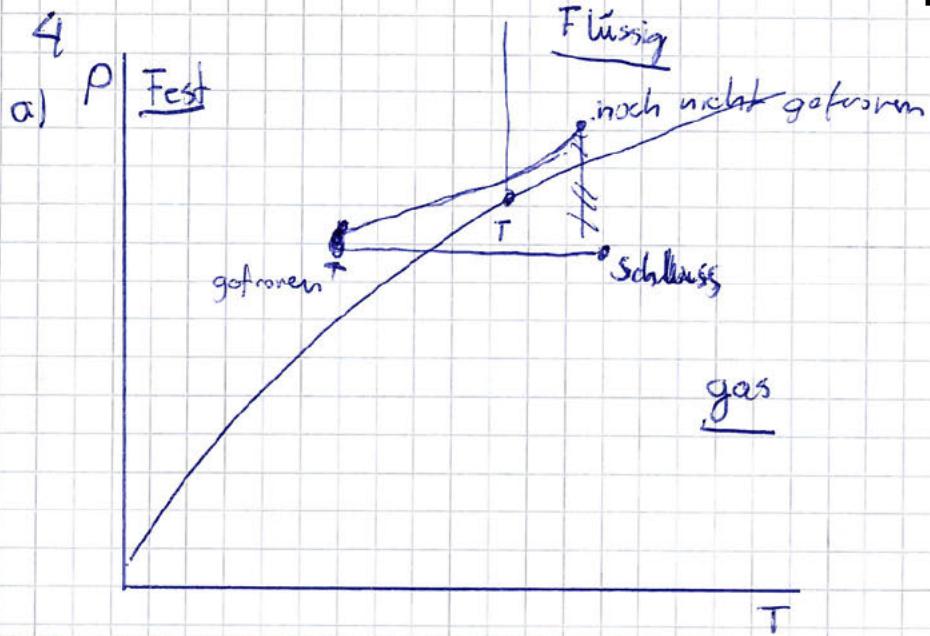
$$U_1 = u_f + x \cdot (u_g - u_f) = -200,09 \frac{\text{kJ}}{\text{kg}}$$

$$u_2 = \frac{Q_{72}}{m} - U_1 = -601,17 + 200,09 \Rightarrow -401,08$$

$$u_2 = \frac{Q}{m} - u_1$$

$$u_2 = -200,398 \rightarrow \frac{-200,398 + 333,458}{-0,045 + 3,33,458} = 0,40$$

→ 40%



b)

	P	V	T	n	x	s
1						
2			-16°C		1 0,9294	
3	8				1 0,9298	
4	8			0		

$$\text{gef } T_1 = -10^\circ \text{C} \quad T_2 = -16^\circ \text{C}$$

$$h_2 = 237,74 \quad s_2 = 0,9298$$

gef x_{sat}

$$T_3 = y_1 + (x_0 - x_1) \frac{y_2 - y_1}{x_2 - x_1}$$

gef x_{sat} $x = \text{Temp}$

$y = \text{Temp}$

1) \Rightarrow at T_{sat}

2) \Rightarrow at 40°C

$$\dot{m} (\Delta h) = \dot{W}_{23}$$

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

$$\dot{m} = \frac{\dot{W}}{h_3 - h_2} = \frac{28 \text{ W}}{271,21 - 237,74} = \underline{\underline{0,00834 \frac{\text{kg}}{\text{s}}}}$$

$$T_3 = 37,86^\circ \text{C}$$

$h_3 \Rightarrow \text{Lvp: } x = \text{temp allg 8bar}$

$$h_3 = 271,37 \quad y = h$$

1) \Rightarrow at T_{sat}

2 \Rightarrow at 40°C

$$\dot{m} \cdot 3600 = \underline{\underline{3,0 \frac{\text{kg}}{\text{h}}}}$$

C)

$$h_4 = \cancel{205} \quad 93,42$$

$$S_4 = 0,3459$$

$$P_1 = P_2 = 7,5748 \text{ bar}$$

$$m(h_1 - h_4) = 0$$

$$h_1 = h_4 \rightarrow h_1 = 93,42$$

D)

$$x_1 = \frac{93,42 - 29,30}{208,45} = 0,3076$$

d)

$$\varepsilon_k = \frac{|\dot{Q}_{zul}|}{|\dot{W}_{el}|}$$

$$\dot{Q}_{zul} = \dot{Q}_k$$

$$\dot{Q}_k = + m(h_2 - h_1)$$

$$= 0,000834$$

E)

erwärme sich noch ein bisschen abkühlen bis es ein gleichgewicht hat