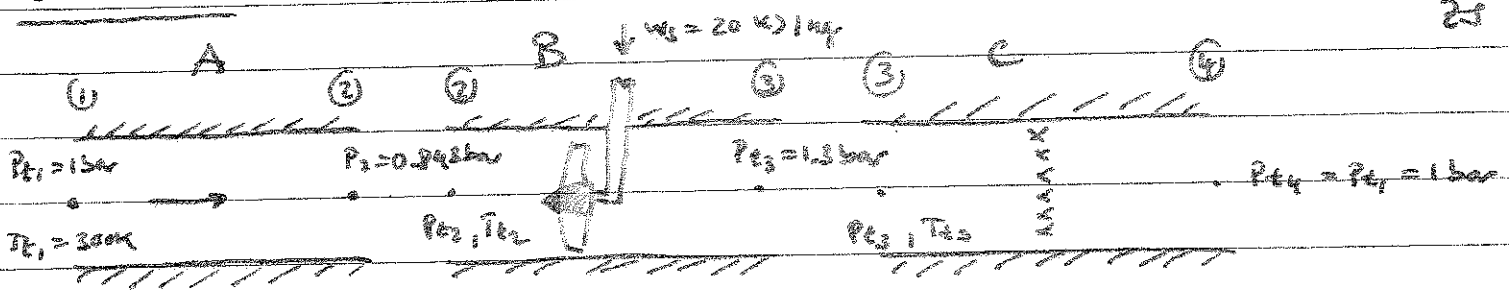


Übung 2 T1

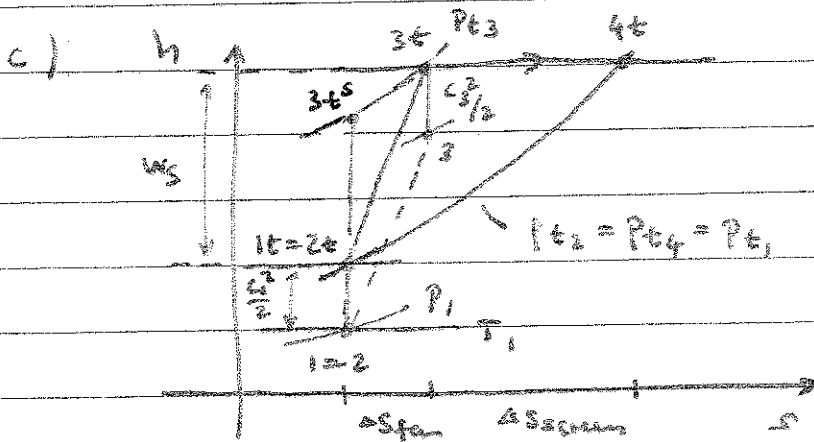
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a) adiabatic  $\Rightarrow$  no flow:  $P_{t1} = P_{t2}$   
 no work done  $T_{t1} = T_{t2}$  }  $\frac{T_2}{T_{t2}} = \left(\frac{P_2}{P_{t2}}\right)^{\frac{\gamma-1}{\gamma}}$ ,  $T_2 = 285.7 \text{ K}$

b)  $\frac{T_{t2}}{T_2} = 1 + \frac{\gamma-1}{2} M_2^2$  or  $T_{t2} = T_2 + \frac{c_2^2}{2c_p}$ ,  $c_2 = \sqrt{2c_p(T_{t2} - T_2)}$ ,  $c_2 = 169.4 \text{ m/s}$



f)  $w_s = h_{t3} - h_{t2}$ ;  $w_s^{ideal} = h_{t3}^* - h_{t2}$

h)  $T_{ds} = ds > 0 \Rightarrow ds > 0$

d) 1st law:  $h_{t3} = h_{t2} + w_s$ ,  $T_{t3} = 319.9 \text{ K}$

Gibbs:  $T_2 ds = dh_t - v dp_t$   $\Delta S_{fan} = c_p \ln\left(\frac{T_{t3}}{T_{t2}}\right) - R \ln\left(\frac{P_{t3}}{P_{t2}}\right) = 12.2 \text{ J/kg-K}$

2nd law:  $\Delta S_{total} = \Delta S_{fan} > 0$  irreversible

e)  $\eta_{ad} = \frac{w_{ideal}}{w_{actual}} = \frac{h_{t3}^* - h_{t2}}{h_{t3} - h_{t2}}$ ,  $T_{t3}^* = T_{t2} \cdot \left(\frac{P_{t3}}{P_{t2}}\right)^{\frac{\gamma-1}{\gamma}} = 316 \text{ K}$ ;  $\eta_{ad} = 0.8$

g) 1st law:  $h_{t3} = h_{t4}$  (no shaft work, adiabatic)  $T_{t4} = 319.9 \text{ K}$

i) Gibbs:  $T_2 ds = dh_t - v dp_t$   $\Delta S_{scm} = -R \ln\left(\frac{P_{t4}}{P_{t2}}\right) = R \ln\left(\frac{P_{t3}}{P_{t1}}\right) = 52.5 \text{ J/kg-K}$

$\Delta S_{gen} = \Delta S_{fan} + \Delta S_{scm} = 64.5 \text{ J/kg-K}$   
 A, B, C