$n = 3$, mono, $T_A = 300\ K$, $\Delta S_{u,ciclo} = 60\ J/K$

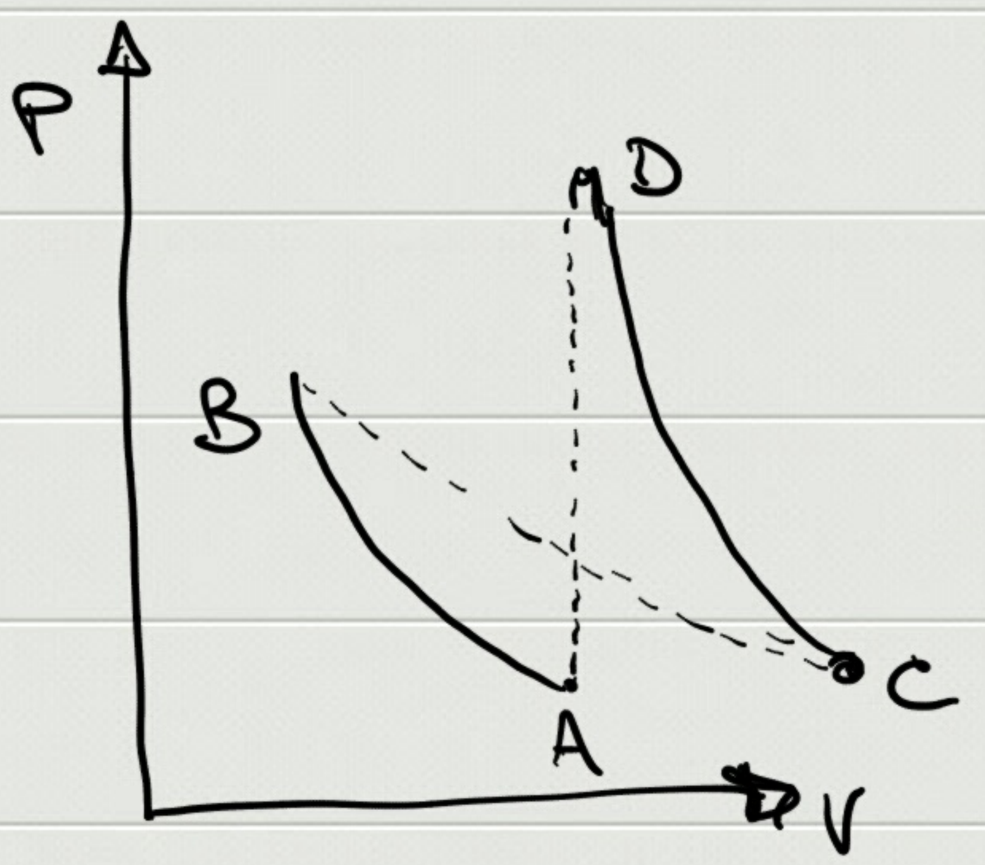
AB: compr. adiab. rev. $V_B = \frac{V_A}{2}$

BC: espansione libera

CD: compr. adiab. rev. $V_D = V_A$

DA: isocora contatto termico T_A

$T_C, T_D, W_{ciclo}, \Delta S_{u,BC}$



$$T_A V_A^{\gamma-1} = T_B V_B^{\gamma-1}$$

$$\Rightarrow T_B = T_A \left(\frac{V_A}{V_B}\right)^{\gamma-1} = 476\ K$$

$$\| \quad T_C$$

$$T_C V_C^{\gamma-1} = T_D V_D^{\gamma-1}$$

$$\Delta S_{u,ciclo} = -\frac{nC_V(T_A - T_D)}{T_A} = \frac{Q_{assorb,DA}}{T_A} \quad *$$

$$T_D = T_C$$

$$\Delta S_{u,ciclo} = \underbrace{nR \ln \frac{V_C}{V_B}}_{\Delta S_{gas,BC}} + \underbrace{nC_V \ln \frac{V_A}{V_D} - \frac{nC_V(T_A - T_D)}{T_A}}_{\Delta S_{u,DA}} \quad *$$

$$T_D = T_A + \frac{T_A \Delta S_{u,ciclo}}{MC_V} = 781\ K$$

$$W_{AB} = -\Delta U_{AB} = -MC_V(T_B - T_A)$$

$$W_{CD} = -\Delta U_{CD} = -MC_V(T_D - T_C)$$

$$W_{TOT} = W_{AB} + W_{CD} = -1.8 \cdot 10^4\ J$$

$$T_C V_C^{\gamma-1} = T_D V_D^{\gamma-1} \Rightarrow V_C = V_D \left(\frac{T_D}{T_C}\right)^{\frac{1}{\gamma-1}}$$

$$\Rightarrow \Delta S_{u,BC} = \Delta S_{gen,BC} = MR \ln \frac{V_C}{V_B} = 35.8\ J/K$$

$$\Delta S_{gen,ciclo} = 0 = \Delta S_{gen,BC+DA}$$

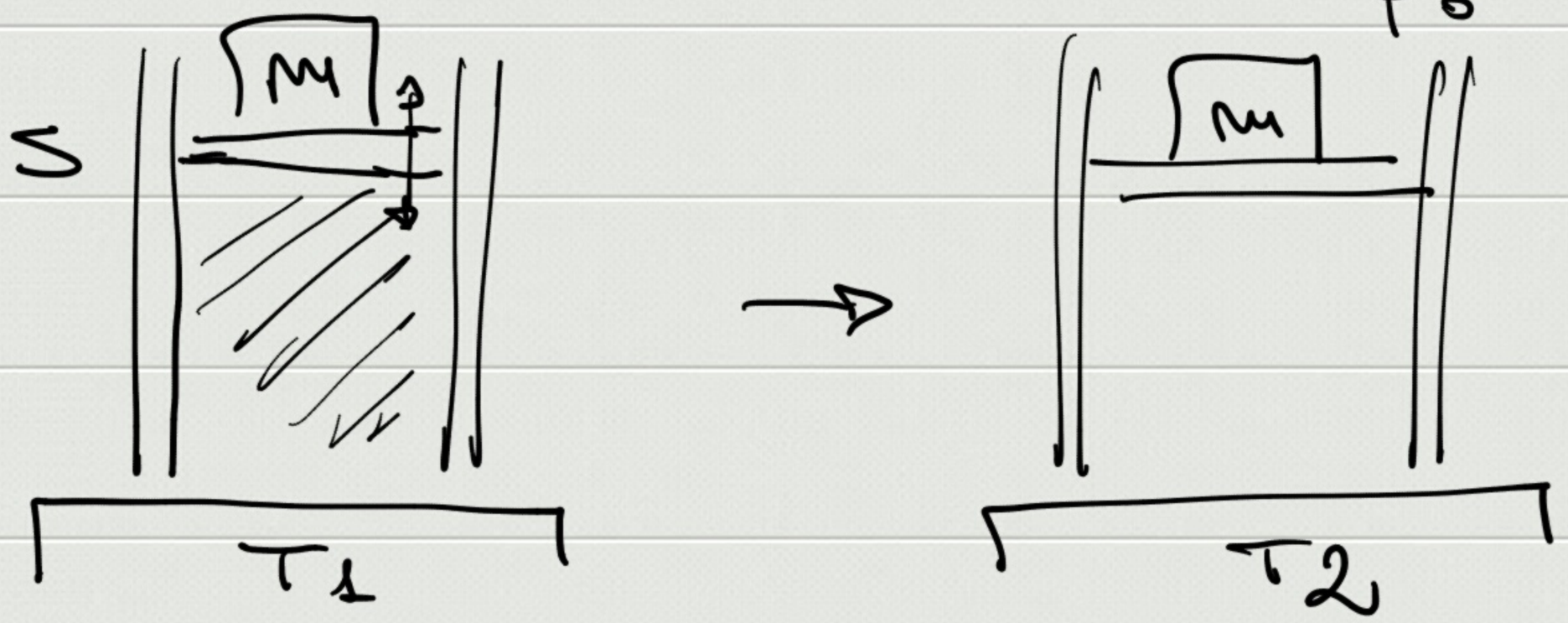
$$\Rightarrow \Delta S_{u,BC} = -\Delta S_{gen,DA} = -MC_V \ln \frac{T_A}{T_D}$$

$$\Downarrow$$

$$\Delta S_{u,ciclo} = \Delta S_{u,BC} + \Delta S_{u,DA}$$

mono, $T_1 = 290\ K$, $V_1 = 0.02\ m^3$, $S = 0.1\ m^2$

$m = 500\ kg$, $p_0 = p_{amb} = 10^5\ Pa$, $T_2 = 410\ K$



W_{gas}, ΔS_U

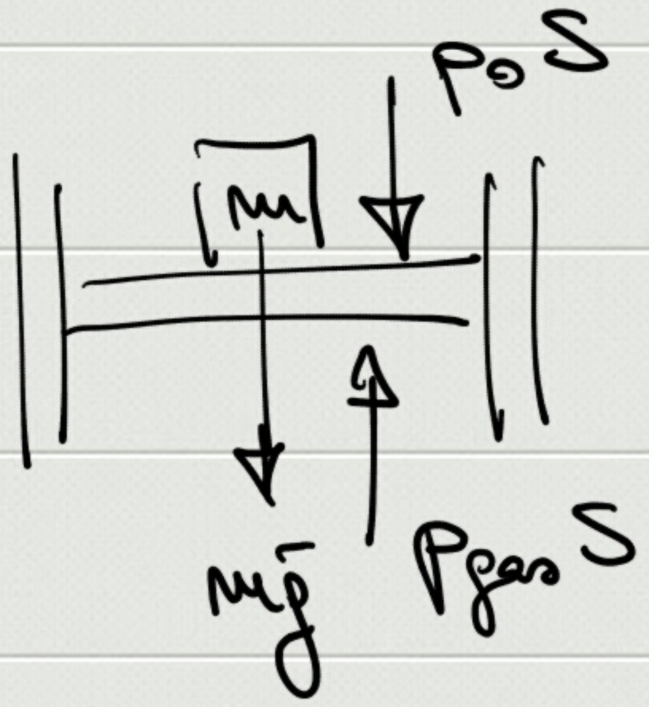
$$W_{12} = p_0 (V_2 - V_1)$$

$$= \left(p_0 + \frac{Mg}{S} \right) (V_2 - V_1) \quad *$$

$$= MR(T_2 - T_1) \quad *$$

$$= Mc_p (T_2 - T_1) + Mc_V (T_2 - T_1)$$

$$W_{gas} = -W_{amb} = -p_{amb} \Delta V_{amb} = p_{amb} \Delta V_{gas}$$



$(F = pS)$

$$mg + p_0 S - p_{gas} S = 0$$

$$\Rightarrow \boxed{p_{gas} = p_0 + \frac{mg}{S}} = 1.49 \cdot 10^5 \text{ Pa}$$

$$p = \text{cost} \Rightarrow \frac{V}{T} = \text{cost} \Rightarrow \frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow V_2 = V_1 \frac{T_2}{T_1} =$$

$$= 0.0283 \text{ m}^3$$

$$\Rightarrow W_{12} = 1237 \text{ J}$$

$$n = \frac{p_{gas} V_1}{R T_1} = 1.236 \text{ moli} \qquad \Delta S_U = 1.37 \text{ J/K}$$

$$\Delta S_U = mc_p \ln \frac{T_2}{T_1} + \frac{mc_p (T_2 - T_1)}{T_2}$$

$$= mc_p \ln \frac{T_2}{T_1} - \frac{mc_p (T_2 - T_1)}{T_2} \qquad *$$

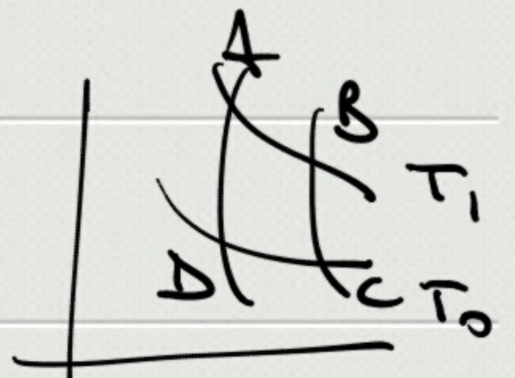
$$= mc_v \ln \frac{T_2}{T_1} + mR \ln \frac{V_2}{V_1} - \frac{mc_p (T_2 - T_1)}{T_2} \qquad *$$

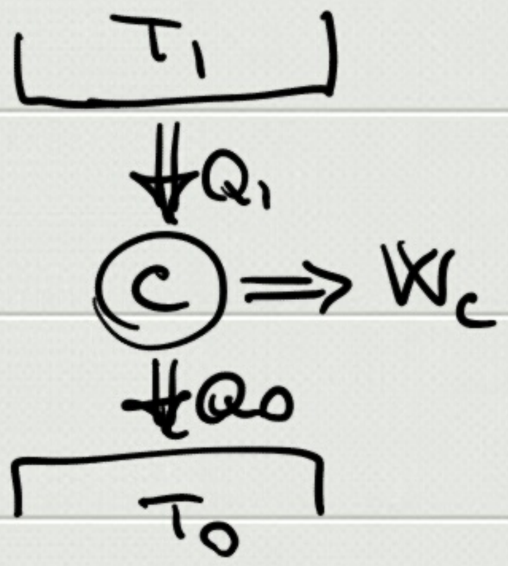
$$= mc_p \ln \frac{T_2}{T_1} + \frac{mc_p (T_2 - T_1)}{T_1}$$

Macchina di Carnot $T_1 = 390\,K$ $T_0 = 279\,K$

$n = 2$ esp. isot (rev) $V_f/V_i = 3$

$W_C = ?$





$$W_{AB} = nRT_1 \ln \frac{V_f}{V_i} = 5480 \text{ J}$$

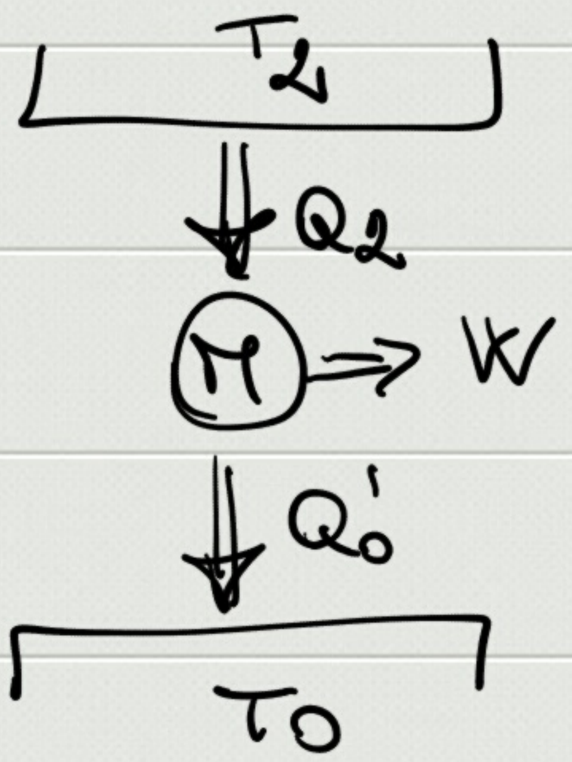
$$\stackrel{!}{=} Q_{AB} = Q_{ASS} \quad (\leftarrow Q_1)$$

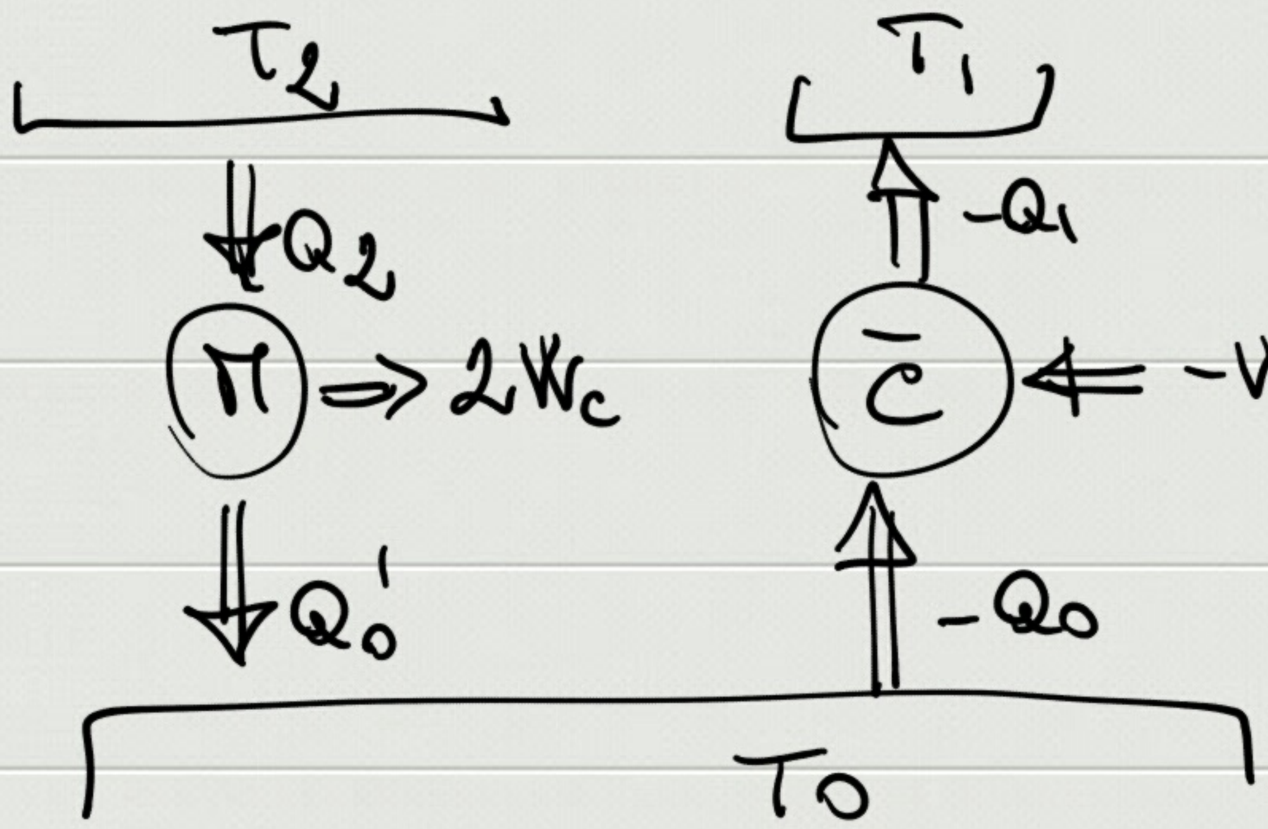
$$\eta_C = 1 - \frac{T_1}{T_2} = \frac{W_C}{Q_{ASS}} \Rightarrow$$

$$\Rightarrow W_C = Q_{ASS}\left(1 - \frac{T_1}{T_2}\right) = 383.6 \text{ J}$$

$$W_C = Q_1 + Q_0 \Rightarrow Q_0 = W_C - Q_1 = -5096.7 \text{ J}$$

$T_2 = 400\,K$, $W = 2W_C$





$\Delta S_U = 4.7$ J/K

$\eta_M = ?$

$$\eta = \frac{2W_c}{Q_2}$$

$$\begin{cases} \Delta S_U = \Delta S_{U,M} + \cancel{\Delta S_{U,C}} = \Delta S_{amb,M} = \dfrac{-Q_2}{T_2} + \dfrac{-Q_0'}{T_0} \\ Q_2 + Q_0' = 2W_c \end{cases}$$

$$\Rightarrow Q_2 = \frac{\Delta S_U + 2W_c/T_0}{\frac{1}{T_0} - \frac{1}{T_2}} = 6871 \text{ J}$$

$$\eta = 0.112$$