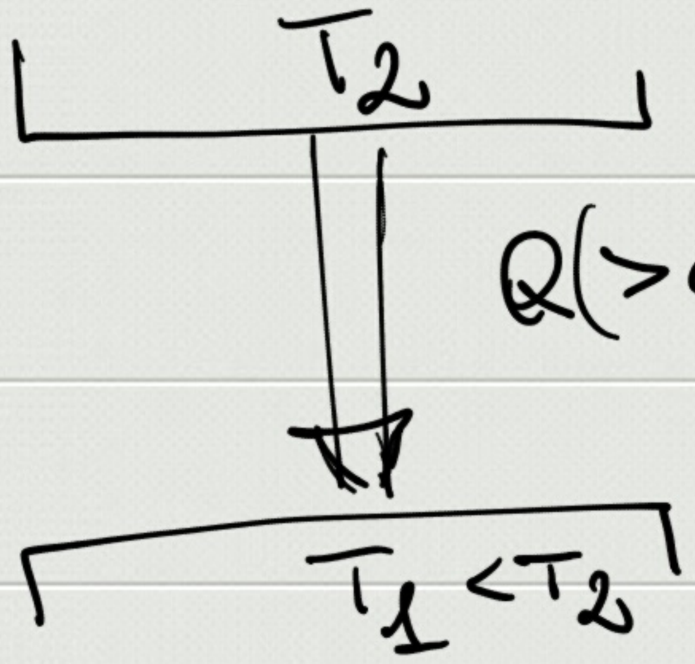


$$Q_{cess,2} = -Q < 0$$

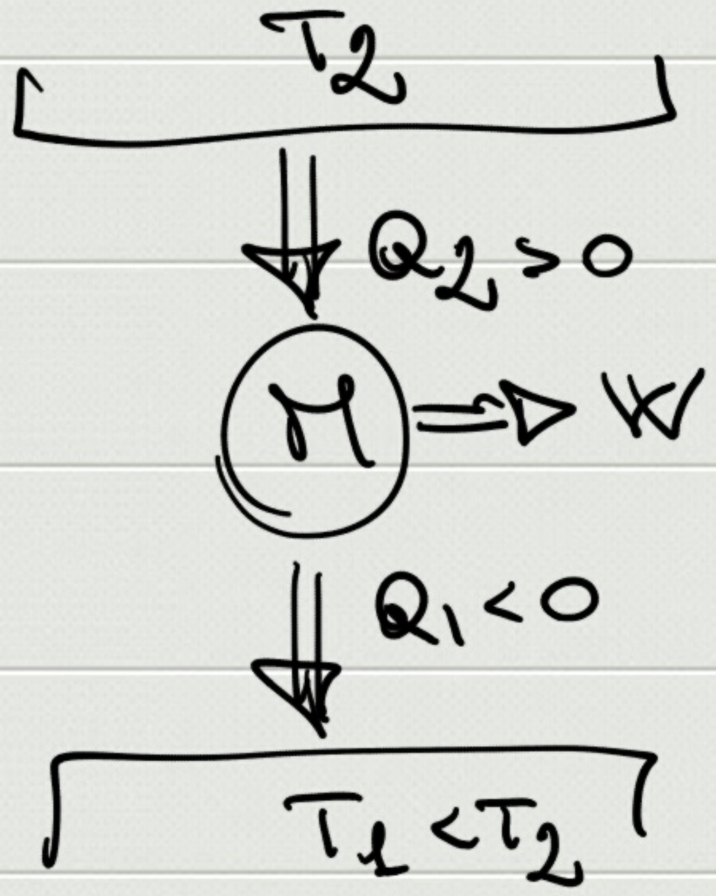
$$Q_{cess,1} = Q > 0$$

$$\Delta S = \int \left(\frac{\delta Q}{T}\right)_{rev}$$

$$\Delta S_2 = \int \left(\frac{\delta Q}{T_2}\right)_{rev} = \frac{1}{T_2} \int (\delta Q)_{rev} = -\frac{Q}{T_2}$$

$$\Delta S_1 = \int \left(\frac{\delta Q}{T_1}\right)_{rev} = \frac{1}{T_1} \int (\delta Q)_{rev} = \frac{Q}{T_1}$$

$$\Delta S_U = \Delta S_1 + \Delta S_2 = Q\left(\frac{1}{T_1} - \frac{1}{T_2}\right) > 0$$



$$\Delta S_U = \Delta S_{mech} + \Delta S_{ambs.}$$

(ciclo)

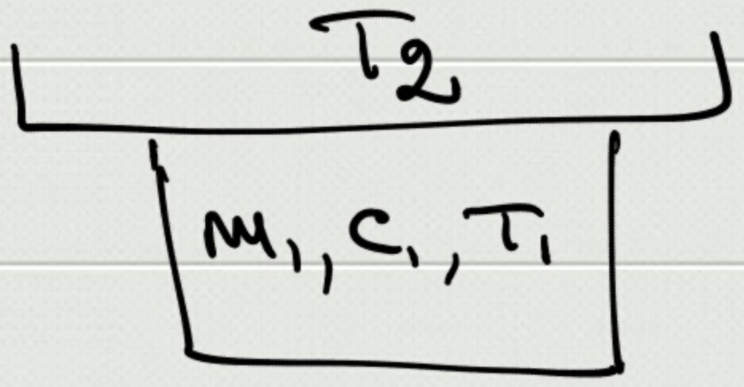
$$\Delta S_2 = \int \left(\frac{\delta Q}{T_2}\right)_{rev} = \frac{1}{T_2}\int (\delta Q)_{rev} = \frac{Q_{2,ceduto}}{T_2} = -\frac{Q_2}{T_2}$$

$$\Delta S_1 = \int \left(\frac{\delta Q}{T_1}\right)_{rev} = \frac{1}{T_1}\int (\delta Q)_{rev} = \frac{Q_{1,ceduto}}{T_1} = \frac{-Q_1}{T_1}$$

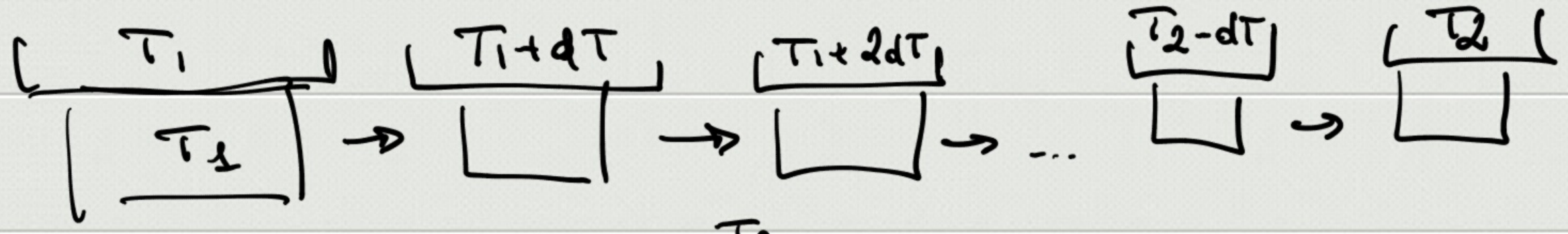
$$\Rightarrow \Delta S_U = -\left(\frac{Q_1}{T_1} + \frac{Q_2}{T_2}\right) \geq 0 \begin{cases} = 0 & rev \\ > 0 & irrev. \end{cases}$$

T. Carnot $\quad \frac{Q_1}{T_1} + \frac{Q_2}{T_2} \leq 0$

$$[Q = mc\,\Delta T]$$



irrev. $\quad \Delta S_U = ?$



$$\Delta S_{corpo} = \int \left(\frac{\delta Q}{T}\right)_{rev} = \int_{T_1}^{T_2} \frac{m_1 c_1 dT}{T} = m_1 c_1 \ln \frac{T_2}{T_1}$$

$$\Delta S_{serb} = \int \left(\frac{\delta Q}{T_2}\right)_{rev} = \frac{1}{T_2} \int (\delta Q)_{rev} = \frac{Q_{serb}}{T_2} =$$

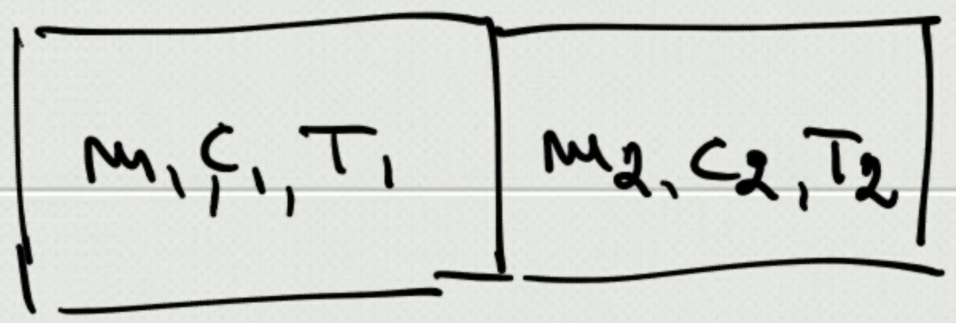
$$= \frac{-Q_{corpo}}{T_2} = - \frac{m_1 c_1 (T_2 - T_1)}{T_2} = \frac{m_1 c_1 (T_1 - T_2)}{T_2}$$

$$\Delta S_U = m_1 c_1 \ln \frac{T_2}{T_1} + m_1 c_1 \frac{(T_1 - T_2)}{T_2}$$

$$dS_U = \frac{m_1 c_1 dT}{T} - \frac{m_1 c_1 dT}{T_2} = m_1 c_1 dT \left(\frac{1}{T} - \frac{1}{T_2}\right)$$

$T_1 < T_2 \quad \left(\frac{1}{T} - \frac{1}{T_2}\right) > 0 \qquad dS_U > 0$

$T_2 < T_1 \quad \left(\frac{1}{T} - \frac{1}{T_2}\right) < 0 \qquad dT < 0 \implies dS_U > 0$



$\Delta S_U = ?$

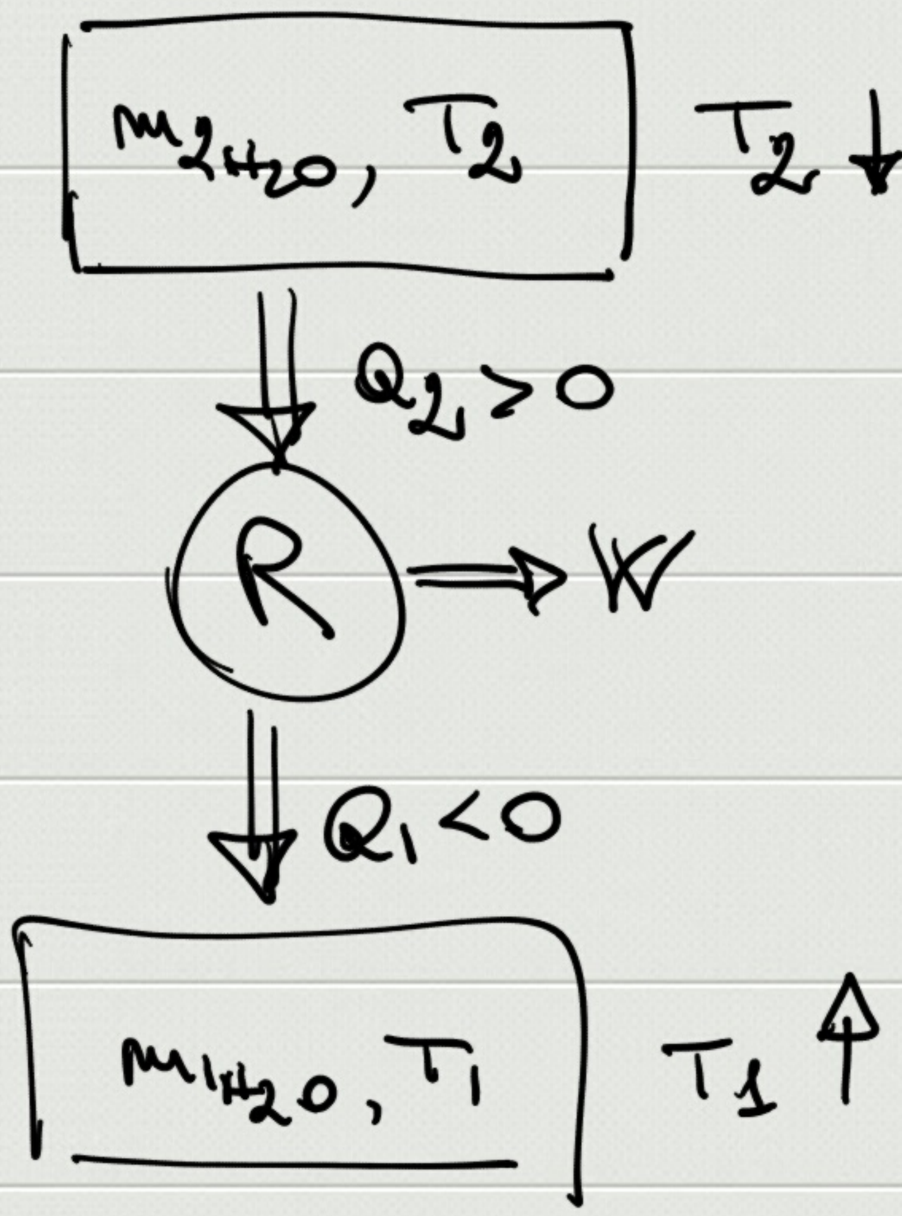
$$T_e = \frac{m_1 c_1 T_1 + m_2 c_2 T_2}{m_1 c_1 + m_2 c_2}$$

$$\Delta S_U = m_1 c_1 \ln \frac{T_e}{T_1} + m_2 c_2 \ln \frac{T_e}{T_2} > 0$$

H_2O $\quad m_2 = 150\ kg \quad m_1 = 300\ kg$

$T_2 = 353.15 K \quad T_1 = 283.15 K$

$T_e = 306,5\ K \quad \Delta S_U = 10432\ J/K$



T_e' , $M_{TOT} = \frac{W_{TOT}}{Q_{ASS,TOT}}$

$\Delta S_U = 0$

$\Delta S_U = \cancel{\Delta S_{Mgcch}} + \Delta S_{corpi} = 0$

(ciclo)

$$\Delta S_U = m_2 \cancel{c_{H_2O}} \ln \frac{T_e'}{T_2} + m_1 \cancel{c_{H_2O}} \ln \frac{T_e'}{T_1} = 0$$

$$\ln \left(\frac{T_e'}{T_2} \right)^{m_2} + \ln \left(\frac{T_e'}{T_1} \right)^{m_1} = 0$$

$$\ln \left(\frac{T_e'^{\,m_1+m_2}}{T_2^{\,m_2}\, T_1^{\,m_1}} \right) = 0$$

$$T_e' = T_2^{\frac{m_2}{m_1+m_2}} \, T_1^{\frac{m_1}{m_1+m_2}} = 304.8 K$$

$$\eta_{TOT} \simeq 1 + \frac{Q_{CED}}{Q_{ASS}} = 1 + \frac{-m_1 c_{H_2O} (T_e' - T_1)}{-m_2 c_{H_2O} (T_e' - T_2)} = 0.2\%$$

Cambiamento di fase $\quad Q = m\lambda$

$\Rightarrow$ reversibile

$$\Delta S = \int \left(\frac{\delta Q}{T} \right)_{rev} = \frac{1}{T} \int (\delta Q)_{rev} = \frac{m\lambda}{T}$$

$T_2 =$
$m_2, H_2O, 283.15 K$

$m_2 = 10^6 kg \qquad m_1 = 0.2 \cdot 10^6 kg$

Q_2

M $\Rightarrow W$

$W_{max} = ?$

Q_1

$T_1 =$
$m_1, ghiaccio, 273.15 K$

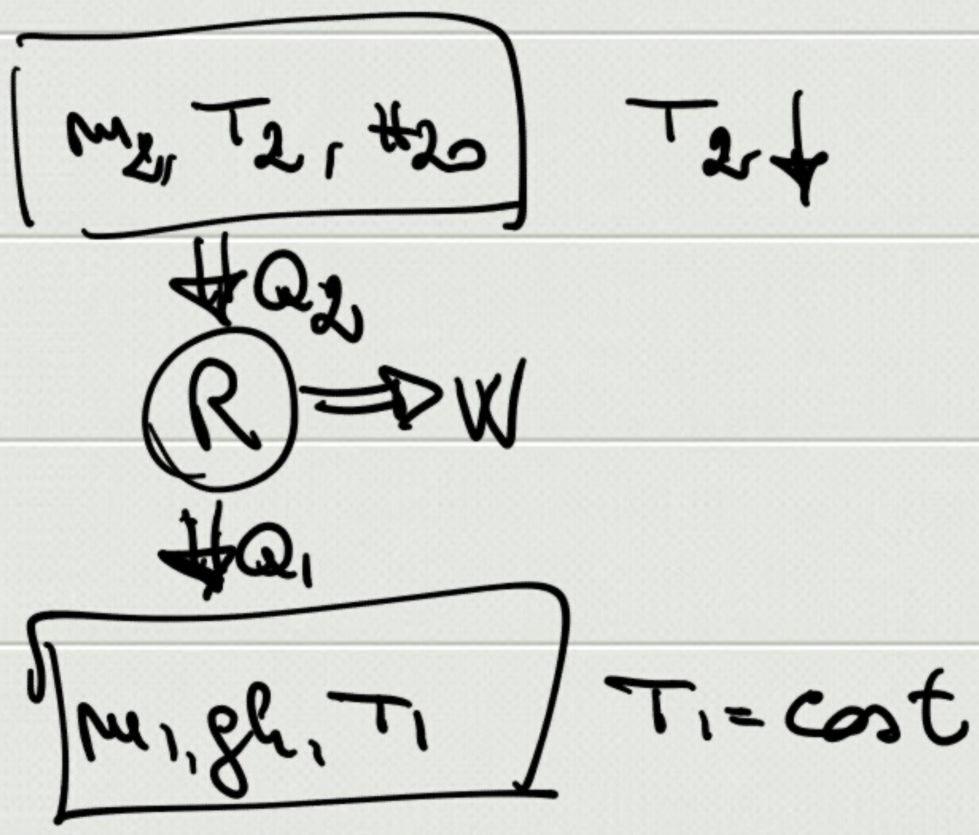
$\Rightarrow$ reversibile

$\Rightarrow \Delta S_U = 0$

$\Rightarrow \Delta S_{H_2O} + \Delta S_{gh} = 0$

$Q_{2,max} = ?$ $\quad |m_2 c_{H_2O} (T_1 - T_2)| = 4.19 \cdot 10^{10}\ J$

$Q_{1,fondere\ tutto} = ?$ $\quad m_1 \lambda = 6.69 \cdot 10^{10}\ J$



$T_2 \downarrow$ $\quad T_2 \to T_1$

$T_1 = cost$

$\Delta S_U = 0 \Rightarrow \quad \Delta S_2 + \Delta S_1 = 0$

$\Delta S_2 = m_2 c_{H_2O} \ln \frac{T_1}{T_2}$ $\quad \Delta S_1 = \frac{Q_{ass,gh}}{T_1}$

$\Rightarrow \quad Q_{ass,gh} = -T_1 m_2 c_{H_2O} \ln \frac{T_1}{T_2} = 4.11 \cdot 10^{10}\ J$

$Q_{CED,H_2O} = m_2 c_{H_2O} (T_1 - T_2)$

$Q_{2,TOT} = -Q_{CED,H_2O}$ $\quad Q_{1,TOT} = -Q_{ass,gh}$

$$W_{MAX} = Q_{TOT} = 8 \cdot 10^8 \ J$$

$$\eta_{TOT} = \frac{W_{TOT}}{Q_{LOSS}} = 1.9\%$$