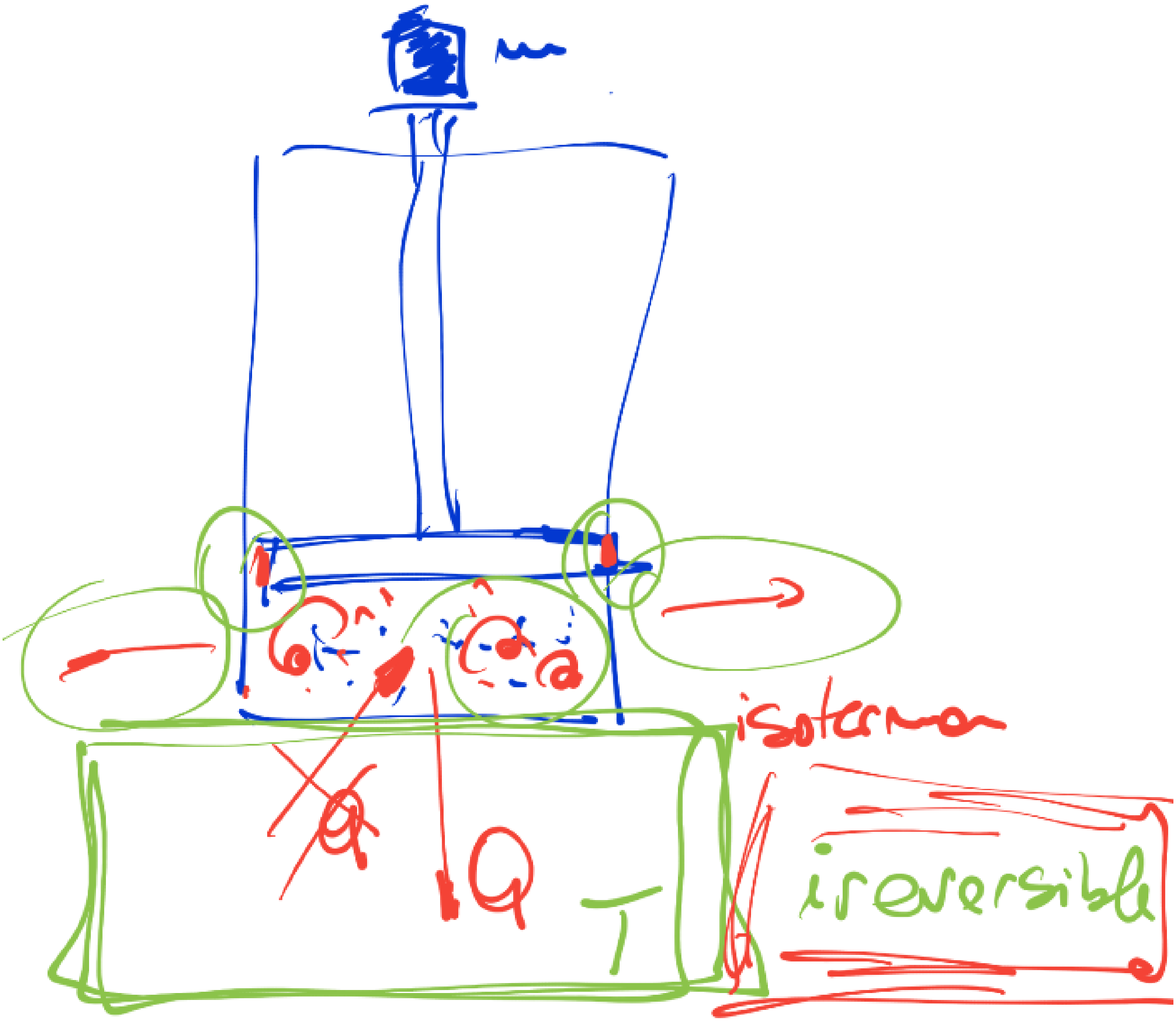
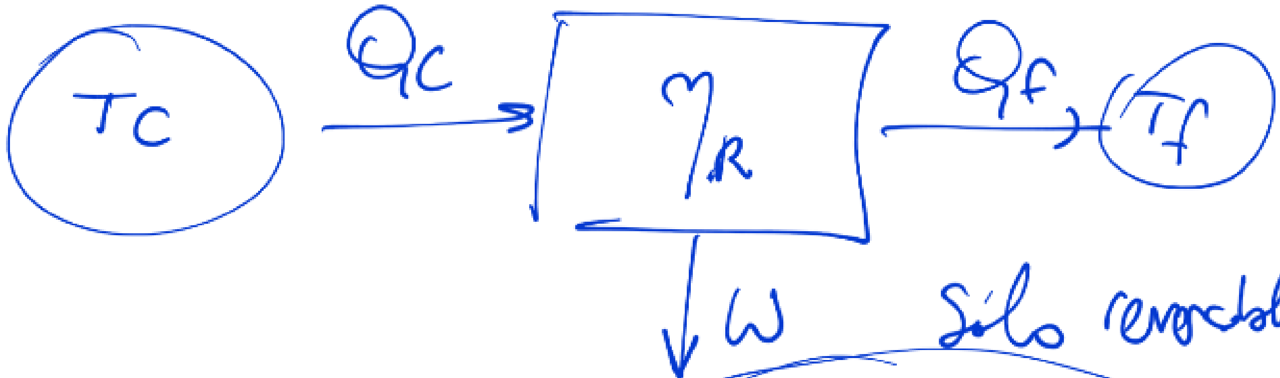
f3b-20190430-U03C03-Entropia_apuntes.pdf





Sólo reversibles.

$$Q_c = W + Q_f$$

$$\eta_R = 1 - \frac{T_f}{T_c}$$

$$\underbrace{\frac{Q_c}{Q_c}}_{1} = \underbrace{\frac{W}{Q_c}}_{\eta_R} + \frac{Q_f}{Q_c} \Rightarrow \eta_R = 1 - \frac{|Q_f|}{|Q_c|}$$

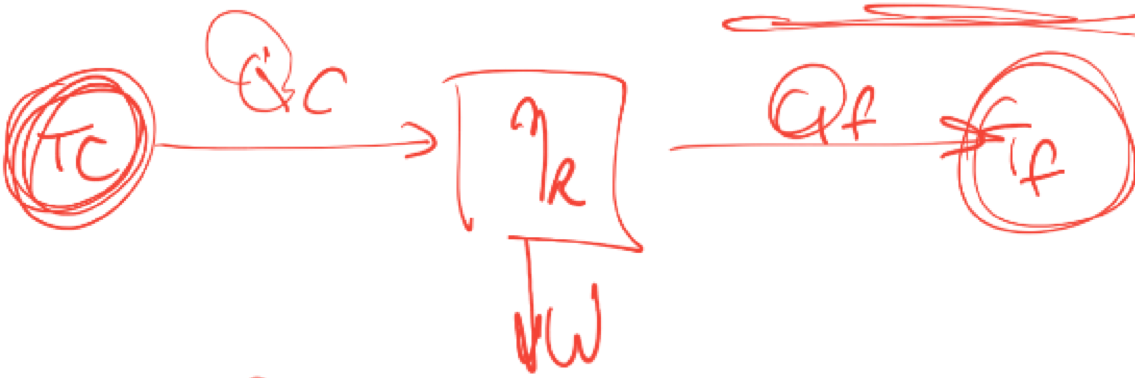
$$1 - \frac{T_f}{T_c} = 1 - \frac{|Q_f|}{|Q_c|} \Rightarrow \frac{T_f}{T_c} = \frac{|Q_f|}{|Q_c|}$$

$$\Rightarrow \boxed{\frac{|Q_c|}{T_c} = \frac{|Q_f|}{T_f}}$$

En una máq térmica $Q_c > 0$

$Q_f < 0$

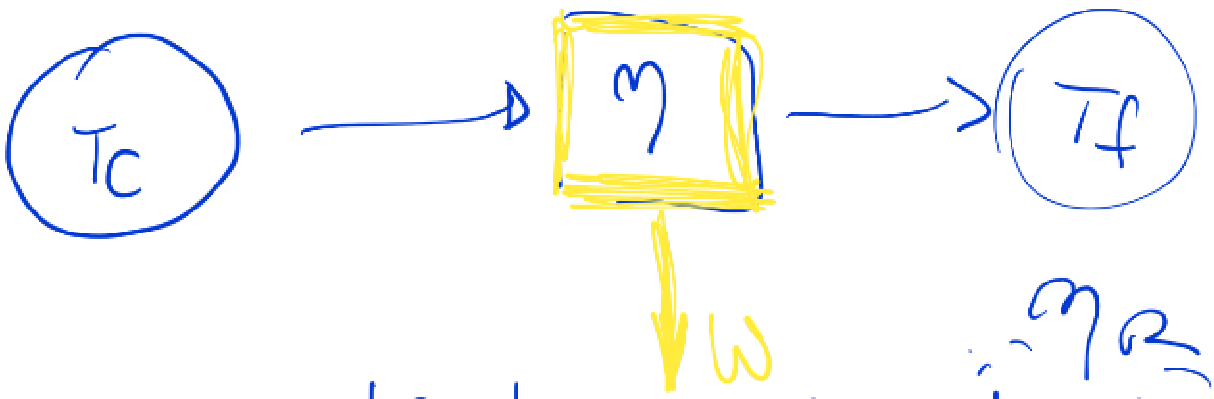
$$\frac{Q_c}{T_c} = -\frac{Q_f}{T_f} \Rightarrow \boxed{\frac{Q_c}{T_c} + \frac{Q_f}{T_f} = 0}$$



$$\frac{Q_c}{T_c} + \frac{Q_f}{T_f} = 0 \qquad T_c = T_f = T$$

$$\frac{Q_c}{T} + \frac{Q_f}{T} = 0 \Rightarrow \cancel{\frac{1}{T}}\left(Q_c+Q_f\right)=0$$

$$Q_c = -Q_f \qquad W=0.$$



$$\eta = 1 - \frac{|Q_f|}{|Q_c|} \qquad \eta < \overbrace{1 - \frac{T_f}{T_c}}^{\eta_R}$$

$$\eta < \eta_R \Rightarrow 1 - \frac{|Q_f|}{|Q_c|} < 1 - T_f/T_c$$

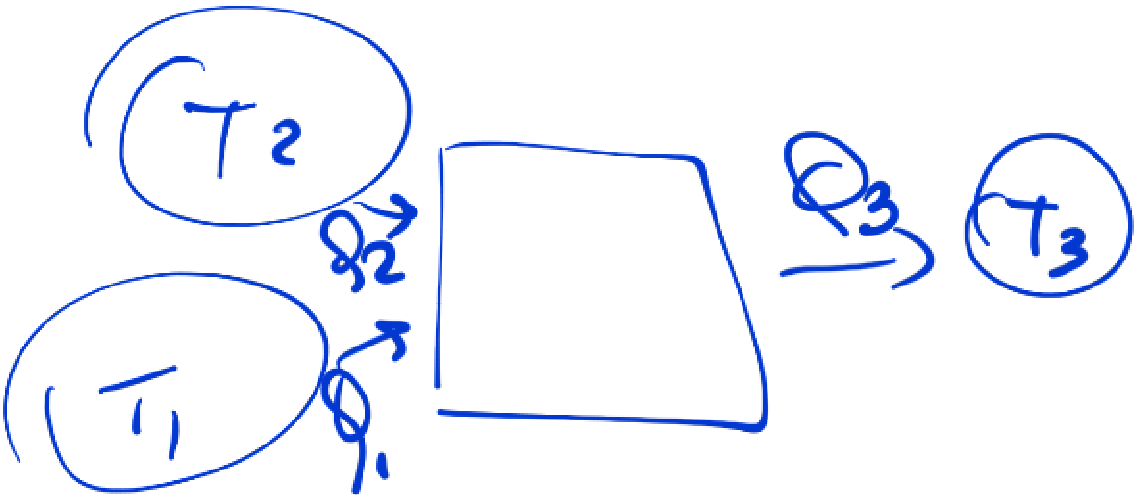
$$\frac{|Q_f|}{|Q_c|} > \frac{T_f}{T_c} \Rightarrow \boxed{\frac{|Q_f|}{T_f} > \frac{|Q_c|}{T_c}}$$

$Q_c > 0$ y $Q_f < 0$ maq irreversible

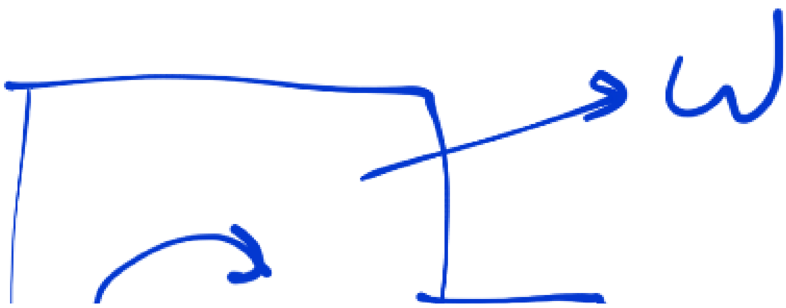
$$-Q_f/T_f > \frac{Q_c}{T_c} \Rightarrow \boxed{\frac{Q_c}{T_c} + \frac{Q_f}{T_f} < 0}$$

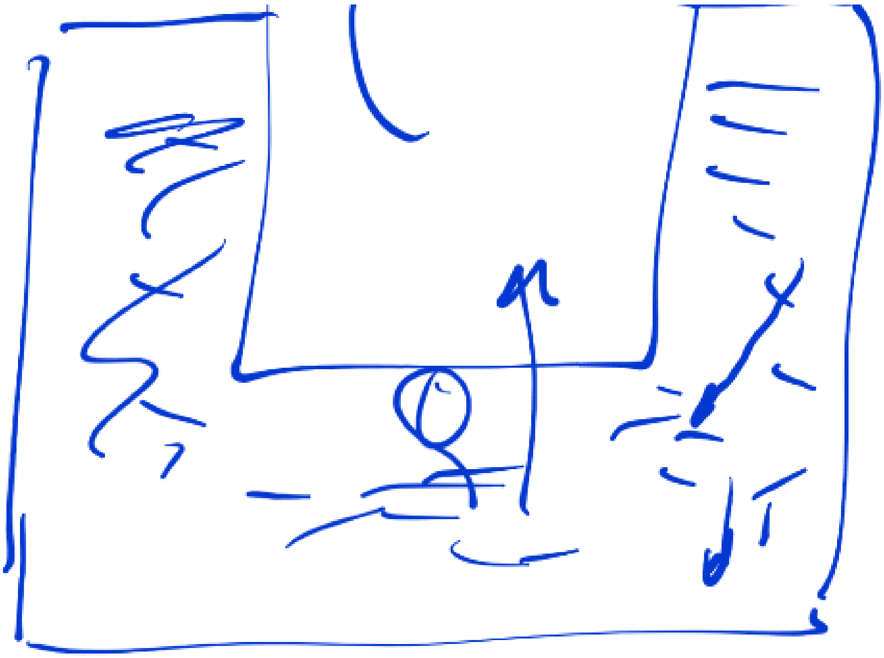
maq irreversible

$$\frac{Q_1}{T_1} + \frac{Q_2}{T_2} + \frac{Q_3}{T_3} + \dots + \frac{Q_{n-1}}{T_{n-1}} + \underbrace{\frac{Q_n}{T_n}}_{<0.} \leq 0$$



$T_2 = T_1 - dT_1$





$T_c - T_f \sim dT$

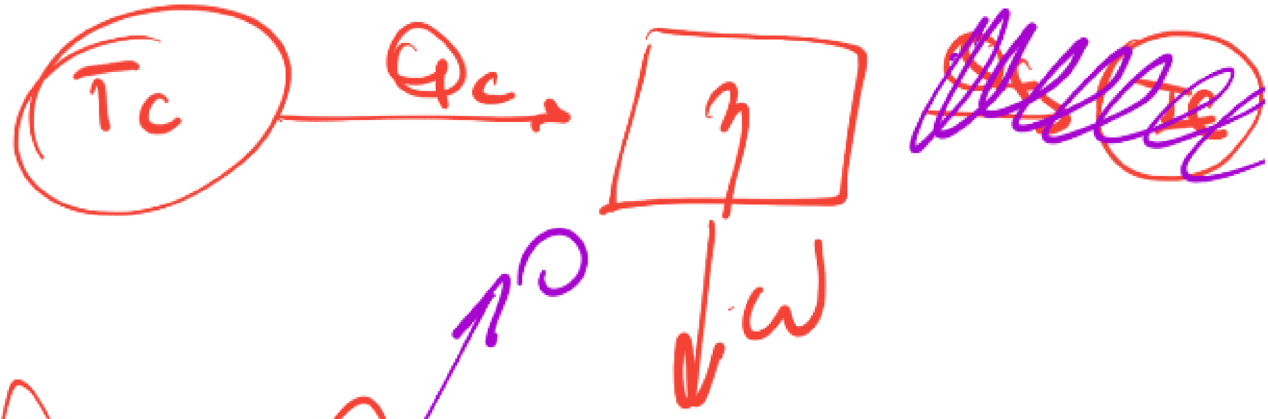
$$\sum \frac{Q_i}{T_i} \leq 0 \rightarrow \boxed{\oint \frac{dQ}{T} \leq 0}$$

Desigualdad de Clausius.

$\oint \frac{dQ}{T} = 0 \longrightarrow$ Ciclo reversible

$\oint \frac{dQ}{T} < 0 \longrightarrow$ Ciclo irreversible

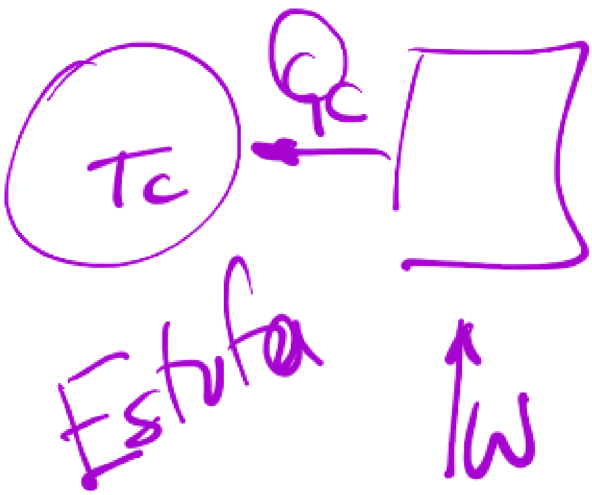
$\oint \frac{dQ}{T} < 0 \rightarrow$

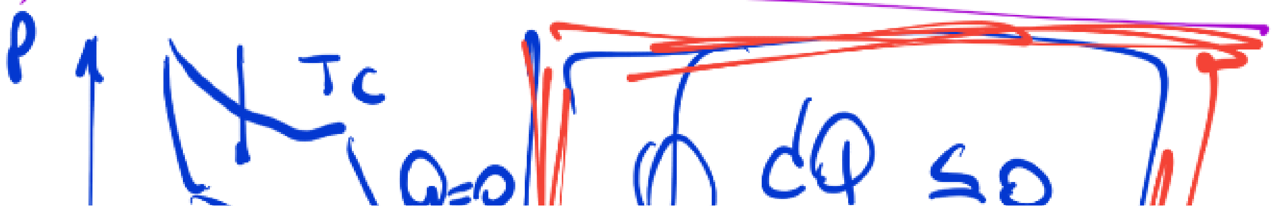


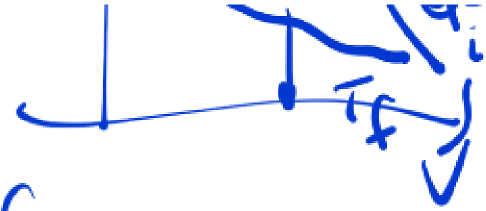
$$\frac{Q_c}{T_c} + \cancel{\frac{Q_f}{T_f}} < 0$$

$$\frac{Q_c}{T_c} < 0 \qquad T_c > 0$$

$$Q_c \leq 0$$







$$\boxed{\oint \frac{dQ}{T}}$$

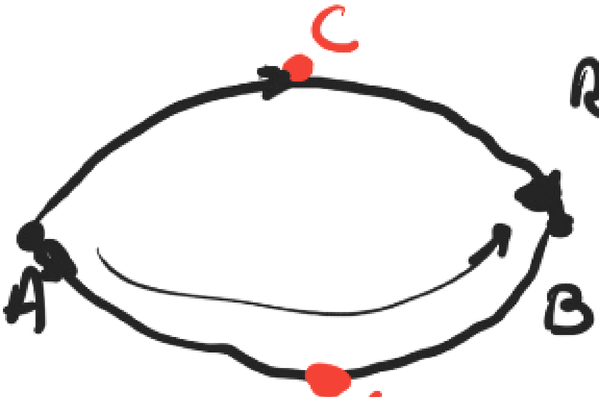
$$\oint \frac{dQ}{T} = 0 = \int_{T_C} \frac{dQ_c}{T_c} + \int_{T_f} \frac{dQ_f}{T_f} + \cancel{\int \frac{dQ}{T}}^{\,0}$$

$$\frac{1}{T_c}\int^{Q_c} dQ_c + \frac{1}{T_f}\int^{Q_f} dQ_f = 0$$

$$\frac{Q_c}{T_c} + \frac{Q_f}{T_f} = 0 \Rightarrow \boxed{\frac{Q_c}{T_c} + \frac{Q_f}{T_f} \le 0}$$

$$I = \oint \frac{dQ}{T} \le 0$$

- < 0 irreversible
- $= 0$ reversible
- > 0 impossible



Reversible

$$\oint \frac{dQ}{T} \le 0 \Rightarrow \int_{A\ (C)}^{B} \frac{dQ}{T} + \int_{B\ (C')}^{A} \frac{dQ}{T} = 0$$

$$\int_{A\ (C)}^{B} \frac{dQ}{T} = -\int_{B\ (C')}^{A} \frac{dQ}{T}$$

$$= -\left(-\int_{A\ (C')}^{B} \frac{dQ}{T}\right)$$

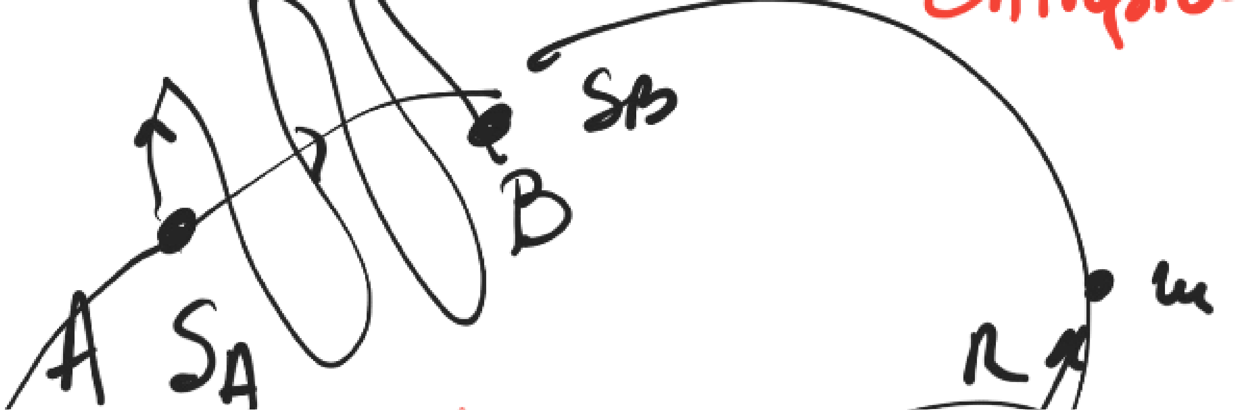
$$\boxed{\int_{A\ (C)}^{B} \frac{dQ}{T} = \int_{A\ (C')}^{B} \frac{dQ}{T}}$$

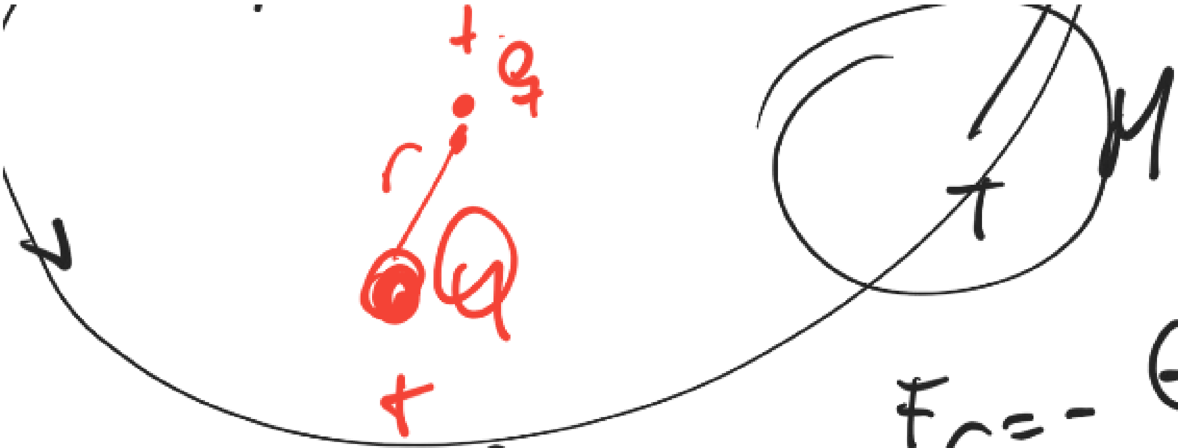
Entropía

función de estado!

$$\boxed{dS = \frac{dQ_R}{T}}$$

Entropía





$$E_G = -\frac{GMm}{R}$$

$$dS = \frac{dQ_R}{T}$$

$$[S] = \frac{[Q]}{[T]} = J/K$$

$$\Delta S = S_B - S_A = \int_A^B \frac{dQ_R}{T} = \int_A^B dS$$

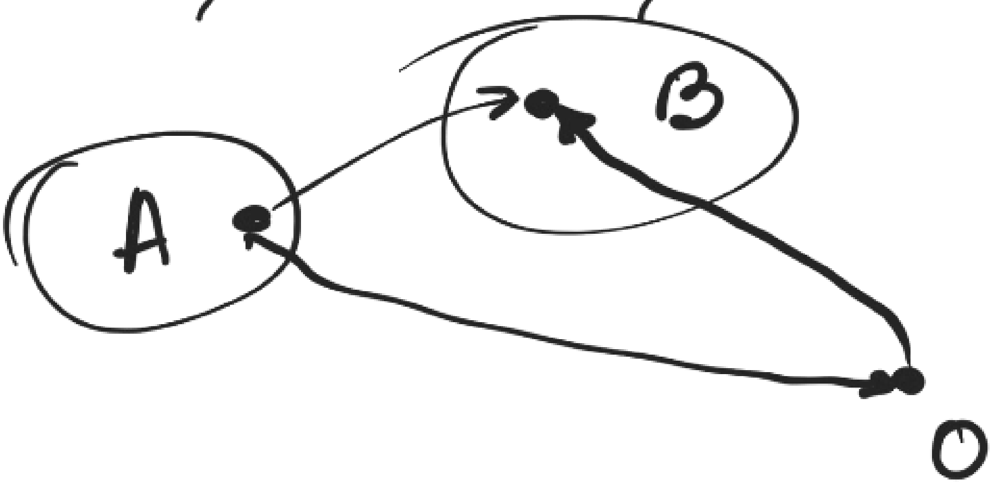
$$S_0$$

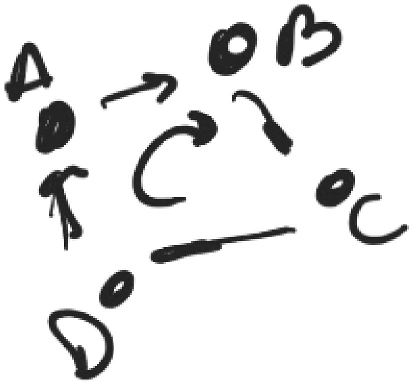
$$S_A = S_A - S_0 = \int_0^A \frac{dQ_R}{T}$$

$$S_B = S_B - S_0 = \int_0^B \frac{dQ_R}{T}$$

$$\Delta S = S_B - S_A = (S_B - S_0) - (S_A - S_0)$$

$$= S_B - \cancel{S_0} - S_A + \cancel{S_0} = S_B - S_A$$





$$\Delta S = 0$$

$$dQ = dU + dW \quad \Big| \quad Q = \Delta U + W$$

$$dW = p\,dV \quad a \; p = cte \qquad dS = \frac{dQ_R}{T}$$

$$\Rightarrow dQ_R = dS\,T$$

$$\frac{dQ}{T} = \frac{dU}{T} + \frac{dW}{T} \quad \text{Si es Reversible}$$

$$\underbrace{\frac{dQ_R}{T}}_{dS} = \frac{dU}{T} + \frac{p}{T}\,dV$$

$$dS = \frac{dU}{T} + \frac{p}{T}\,dV$$

$$dS.T = dU + p\,dV \quad \text{1ª Ec. Gibbs}$$

$$\Rightarrow \boxed{dU = T\,dS + p\,dV}$$

Última modificación: 23:06