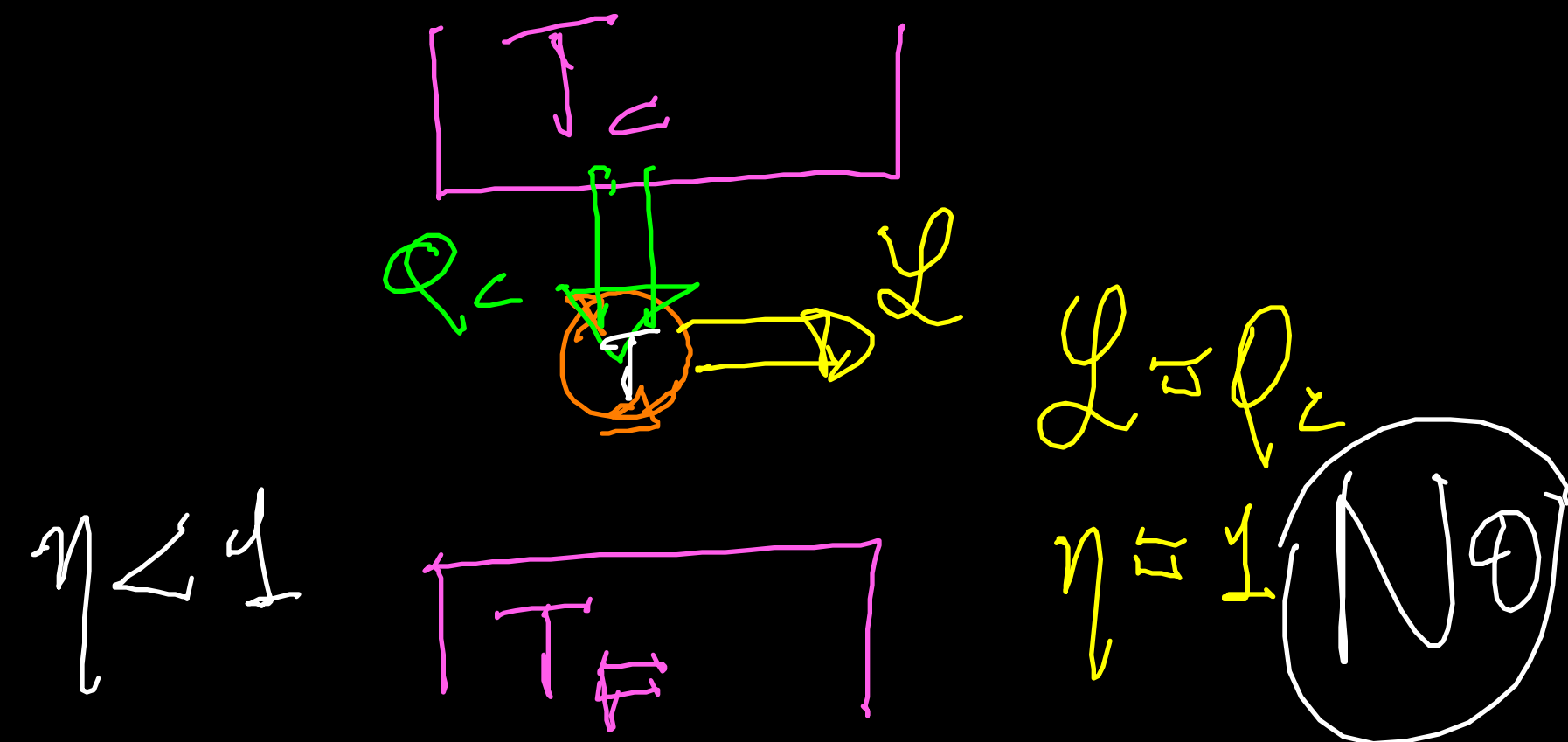
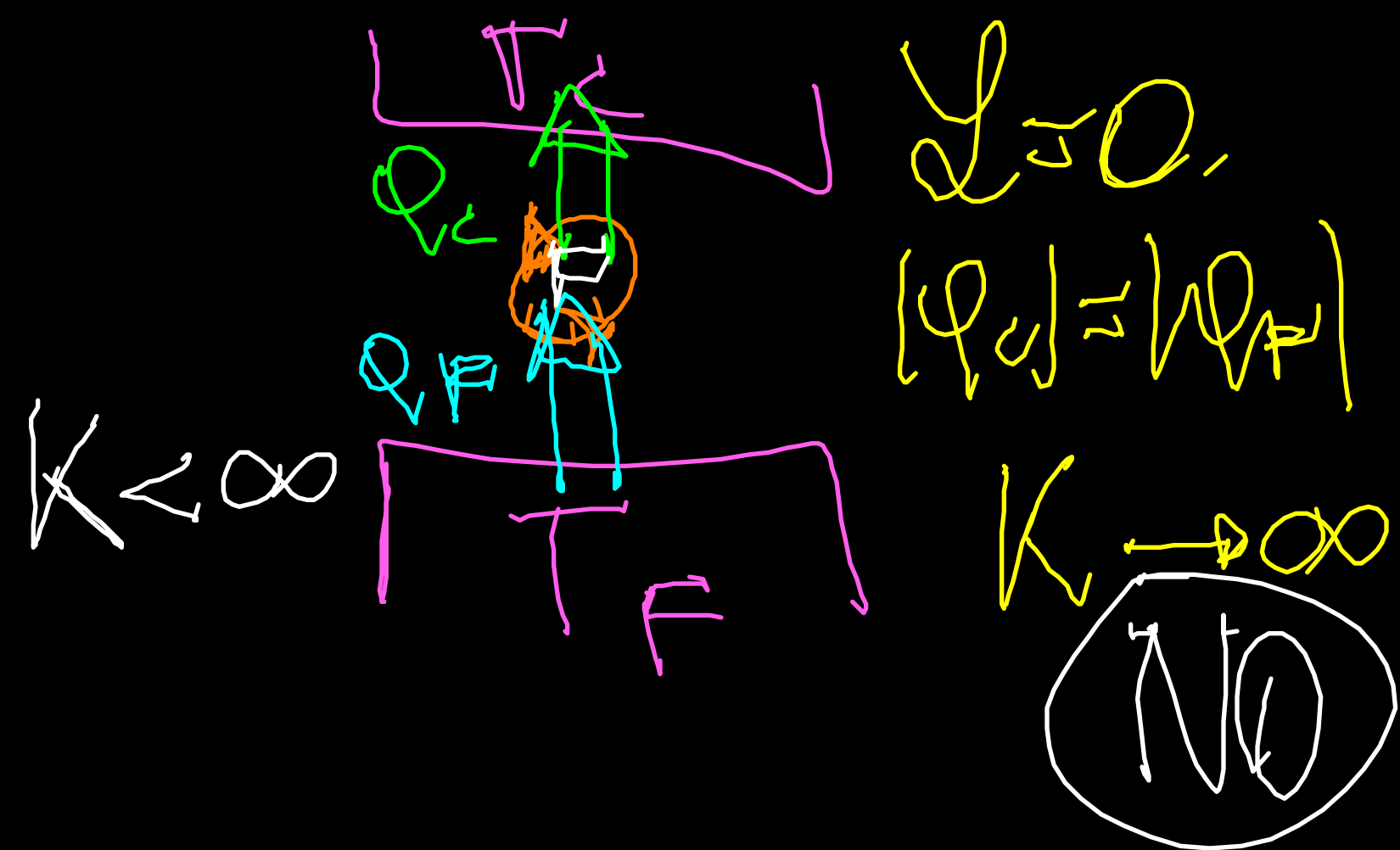


SECONDO PRINCIPIO DELLA TERMODINAMICA

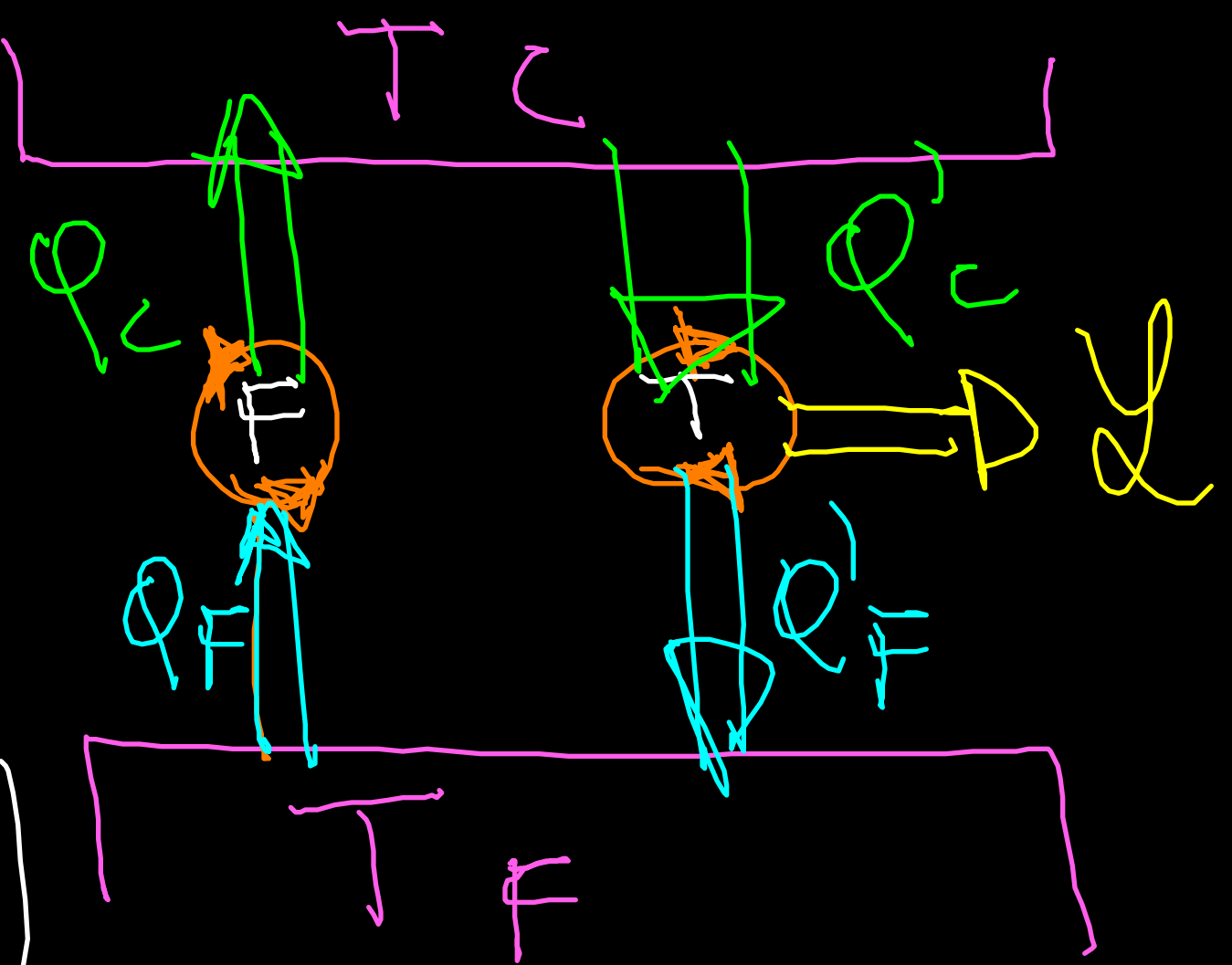
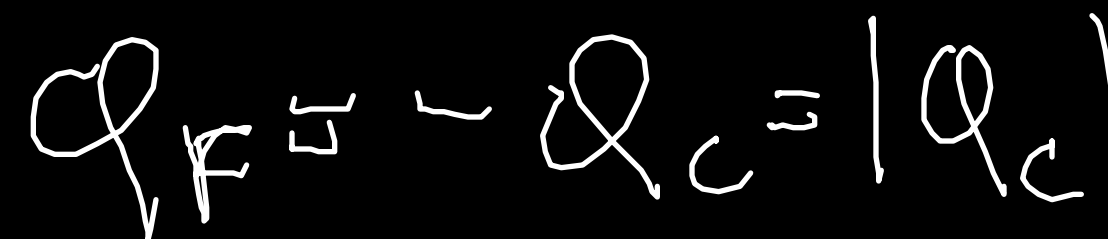
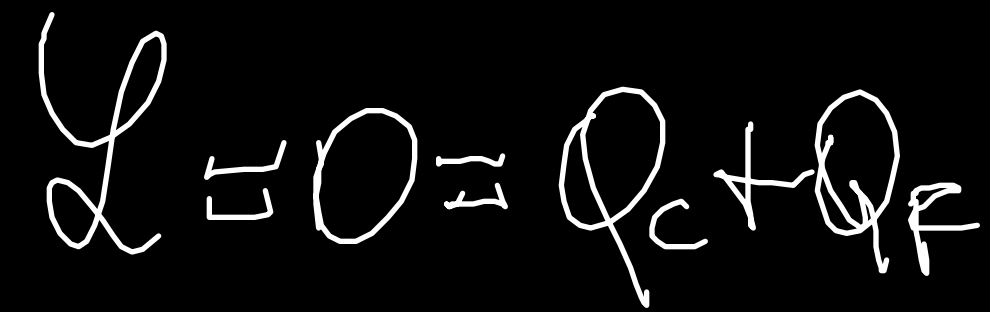
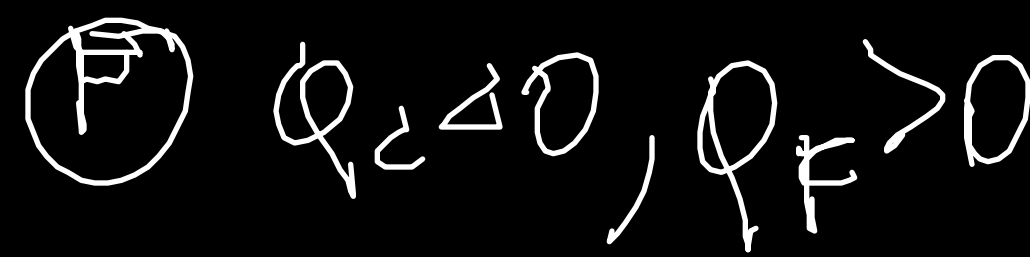
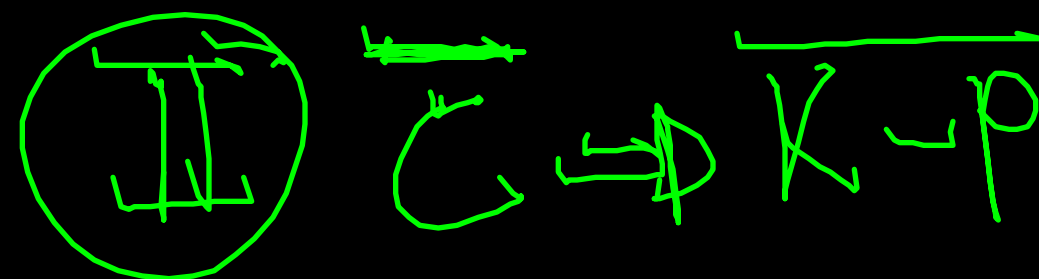
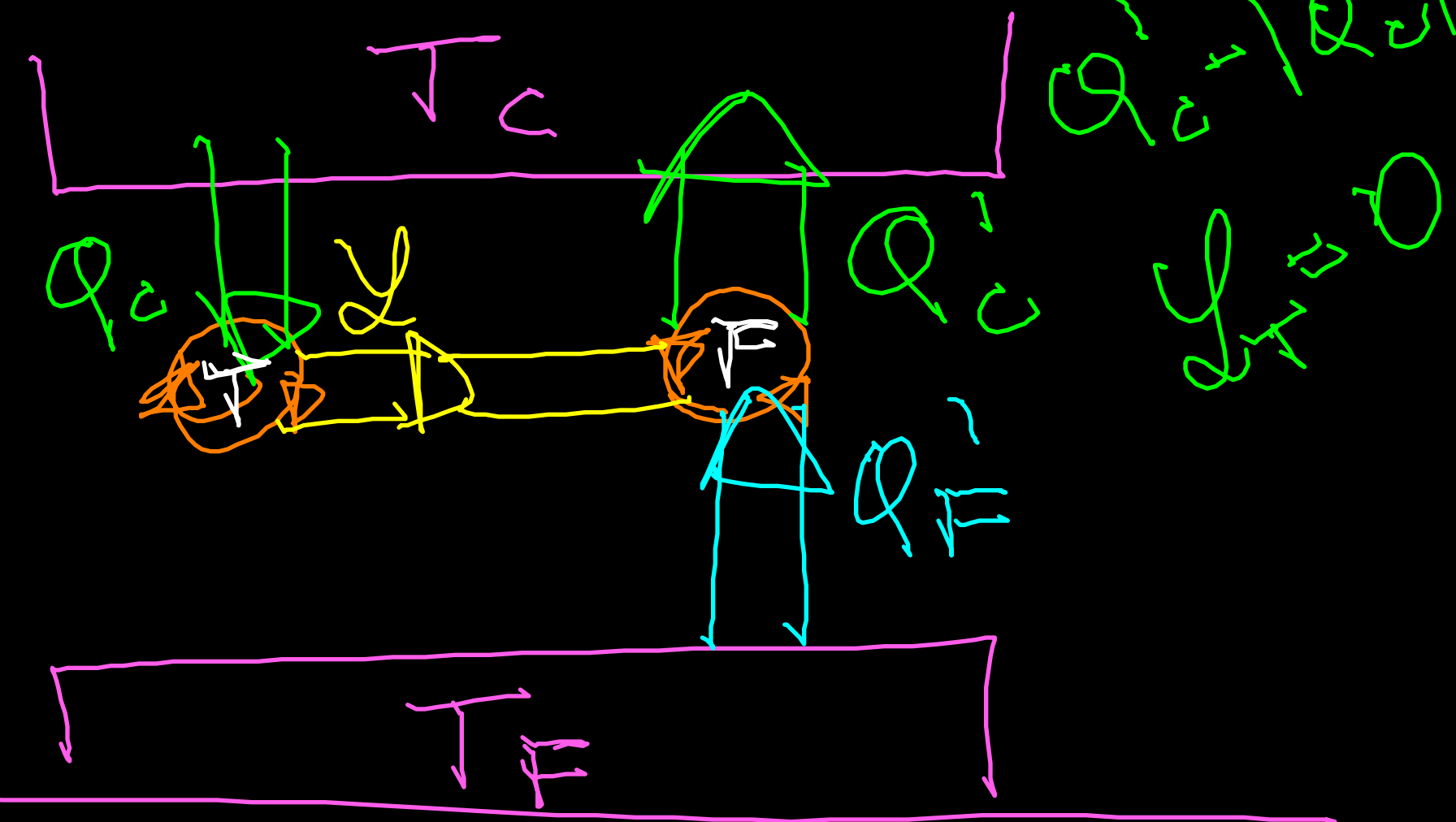
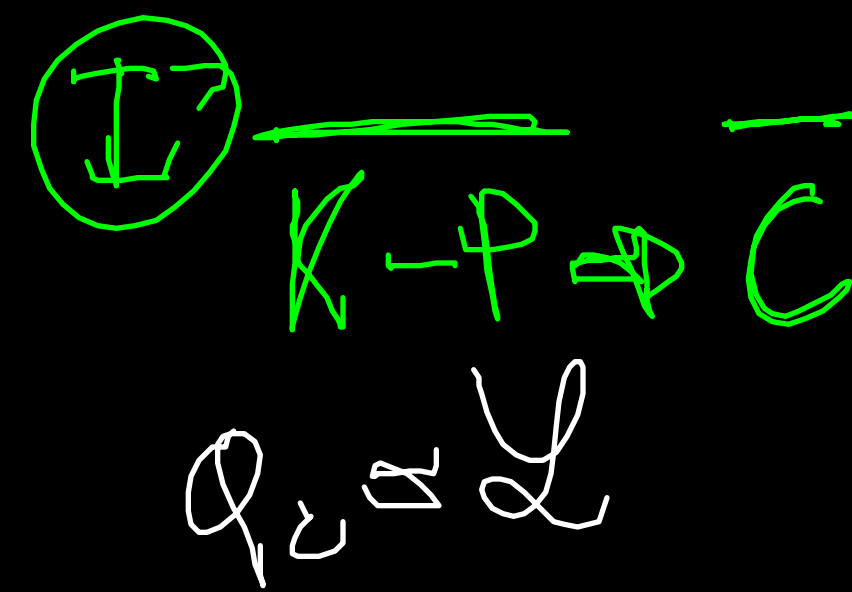
KELVIN - PLANCK



CLAUSIUS



EQUVALENZA K-P \leftrightarrow C

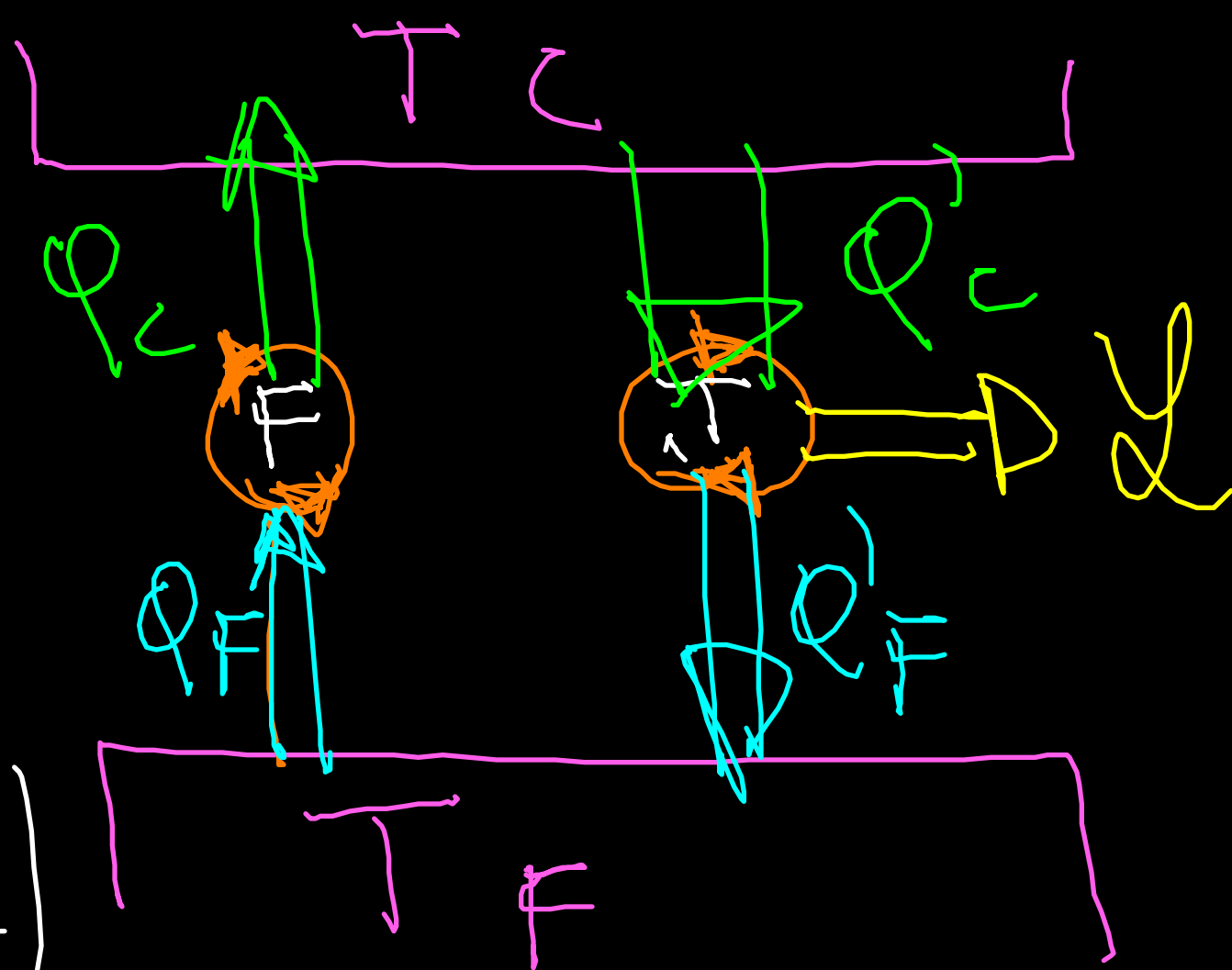


II $C \rightarrow K-p$

(F) $Q_C < 0, Q_F > 0$

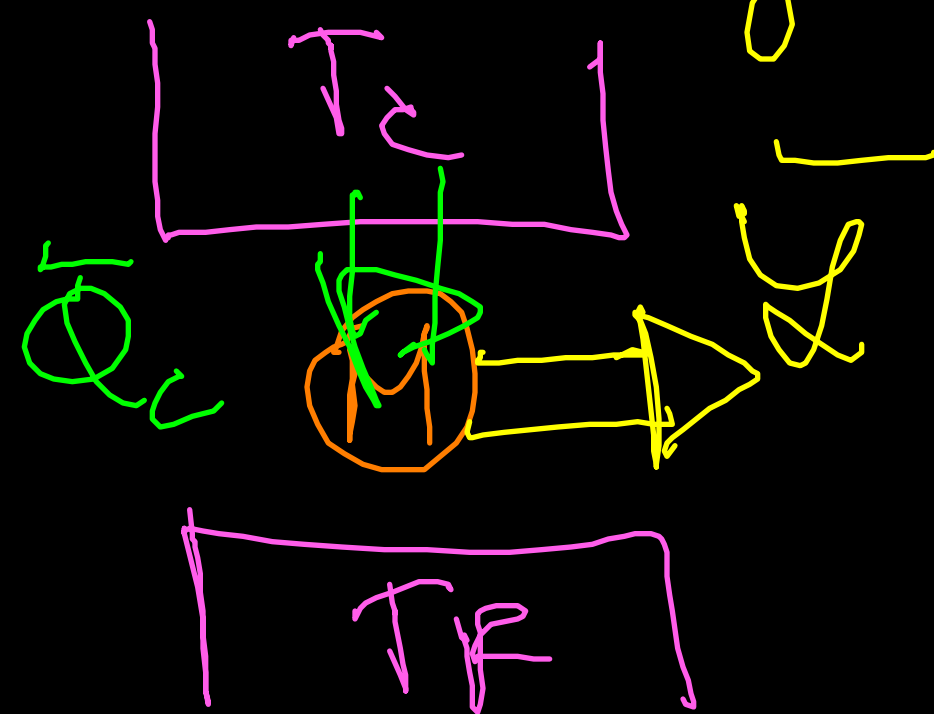
$L = 0 = Q_C + Q_F$

$Q_F = -Q_C = |Q_C|$



(T) $L = Q'_C + Q'_F > 0$

$Q'_C > 0, Q'_F < 0$



Per la macchina globale (F) + (T)

$L = Q_C + Q'_F = Q_C$

$Q'_F = Q_F + Q'_F = 0$

$Q_F = -Q'_F = |Q'_F|$
 uguale la macchina

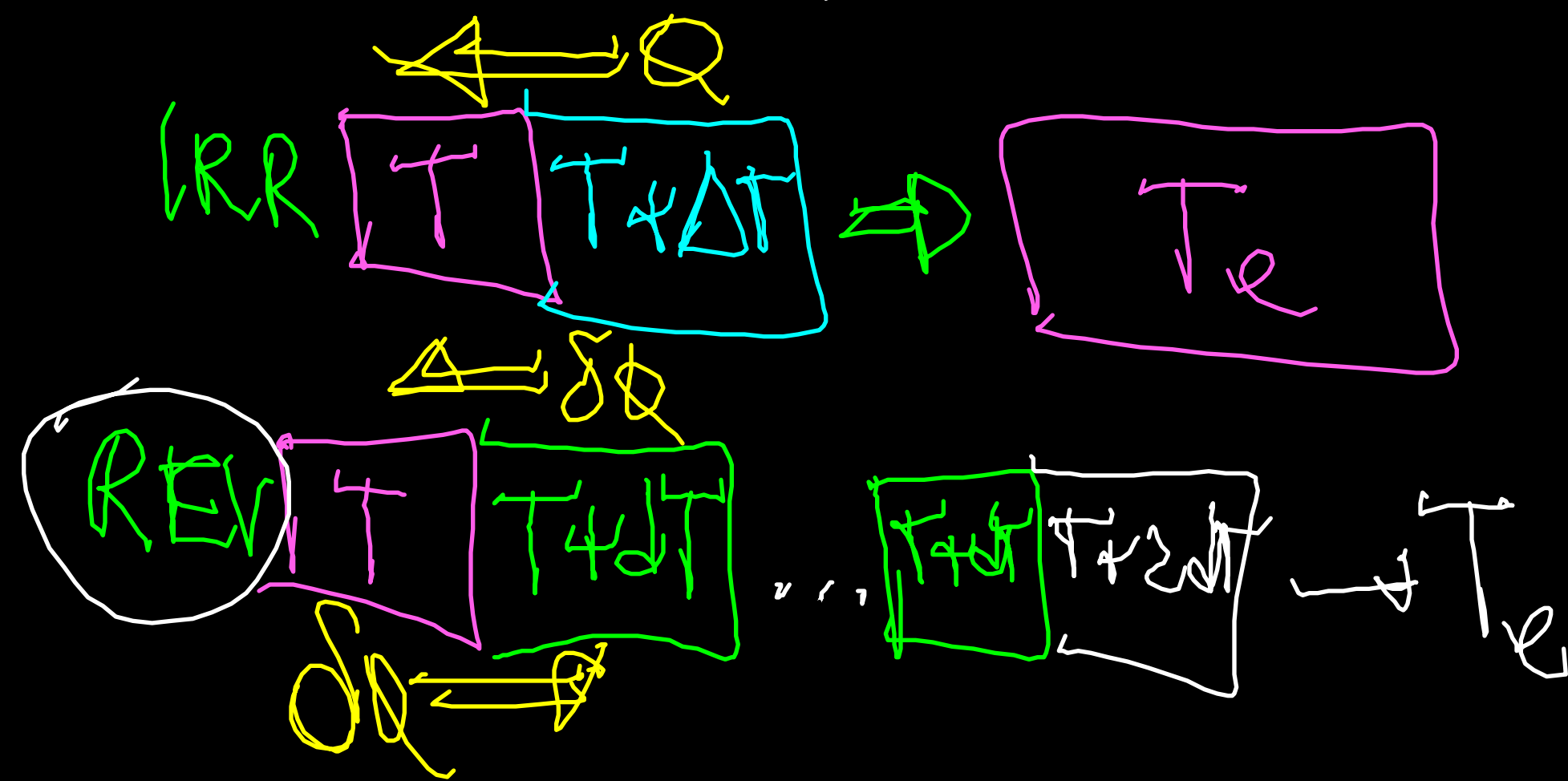
$K-p$

TRASFORMAZIONI REVERSIBILI E NON

• TRASF. "REALI" → IRREVERSIBILI

• TRASF. "IDEALI" → POSSONO ESSERE REVERSIBILI

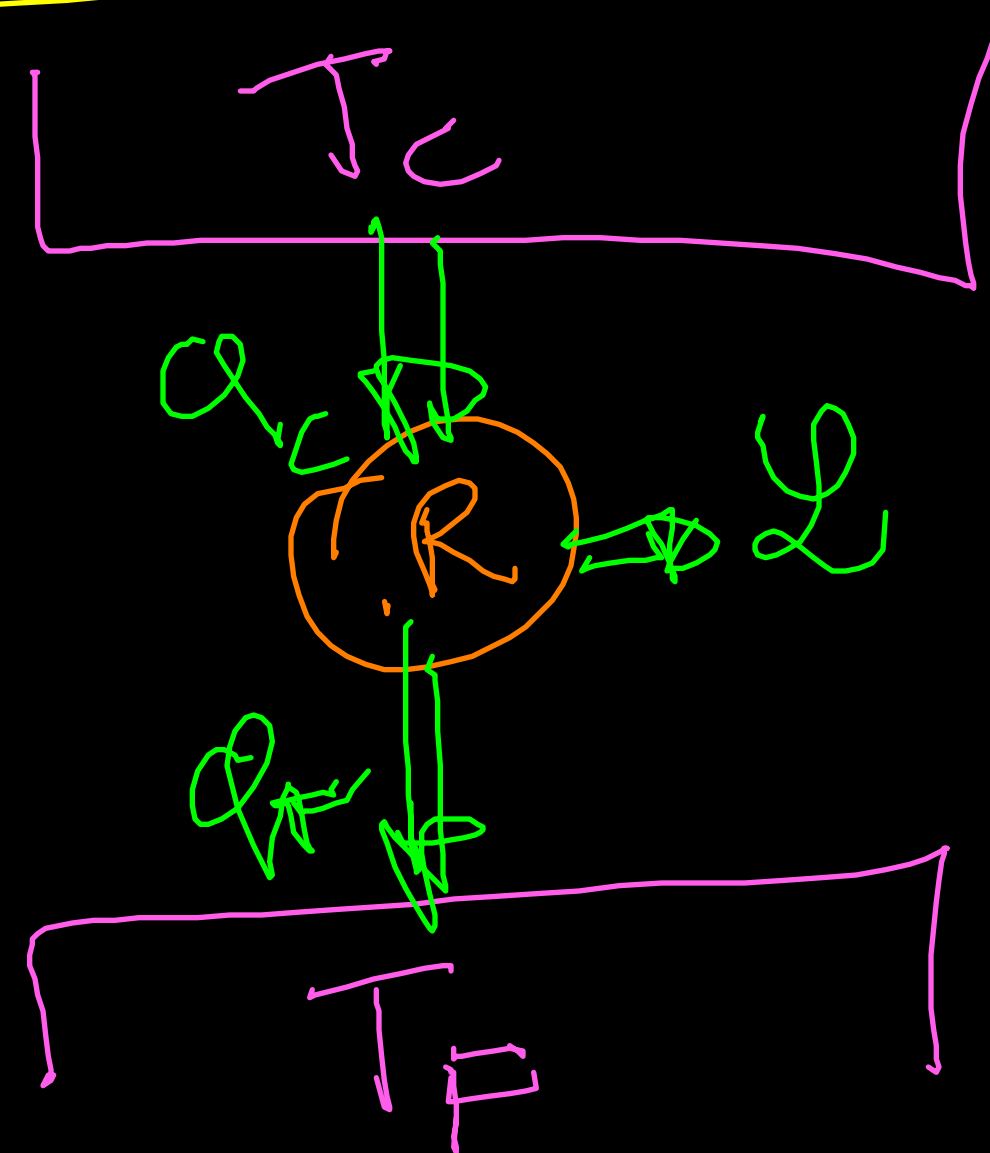
Reversibile \equiv si può invertire il verso in qualsiasi momento senza modifiche dell'ambiente



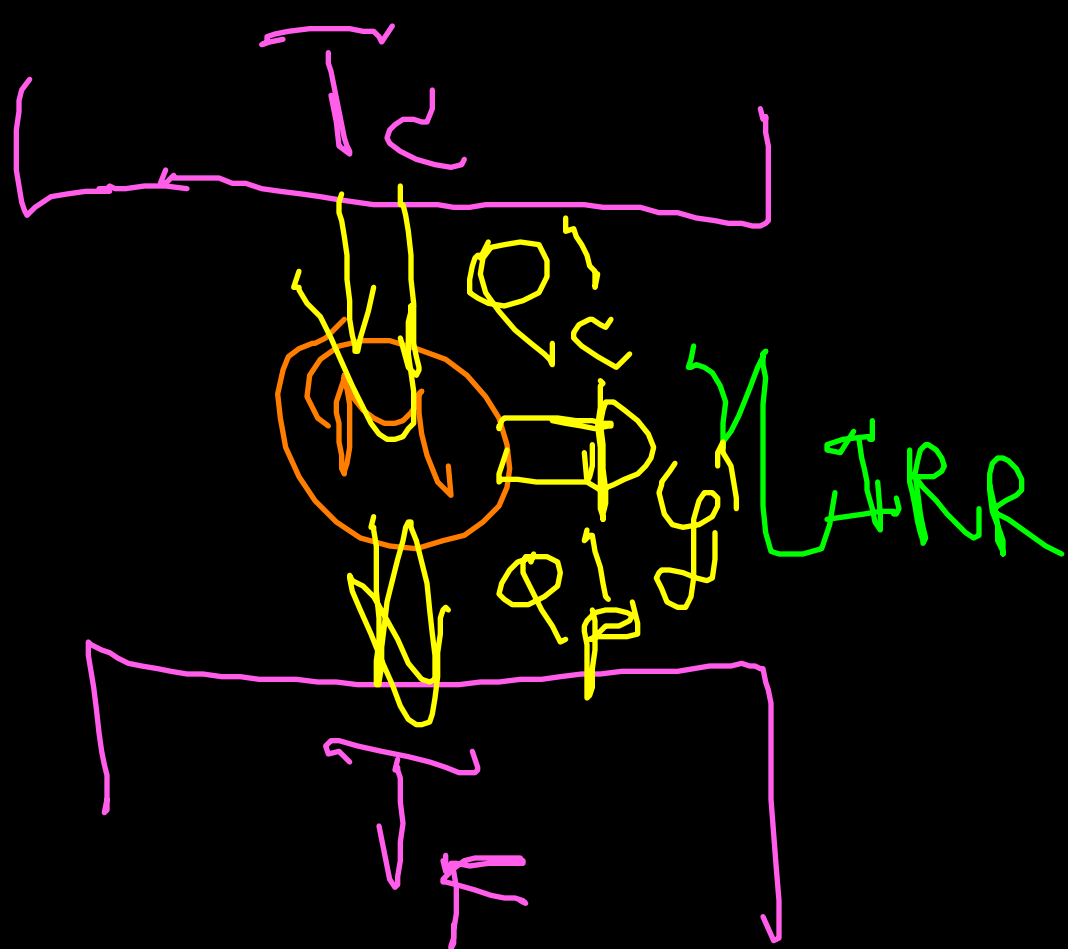
* NO ATTRITI

* QUASI-STATICA

TEOREMA DI CARNOT



$$\eta_R = \frac{W}{Q_C}$$

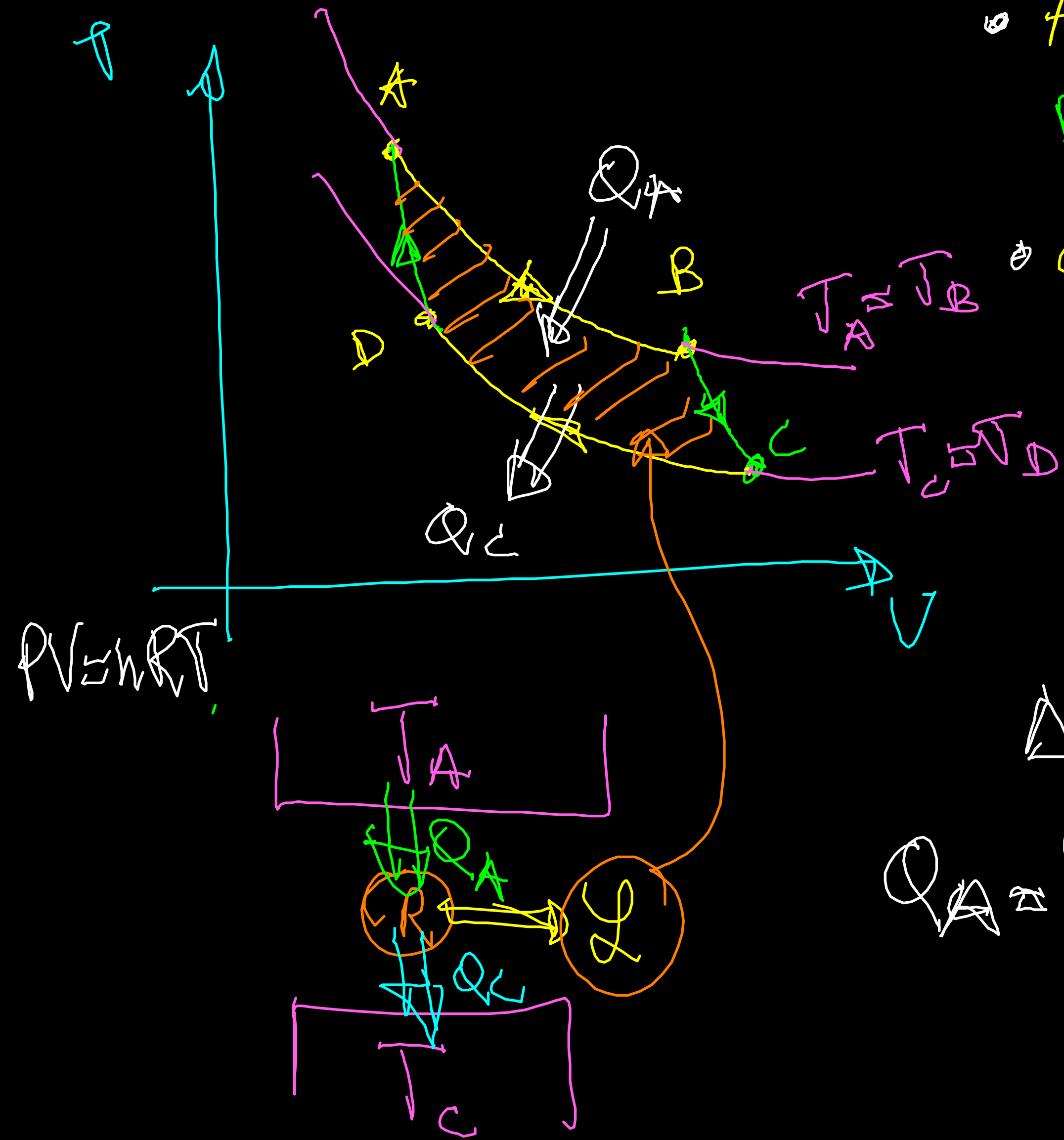


(i) Date T_C e T_F , η_R è indipendente dalla natura della macchina \Rightarrow è lo stesso per tutte le M reversibili

(ii) Date T_C e T_F , $\forall M$ irreversibile vale

$$\eta_{MRR} < \eta_R$$

CICLO DI CARNOT DI UN GAS PERFETTO (REV.)



$A \rightarrow B$ ESP. ISOTERMA REV.

$B \rightarrow C$ ESP. ADIAB. REV.

$C \rightarrow D$ COMP. ISOTERMA REV.

$D \rightarrow A$ COMP. ADIABATICA REV.

$$\eta_c = \frac{L}{Q_A} = 1 - \frac{|Q_C|}{Q_A}$$

$\Delta U = Q - L \Rightarrow$ nelle isoterme $L = Q$

$$Q_A = L_{AB} = \int_{V_A}^{V_B} p \, dV = \int_{V_A}^{V_B} \frac{nRT_A \, dV}{V} = nRT_A \ln \frac{V_B}{V_A}$$

$$Q_A = n R T_A \ln \frac{V_B}{V_A}$$

calore scambiato nelle esp. ist a T_A

$$Q_C = n R T_C \ln \frac{V_D}{V_C}$$

calore scambiato nelle comp. ist a T_C

$$\eta_C = 1 - \frac{n R T_C \ln \frac{V_D}{V_C}}{n R T_A \ln \frac{V_B}{V_A}}$$

$$\Rightarrow 1 - \frac{T_C}{T_A} \frac{\ln \frac{V_C}{V_D}}{\ln \frac{V_B}{V_A}} = 1 - \frac{T_C}{T_A}$$

↑ *isop. P fredda*
↑ *isop. P calda*

$$\text{Se } \frac{V_C}{V_D} = \frac{V_B}{V_A} \Rightarrow \frac{\ln V_C/V_D}{\ln V_B/V_A} = 1$$