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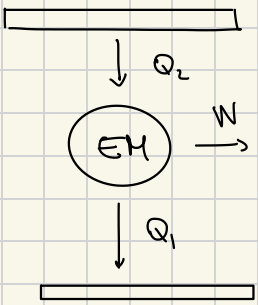

$W = Q_1 + Q_2$

$Q_2 = 2{,}5 \cdot 10^6\ J$

35 cicli al secondo $\quad c = 35\ Hz$

$P = 322\ kW$ ↓ potenza fatta in 1 secondo $\quad P = \frac{W}{\Delta t}$

1) $\eta = \frac{W}{Q_2} = ?$

2) Calore ceduto in 1h

Calcolo il lavoro ad ogni ciclo. In un secondo faccio 35 cicli dunque il lavoro in ogni ciclo è

$$W_{1\,sec} = P \cdot 1\,sec = 322\ kJ$$

$$W_{1\,ciclo} = W = \frac{W_{1\,sec}}{35} = 9{,}2\ kJ$$

$$\rightsquigarrow \eta = \frac{W_{1\,ciclo}}{Q_2} = \frac{9{,}2\ kJ}{25\ kJ} \simeq 37\,\%$$

Q_1 ad ogni ciclo: $\quad Q_1 + Q_2 = W \Rightarrow Q_1 = W - Q_2$

$1h = 60\,min = 3600\,s \rightsquigarrow$ cicli in $1\,h = 3600 \cdot 35$

$$Q_{1,1h} = Q_1 \cdot \text{cicli in } 1h = -2{,}0 \cdot 10^9\ J$$

$$= (W - Q_2) \text{ cicli in } 1h$$

▷ Calcolare η_{new} se $Q_{2,new} = Q_2$

$$Q_{1,new} = \frac{9}{10} Q_1$$

$$\eta_{new} = 1 - \frac{|Q_{1,new}|}{Q_{2,new}} = 1 - \frac{\frac{9}{10}|Q_1|}{Q_2} \approx 43\%$$

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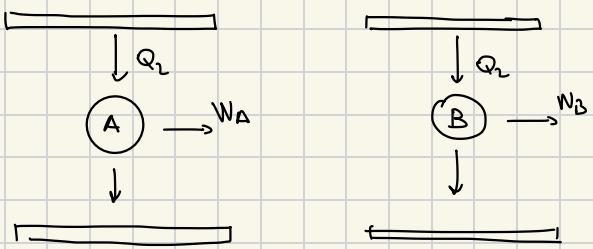

$\eta_A = 0{,}35$ e sono 4

$\eta_B = 0{,}22$ e sono 6

$Q_2 = 8{,}2 \cdot 10^2 J$

$f = 3 Hz$] 3 cicli al secondo

1) Formula rendimento dell'intero impianto
2) Calcolo rendimento
3) Q_1 emesso da tutto l'impianto in 1h

Chiamo I l'impianto: $\eta_I = ?$ $\eta_I = \frac{W_I}{Q_{2,I}}$

$W_I = 4 W_A + 6 W_B$

$Q_{2,I} = 10 Q_2$

$$\eta_I = \frac{4 W_A + 6 W_B}{10 Q_2} = \frac{1}{10}\left(4\frac{W_A}{Q_2} + 6\frac{W_B}{Q_2}\right)$$

$$\boxed{\eta_I = \frac{1}{5}(2\eta_A + 3\eta_B)}$$

▷ η_I = metto i numeri = 0,272

▷ $Q_{1,I}$ è il calore emesso in un ciclo

$[\ Q_{2,I} + Q_{1,I} = W_I \qquad Q_{1,I} = W_I - Q_{2,I}\ ]$ Non serve davvero

$Q_{2,I} = 10\, Q_2$ e lo conosco.

$$\eta_I = 1 + \frac{Q_{1,I}}{Q_{2,I}} \rightsquigarrow \boxed{(\eta_I - 1)\, Q_{2,I} = Q_{1,I}}$$

In un'ora vengono fatti $f \cdot (1h)$ cicli, quindi vengono fatti:

$$\boxed{f \cdot 3600s \text{ cicli}}$$

$$Q_{1,I,1h} = Q_{1,I} \cdot f \cdot 3600s \approx -6{,}5 \cdot 10^{*}\, J$$

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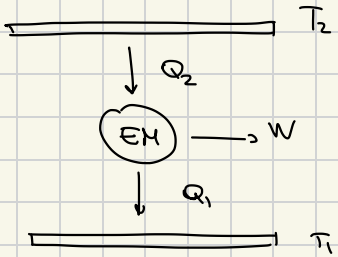
Macchina di Carnot



$$\eta = \frac{58}{100}$$

$\Delta T = T_2 - T_1 = 348k$

▷ $T_1 = ?$, $T_2 = ?$

▷ Se $T_{1,new} = T_1 + 50k$, $T_{2,new} = T_2 + 50k$, quanto vale η_{new}?

▷ $\begin{cases} \eta = 1 - \frac{T_1}{T_2} \\ \Delta T = T_2 - T_1 \end{cases}$ con T_1 e T_2 incognite

$$\begin{cases} \eta = \frac{T_2 - T_1}{T_2} \\ \Delta T = T_2 - T_1 \end{cases} \qquad \begin{cases} \boxed{\eta = \frac{\Delta T}{T_2}} \\ \Delta T = \frac{\Delta T}{\eta} - T_1 \end{cases}$$

$$\rightsquigarrow T_2 = \frac{\Delta T}{\eta} \quad (*)$$

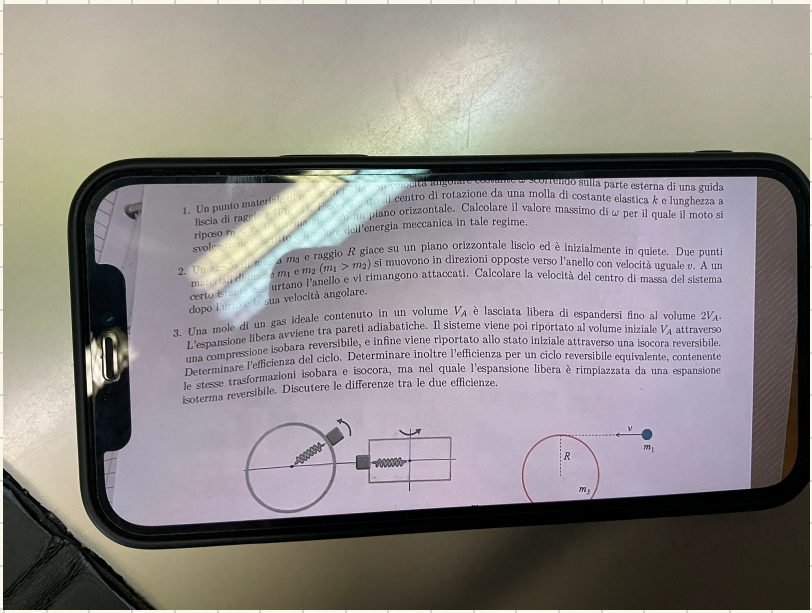
$$\rightsquigarrow T_1 = \Delta T \left(\frac{1}{\eta} - 1\right)$$

Viene quindi $T_2 \approx 600\,K$

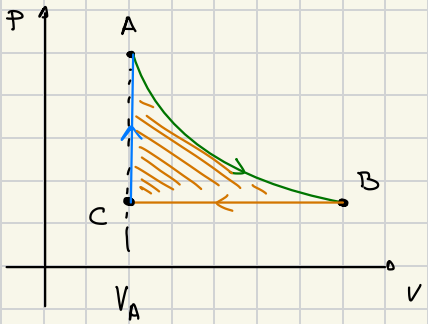
$T_1 \approx 252\,K$

▷ Uso (*):

$$\eta_{new} = \frac{\Delta T_{new}}{T_{2,new}} = \frac{\Delta T}{T_{2,new}} \approx \frac{56}{100}$$



Compito fisica - Ing Biomedica - Firenze



$V_B = 2V_A$

AB adiabatica
BC isobare
CA isocora

$\eta = ?$

$$\eta = \frac{W}{Q_2} = 1 - \frac{|Q_1|}{Q_2}$$

Partiamo dal lavoro: $W_{TOT} = W_{AB} + W_{BC} + W_{CA}$

AB: $\Delta U_{AB} = Q_{AB} - W_{AB}$, ma $Q = 0$ per adiabatica

$\Delta U_{AB} = -W_{AB} \rightsquigarrow W_{AB} = -\Delta U = -\frac{\ell}{2} nR\Delta T$ $\qquad Q_{AB} = 0$

BC: $W_{BC} = P_B \cdot \Delta V = P_B (V_A - 2V_A) = -P_B V_A$

$Q_{BC} = \frac{\ell+2}{2} nR\Delta T \rightsquigarrow$ Calore uscente dal sistema

$\Delta T \downarrow T_C - T_B$

CA: $W_{CA} = 0$

$Q_{CA} = \frac{\ell}{2} nR\Delta T \rightsquigarrow$ calore entrante nel sistema

$\Delta T \downarrow T_A - T_C$

$$\eta = 1 - \frac{|Q_1|}{Q_2} = 1 - \frac{\frac{\ell+2}{2} nR\,|T_C - T_B|}{\frac{\ell}{2} nR\,(T_A - T_C)} = 1 - \underbrace{\frac{\ell+2}{\ell}}_{\gamma} \frac{|T_C - T_B|}{T_A - T_C}$$

Calcolo T_B e T_C in funzione di T_A

Partiamo da T_B: È adiabatica e dunque $T_B = \left(\frac{V_A}{2V_A}\right)^{\gamma-1} T_A$

$$\Rightarrow \boxed{T_B = \left(\frac{1}{2}\right)^{\gamma-1} \cdot T_A}$$

Per T_C considero che BC è isobara; e per le isobare vale che

$$\frac{V_C}{T_C} = \frac{V_B}{T_B} \rightsquigarrow T_C = \frac{V_C}{V_B} \cdot T_B = \frac{V_A}{2V_A} \cdot \left(\frac{1}{2}\right)^{\gamma-1} T_A$$

$$\rightsquigarrow \boxed{T_C = \left(\frac{1}{2}\right)^{\gamma} T_A}$$

$$\eta = 1 - \gamma \frac{\left|\left(\frac{1}{2}\right)^{\gamma} T_A - \left(\frac{1}{2}\right)^{\gamma-1} T_A\right|}{T_A - \left(\frac{1}{2}\right)^{\gamma} T_A} = 1 - \frac{\gamma \left(\frac{1}{2}\right)^{\gamma-1} \left|\frac{1}{2} - 1\right|}{1 - \left(\frac{1}{2}\right)^{\gamma}}$$

$$= 1 - \gamma \frac{\left(\frac{1}{2}\right)^{\gamma}}{1 - \left(\frac{1}{2}\right)^{\gamma}} = 1 - \gamma \frac{1}{2^{\gamma} - 1}$$

⇝ Completare il problemino per casa (Soluti a EQ)

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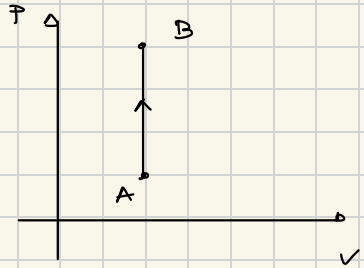
$V_A = 30L = 30 \cdot 10^{-3} m^3$
$n = 0{,}5$ mol
$\ell = 5$
$T_B = 80°C = 353$ k $\quad V_B = V_A$
$T_A = 20°C = 293$ k
La Trasformazione è isocora.

$W = ?$
$P_B - P_A$
$\Delta U = ?$



- $W = 0$ perché isocore

- $P_A \cdot V_A = nRT_A \rightsquigarrow P_A = \frac{nRT_A}{V_A}$

$$\frac{P_B}{T_B} = \frac{P_A}{T_A} \rightsquigarrow P_B = P_A \cdot \frac{T_B}{T_A}$$

$$P_B - P_A = P_A\left(\frac{T_B}{T_A} - 1\right) = \frac{nRT_A}{V_A}\left(\frac{T_B - T_A}{T_A}\right) = \frac{nR}{V_A} \cdot (T_B - T_A) \approx 8{,}3\,10^3 Pa$$

- $\Delta U = \frac{\ell}{2} nR\Delta T = \frac{\ell}{2} nR(T_B - T_A) = 6{,}2 \cdot 10^2 J$

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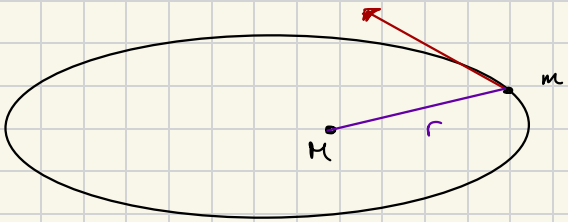
$M = 8{,}72 \cdot 10^{29}\ kg$
$m = 2{,}86 \cdot 10^{22}\ kg$

$a = 3{,}5 \cdot 10^{8}\ km$
$v = 6{,}4 \cdot 10^{4}\ \frac{m}{s}$
$r = ?$



$$E_{TOT} = K_{TOT} + U = 0 + \frac{1}{2}mv^2 + \left(-G\frac{mM}{r}\right)$$

$\parallel$

$$-G\frac{mM}{2a}$$

$$-\frac{GmM}{2a} = \frac{1}{2}mv^2 - \frac{GmM}{r}$$

$$\frac{GM}{r} = \frac{1}{2}v^2 + \frac{GM}{2a} \quad \rightsquigarrow \quad \frac{1}{r} = \frac{v^2}{2GM} + \frac{1}{2a}$$

$$\rightsquigarrow \frac{1}{r} = \frac{av^2 + GM}{2aGM} \quad \rightsquigarrow \quad r = \frac{2aGM}{av^2 + GM} \approx 2{,}43 \cdot 10^{10}\ m$$