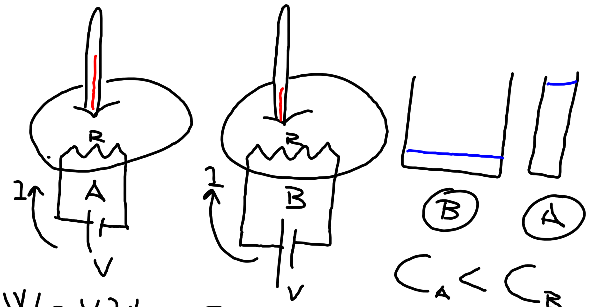


$C_A < C_B$

$$W = VIt = Q$$

$$C = \frac{Q}{\Delta T}$$

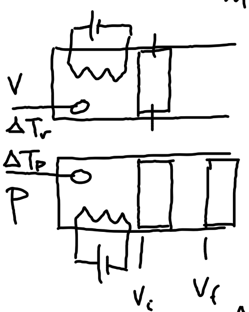
$$\left.\begin{array}{l} C_A = \dfrac{Q}{\Delta T_A} \Rightarrow Q = C_A \Delta T_A \\ C_B = \dfrac{Q}{\Delta T_B} \Rightarrow Q = C_B \Delta T_B \end{array}\right\} \Rightarrow$$

$$\left.\begin{array}{l} \Rightarrow C_A \Delta T_A = C_B \Delta T_B \Rightarrow \dfrac{\Delta T_A}{\Delta T_B} = \dfrac{C_B}{C_A} \\ \Delta T_A > \Delta T_B \Rightarrow \dfrac{\Delta T_A}{\Delta T_B} > 1 \end{array}\right\} \Rightarrow$$

$$\Rightarrow \frac{C_B}{C_A} > 1 \Rightarrow C_B > C_A$$

$$[C] = \frac{J}{K} = \frac{J}{^\circ C} \rightarrow (\text{ES } \Delta T!)$$

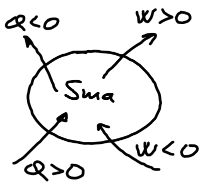
$$\frac{C}{m} = c = \frac{Q}{m \Delta T} \rightarrow [c] = \frac{J}{kg\, K} = \frac{J}{kg\, ^\circ C}$$



$$C_v = \frac{Q}{\Delta T_v}$$

$\Delta T_v > \Delta T_p$

$$C_p = \frac{Q}{\Delta T_p}$$



$$\Delta E = Q - W$$

$$\Delta E = \Delta EC + \Delta EP + \Delta U$$

V
$$\left.\begin{array}{l} (\Delta U)_v = Q - \displaystyle\int_i^f p\, dV \\ V = \text{cte} \Rightarrow dV = 0 \end{array}\right\} \Rightarrow \underline{(\Delta U)_v = Q}$$

P
$$\left.\begin{array}{l} (\Delta U)_p = Q - \displaystyle\int_i^f p\, dV \\ p = \text{cte} \end{array}\right\} \Rightarrow$$

$$(\Delta U)_p = Q - p(V_f - V_i) \Rightarrow$$

$$\Rightarrow Q = (\Delta U)_p + pV_f - pV_i \Rightarrow$$

$$\left.\begin{array}{l} \Rightarrow Q = (\Delta U)_p + p(V_f - V_i) \\ Q = (\Delta U)_v \end{array}\right\} \Rightarrow$$

$$\Rightarrow \underset{3}{(\Delta U)_v} = \underset{2}{(\Delta U)_p} + \underbrace{p(V_f - V_i)}_{>0} \Rightarrow (\Delta U)_v > (\Delta U)_p$$

q > c

$(\Delta T)_v > (\Delta T)_p$

$C_p > C_v$

$$C_p = \frac{Q}{(\Delta T)_p} \rightarrow c_p = \frac{Q}{m\Delta T_p} = \frac{q}{\Delta T_p}$$

$$C_v = \frac{Q}{(\Delta T)_v} \rightarrow c_v = \frac{Q}{m\Delta T_v} = \frac{q}{\Delta T_v}$$

$$\left[\begin{array}{l} c_p = \left(\dfrac{\delta q}{\partial T}\right)_p \\ c_v = \left(\dfrac{\delta q}{\partial T}\right)_v \end{array}\right.$$

$$\Delta U = Q - W \Rightarrow \left.\begin{array}{l} dU = \delta Q - \delta W \\ \delta W = p\,dV \end{array}\right\} \Rightarrow$$

$$\Rightarrow dU = \delta Q - p\,dV \underset{\div m}{\Rightarrow} du = \delta q - p\,dv \Rightarrow$$

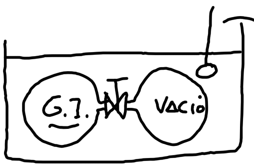
$$\Rightarrow \delta q = du + p\,dv$$

$$\text{Si } V = K \Rightarrow (\delta q = du)_v \Rightarrow c_v = \left(\frac{\partial u}{\partial T}\right)_v$$

$$\text{Si } p = K \Rightarrow \left[\delta q = du + d(pv)\right]_p \Rightarrow$$

$$\Rightarrow \left[\delta q = d(\underbrace{u+pv}_{h})\right]_p \Rightarrow \left[\delta q = dh\right]_p \Rightarrow$$

$$\Rightarrow c_p = \left(\frac{\partial h}{\partial T}\right)_p$$



T = K.

p↓

V↑

$$\left.\begin{array}{l} \Delta U = Q - W \\ W = \int_i^f p\,dV \end{array}\right\} \Rightarrow \left.\begin{array}{l} \Delta U = Q - \int_i^f p\,dV \\ Q = 0,\ p = 0 \end{array}\right\} \Rightarrow$$

$$\Rightarrow \left.\begin{array}{l} \Delta U = 0 \Rightarrow U_f = U_i \\ T_f = T_i \end{array}\right\} \Rightarrow \underline{U = f(T)}$$

$$dU = \left(\frac{\partial U}{\partial T}\right) dT \Rightarrow \frac{dU}{dT} = \frac{\partial U}{\partial T}$$

$$z = z(x,y) \Rightarrow dz = \left(\frac{\partial z}{\partial x}\right)_y dx + \left(\frac{\partial z}{\partial y}\right)_x dy$$

$$c_v = \left(\frac{\partial u}{\partial T}\right)_v \xrightarrow{G.I.} c_v = \frac{du}{dT}$$

$$G.I. \Rightarrow U = f(T) \Rightarrow u = f(T) \Rightarrow u = u(T)$$

$$H = U + pV \rightarrow h = u + pv \xrightarrow{G.I.} h = u + RT \Rightarrow$$

$$\Rightarrow h = f(t) \Rightarrow h = h(T) \Rightarrow dh = \left(\frac{\partial h}{\partial T}\right) dT \Rightarrow$$

$$\Rightarrow \frac{\partial h}{\partial T} = \frac{dh}{dT} \rightarrow c_p = \frac{dh}{dT}$$

$$\left|\begin{array}{l} c_p = \dfrac{dh}{dT} \Rightarrow dh = c_p\,dT \Rightarrow \Delta h = \int_1^2 c_p\,dT \\ c_v = \dfrac{du}{dT} \Rightarrow du = c_v\,dT \end{array}\right.$$

$$h = u + pv \overset{G.I.}{\Rightarrow} h = u + RT \Rightarrow \frac{dh}{dT} = \frac{du}{dT} + R \Rightarrow$$

$$\Rightarrow \underline{c_p = c_v + R} \rightarrow c_p - c_v = R$$

$$\Delta h = \int_1^2 C_p \, dT \Rightarrow \left| \begin{array}{l} G.P. \quad \begin{array}{l} C_p = \text{cte} \\ C_v = \text{cte} \end{array} \Big| \rightarrow \underline{\Delta h = C_p \, \Delta T}. \\ \\ G.I. \quad \begin{array}{l} C_p = C_p(T) \\ \qquad\;\; f(T) \\ C_v = f(T) \end{array} \Big| \rightarrow \Delta h = \int_1^2 C_p(T)\, dT \end{array} \right.$$

$$\gamma = K = \frac{C_p}{C_v}$$

$$C_{p\,\text{aire}} = 1.005 \; \frac{\text{KJ}}{\text{Kg K}}.$$

$$K_{\text{aire}} = 1.4 \Rightarrow C_v = 0.716 \; \frac{\text{KJ}}{\text{Kg K}}$$

$$C_p = \underline{\alpha} + \underline{\beta} T + \underline{\gamma} T^2 + \underline{\delta} T^3 + \varepsilon T^4 + \ldots$$

$$\Delta h = \int^2 C_p(T) \, dT$$

$$\Delta h = \int_1^2 (\alpha + \beta T + \gamma T^2) R \, dT$$

$$\left.\begin{array}{l} dE = \delta Q - \delta W \\ \delta Q \underset{R}{=} TdS \\ \delta W = pdV \end{array}\right\} \Rightarrow dU = TdS - pdV \Rightarrow$$

$$\Rightarrow TdS = dU + pdV$$

$$H = U + pV \Rightarrow dH = \underbrace{dU + pdV}_{TdS} + Vdp \Rightarrow$$

$$\Rightarrow TdS = dH - Vdp \Rightarrow$$

$$\left.\begin{array}{l} \Rightarrow Tds = dh - v\,dp \\ G.I. \Rightarrow dh = c_p dT \end{array}\right\} \Rightarrow \left.\begin{array}{l} Tds = c_p dT - v\,dp \\ G.I. \Rightarrow v = \dfrac{RT}{p} \end{array}\right\} \Rightarrow$$

$$\Rightarrow Tds = c_p dT - RT\frac{dp}{p} \Rightarrow$$

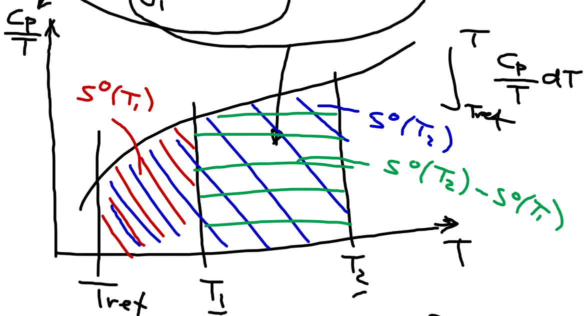
$$\Rightarrow ds = c_p\frac{dT}{T} - R\frac{dp}{p} \Rightarrow$$

$$\Rightarrow \Delta s = \int_1^2 c_p\frac{dT}{T} - R\ln\frac{p_2}{p_1} \Rightarrow$$

$$\Rightarrow \left\{\begin{array}{l} \underset{c_p = cte}{G.P.} \Rightarrow \Delta s = c_p \ln\dfrac{T_2}{T_1} - R\ln\dfrac{p_2}{p_1} \\ \underset{c_p \neq cte}{G.I.} \Rightarrow \Delta s = \displaystyle\int_1^2 \frac{c_p(T)}{T}dT - R\ln\frac{p_2}{p_1} \end{array}\right.$$

$$\frac{c_p}{R} = \alpha + \beta T + \gamma T^2 \ldots \Rightarrow c_p(T) = R(\alpha + \beta T + \gamma T^2 \ldots)$$

$$\Delta s = \int_1^2 \frac{R(\alpha + \beta T + \gamma T^2 \ldots)}{T}dT - R\ln\frac{p_2}{p_1}$$



$$\int_{T_{ref}}^{T} \frac{c_p}{T}dT = s^\circ(T)$$

$$\Delta s = s^\circ(T_2) - s^\circ(T_1) - R\ln\frac{p_2}{p_1}$$

$$\underline{G.P.} \left| \begin{array}{l} pV^k = cte \\ TV^{k-1} = cte \\ p^{1-k}T^k = cte \end{array}\right.$$

$$\text{Iso-s} \Rightarrow \Delta s = 0 = s^\circ(T_2) - s^\circ(T_1) - R\ln\frac{p_2}{p_1} \Rightarrow$$

$$\Rightarrow \ln\frac{p_2}{p_1} = \frac{s^\circ(T_2) - s^\circ(T_1)}{R} \Rightarrow$$

$$\frac{p_2}{p_1} = e^{\frac{s^\circ(T_2) - s^\circ(T_1)}{R}} = \frac{e^{\frac{s^\circ(T_2)}{R}}}{e^{\frac{s^\circ(T_1)}{R}}} = \frac{p_{r2}}{p_{r1}}$$

$$e^{\frac{s^\circ(T)}{R}} = p_r$$

$$\frac{\dfrac{\cancel{R}T_2}{v_2}}{\dfrac{\cancel{R}T_1}{v_1}} = \frac{p_{r2}}{p_{r1}} \Rightarrow \frac{v_1}{v_2} = \frac{\dfrac{p_{r2}}{T_2}}{\dfrac{p_{r1}}{T_1}} = \frac{\dfrac{T_1}{p_{r1}}}{\dfrac{T_2}{p_{r2}}} = \frac{v_{r1}}{v_{r2}}$$

$$\frac{T_1}{p_{r1}} \rightarrow v_{r1}$$

CONSUMO $\frac{\ell}{100\,km}$

$$\dot m = \frac{m}{t}$$

$$\rho_{comb} = \frac{m}{V} \Rightarrow m = \rho_c V$$

$$c = \frac{\ell}{t} \Rightarrow t = \frac{\ell}{c}$$

Si $\ell = 100\,km$ $\Rightarrow t = \frac{100\,km \times 10^3 \frac{m}{km}}{c}$

$$\dot m = \frac{\rho_c\left(\frac{kg}{\ell}\right) V(\ell)}{\frac{100\,Km}{c\left(\frac{Km}{h}\right)}} \Rightarrow$$

$$\Rightarrow \dot m = \rho_c\left(\frac{kg}{\ell}\right) \cdot c\left(\frac{Km}{h}\right) \cdot \text{CONSUMO}\left(\frac{\ell}{100\,Km}\right) \Rightarrow$$

$$\Rightarrow \text{CONSUMO}\left(\frac{\ell}{100\,km}\right) = \frac{\dot m}{\rho_c\left(\frac{kg}{\ell}\right) c\left(\frac{Km}{h}\right)}$$

$6 \frac{\ell}{100\,km}$

$120 \frac{Km}{h}$

$\rho_c = 0.900 \frac{kg}{\ell}$

$\rightarrow \dot m_c = 0.9 \frac{kg}{\cancel{\ell}} \times 120 \frac{\cancel{Km}}{h} \times 6 \frac{\cancel{\ell}}{100\,\cancel{Km}}$

$\rightarrow \dot m_c = 6.48 \frac{kg}{h} = 0.0018 \frac{kg}{s}$

$\text{CAUDAL}_c \rightarrow \dot m_c = \rho_c \dot V_c \Rightarrow$

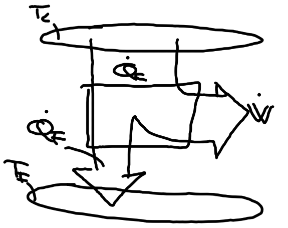
$$\Rightarrow \dot V_c = \frac{\dot m_c}{\rho_c} \Rightarrow \dot V_c = \frac{0.0018 \frac{kg}{s}}{0.9 \frac{kg}{\ell}} = 0.002 \frac{\ell}{s}$$

$PCI = 43000 \frac{kJ}{kg}$

$$\dot Q_c = \dot m_c PCI \Rightarrow \dot Q_c = 0.0018 \frac{kg}{s} \times 43000 \frac{kJ}{kg} = \ldots$$

$$\ldots = \dot Q_c = 77.4 \frac{kJ}{s} = 77.4\ kW$$

$\dot W_{máx} \rightarrow \dot W_{carnot}$



$$\eta = \frac{\dot W}{\dot Q_c}$$

$$\text{CARNOT} \rightarrow \eta_{máx} = 1 - \frac{T_F}{T_C}$$

$$\eta_{max} = 1 - \frac{300\,K}{1500\,K} = 0.80 \rightarrow 80\%$$

Si CARNOT $\Rightarrow \dot W = 61.92\ kW$.

4T

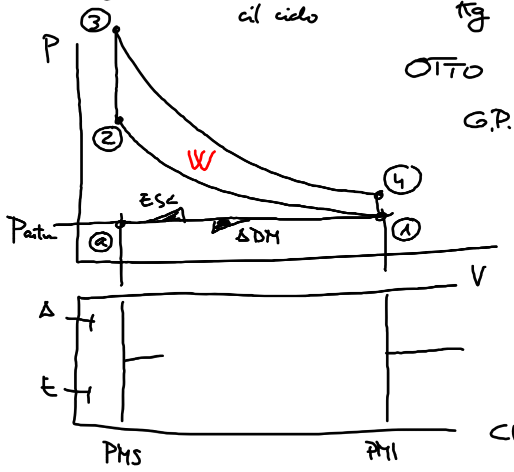
3000 rpm $\rightarrow 1500 \frac{ciclos}{min} = 25 \frac{ciclos}{s}$

4 CIL. $\quad \dot m_c = 0.0018 \frac{kg}{s} / 4$ $\Bigg\} \Rightarrow$

$$\Rightarrow m_c = \frac{0.0018\ kg/s}{4 \times 25\ ciclos/s} = \frac{72\times10^{-5}}{4} kg/cicl = 1.8\times10^{-5} \frac{kg_c}{cil \cdot ciclo}$$

$Q_c = m_c PCI \Rightarrow$

$\Rightarrow Q_c = 1.8\times10^{-5} \frac{kg}{cil\ ciclo} \times 43000 \frac{kJ}{kg} = 0.774 \frac{kJ}{cil\ ciclo}$



OTTO

G.P. $\Rightarrow pV^k = k$

$r = \frac{V_1}{V_2}$, $V_2 = V_a$

$CIL = V_1 - V_a$

$CIL_{TOTAL} = 1200cc$, 4 CIL $\Rightarrow CIL = 300cc$

$r = 8 \Rightarrow \frac{V_1}{V_a} = 8 \Rightarrow V_1 = 8V_a$

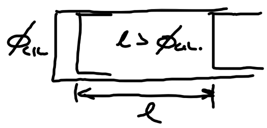
$300cc = V_1 - V_a \Rightarrow 300cc = 8V_a - V_a = 7V_a \Rightarrow V_a = 42.85cc$

$V_1 = 8 \times 42.85cc = 342.85cc$

$\phi_{CIL} = 6\ cm$

$CIL = \pi \frac{\phi_{CIL}^2}{4} \cdot l \Rightarrow l = \frac{CIL}{\pi \frac{\phi_{CIL}^2}{4}} \Rightarrow$

$\Rightarrow l = \frac{300\ cm^3}{\pi \frac{6^2\ cm^2}{4}} = 10.61\ cm$

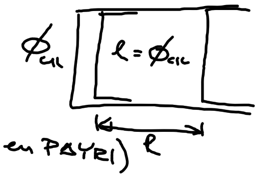


Si □ $\Rightarrow l = \phi_{CIL}$

$300\ cm^3 = \pi \frac{l^2}{4} \times l \Rightarrow$

$\Rightarrow l = \sqrt[3]{\frac{300\ cm^3}{\pi} \times 4} = \phi_{CIL} = 7.26\ cm$

$\bar{C}_{PISTÓN} = \frac{l}{t}$

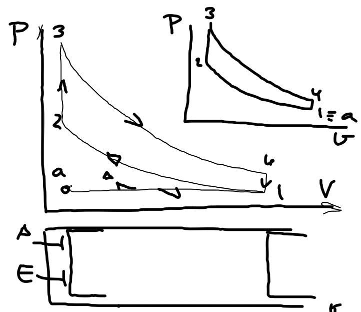


$\omega = 3000\ rpm$ (n en PAYRI)

$\omega \Rightarrow \frac{6000}{60s} = \frac{100}{s} = 100\ s^{-1}$

$C_{PISTÓN} = 7.26\ cm \times \frac{100}{s} = 726 \frac{cm}{s} =$

$= 7.26 \frac{m}{s}$



ⓐ $\begin{cases} 1 \text{ bar} \\ 300\ K \end{cases}$

① $\begin{cases} 1 \text{ bar} \\ 300\ K. \end{cases}$

2GP

$p_1 V_1^{k} = p_2 V_2^{k} \Rightarrow$

$\Rightarrow p_2 = p_1 \left(\frac{V_1}{V_2}\right)^{k} \Rightarrow p_2 = p_1 r^{k} \Rightarrow$

$\Rightarrow p_2 = 1 \text{ bar} \cdot 8^{1.4} = 18.37 \text{ bar}$

$T_1 V_1^{k-1} = T_2 V_2^{k-1} \Rightarrow T_2 = T_1 \left(\underbrace{\frac{V_1}{V_2}}_{r}\right)^{k-1} \Rightarrow$

$\Rightarrow T_2 = 300\ K \cdot 8^{1.4-1} = 689.22\ K = 416.22\ °C$

26.7.

$s^{o}(T)$, $p_r(t)$, $v_r(t)$

① $\begin{cases} 1 \text{ bar} \\ 300\ K \end{cases}$

$r = 8 = \frac{V_1}{V_2} = \frac{v_1}{v_2} = \frac{v_{r1}}{v_{r2}} \Rightarrow$

En Iso-S, 6.7.

$\Rightarrow v_{r2} = \frac{v_{r1}}{r} \Rightarrow v_{r2} = \frac{621.2}{8} = 77.65$

$v_{r2} = 77.65 \Rightarrow 673.16\ K$

TABLAS o HP

$v_2 = \frac{RT_2}{p_2}$

$r = \frac{v_1}{v_2} \Rightarrow v_2 = \frac{v_1}{r} \Rightarrow v_2 = \frac{RT_1}{p_1 r} \Rightarrow$

$\Rightarrow v_2 = \frac{0.287 \frac{kJ}{kg\,K} \times 300\ K}{100\ kPa \times 8} = 0.108 \frac{m^3}{kg}$

$v_1 = 0.861 \frac{m^3}{kg}$

$p_2 = \frac{RT_2}{v_2} \Rightarrow p_2 = \frac{0.287 \frac{kJ}{kg\,K} \times 673\ K}{0.108 \frac{m^3}{kg}}$

$p_2 = 1788.43\ kPa$

17.88 bar

$\underline{\Delta E} = Q - W$

$2 \to 3 \left| \begin{array}{l} V = cte \Rightarrow W = 0 \\ \Delta E = \Delta U \end{array} \right\} \Rightarrow Q = \Delta U \Rightarrow$

$\Rightarrow \underline{Q} = m(u_3 - u_2)$

$Q = 0.774\ kJ$

$V_1 = 342.85\ cc \Rightarrow m = \frac{p_1 V_1}{RT_1} \Rightarrow m = \frac{100\ kPa \times 342.85 \times 10^{-6}\ m^3}{0.287 \frac{kJ}{kg\,K} \times 300\ K}$

$\Rightarrow m = 3.98 \times 10^{-4}\ kg$

$\underline{G.P.}$

$Q = m c_v (T_3 - T_2) \Rightarrow T_3 = \frac{Q}{m c_v} + T_2 \Rightarrow$

$$T_3 = \frac{Q}{m c_v} + T_2 \Rightarrow T_3 = \frac{0.774\ \text{KJ}}{3.98\times10^{-4}\ \text{Kg} \times 0.718\ \frac{\text{KJ}}{\text{Kg K}}} + \ldots$$

$$\ldots + 689.22\ \text{K} = 3397.75\ \text{K} \to \text{¡UF!}$$

$$\text{Iso-}v \Rightarrow \frac{p_2}{T_2} = \frac{p_3}{T_3} \Rightarrow p_3 = p_2 \frac{T_3}{T_2} \Rightarrow$$

$$\Rightarrow p_3 = 18.37\ \text{bar}\ \frac{3397.75\ \text{K}}{689.22\ \text{K}} = 90.56\ \text{bar}$$

G.I.

$$Q = m(u_3 - u_2) \Rightarrow u_3 = \frac{Q}{m} + u_2 \Rightarrow$$

$$\Rightarrow u_3 = \frac{0.774\ \text{KJ}}{3.98\times10^{-4}\ \text{Kg}} + 491.27\ \frac{\text{KJ}}{\text{Kg}} = 2435.98\ \frac{\text{KJ}}{\text{Kg}}$$

TABLAS → ¡NO ESTÁ!

$$u_3 - u_2 = \int_2^3 c_v\, dT \Rightarrow u_3 = u_2 + \int_2^3 c_v\, dT \Big\} \Rightarrow$$

$$c_v = c_p - R \Rightarrow c_v = c_p(T) - R$$

$$\Rightarrow u_3 = u_2 + \int_2^3 R\left\{\left[\alpha + \beta T + \gamma T^2 + \ldots\right] - 1\right\} dT$$

G.P.

$$3 \to 4: \text{Iso-}s \Rightarrow pV^k = K \Rightarrow p_3 V_3^k = p_4 V_4^k \Rightarrow$$

$$\Rightarrow p_4 = p_3 \left(\frac{V_3}{V_4}\right)^k \Rightarrow p_4 = 90.56\ \text{bar} \times \left(\frac{1}{8}\right)^{1.4} = \ldots$$

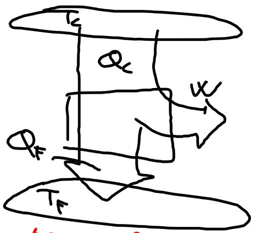
$$\frac{V_3}{V_4} \to \frac{V_2}{V_1} = \frac{1}{r}$$

$$\ldots = p_4 = 4.93\ \text{bar}$$

$$T_3 V_3^{k-1} = T_4 V_4^{k-1} \Rightarrow T_4 = T_3 \left(\frac{V_3}{V_4}\right)^{k-1} \to$$

$$\Rightarrow T_4 = 3397.75\ \text{K} \times \left(\frac{1}{8}\right)^{1.4-1} = 1478.95\ \text{K}.$$

G.I.



$$\frac{v_{r3}}{v_{r4}} = \frac{v_3}{v_4} = \frac{1}{r} \Rightarrow v_{r4} = r\, v_{r3}$$

$$s^0(T_3) = \int_{T_{ref}}^{T} \frac{c_p}{T}\, dT \Rightarrow$$

$$\Rightarrow s^0(T_3) = \int_{0\text{K}}^{3397.75\text{K}} 0.287\ \frac{\text{KJ}}{\text{Kg K}} \times \frac{3.653 - 1.337\cdot10^{-3}T + 3.294\cdot10^{-6}T^2 - 1.913\cdot10^{-9}T^3 + 0.2763\cdot10^{-12}T^4}{T}\, dT$$

$$\frac{\bar{c}_p}{\bar{R}} = \alpha + \beta T + \gamma T^2 + \delta T^3 + \varepsilon T^4 = \frac{c_p}{R}$$

Air	3.653	−1.337	3.294	−1.913	0.2763

$$\Rightarrow s^0(3397.75\text{K}) =$$

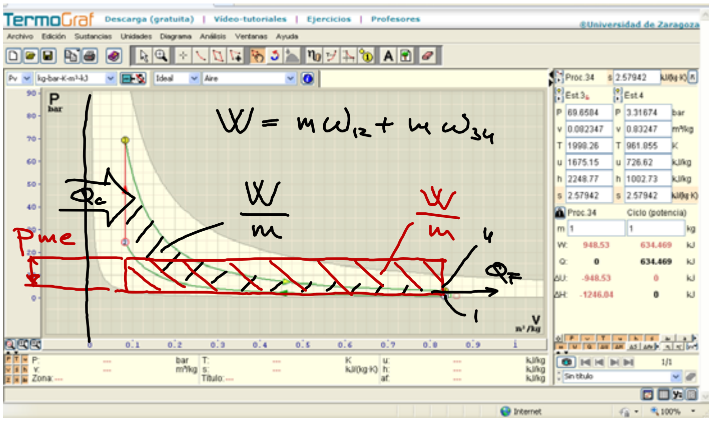
$$p_r = e^{\frac{s^0(T)}{R}} \Rightarrow p_r(T_3) = e^{\frac{s^0(T_3)}{R}} \Rightarrow p_r(3397.75\text{K}) = e^{\frac{\text{KJ/Kg K}}{0.287\ \text{KJ/Kg K}}}$$

$$\Rightarrow p_{r3} =$$

$$v_r(T_3) = \frac{T_3}{p_{r3}} \Rightarrow v_{r3} = \frac{3397.75\text{K}}{}$$

$$v_{r4} = r\, v_{r3} \Rightarrow v_{r4} = 8\times$$

Con $v_{r4} \xrightarrow{} T_4 =$ (TABLAS ó HP)   Y con $\left\{\begin{matrix} T_4 \\ v_4 = v_1 \end{matrix}\right\} \to p_4 =$



$$\underline{m} = m_{cil} + m_{cc}$$

$$\Delta u = q - \omega \Rightarrow \omega = -\Delta u \Rightarrow$$

$$\Rightarrow \begin{cases} \omega_{12} = u_1 - u_2 \\ \omega_{34} = u_3 - u_4 \end{cases}$$

$$W = m\omega = m(\omega_{12} + \omega_{34})$$

$$\Delta U = Q - W$$

$$\eta = \frac{W}{Q_c}$$

$$\left.\begin{array}{l} Q_c = U_3 - U_2 \Rightarrow Q_c = m(u_3 - u_2) \\ W = \sum Q \Rightarrow W = Q_c + Q_F \\ \qquad Q_F = m(u_1 - u_4) \end{array}\right\} \Rightarrow$$

$$\Rightarrow W = m(u_3 - u_2) + m(u_1 - u_4) \Rightarrow$$

$$\Rightarrow W = Q_c - |Q_F| = m(u_3 - u_2) - m(u_4 - u_1)$$

$$\eta = \frac{\cancel{m}(u_3 - u_2) - \cancel{m}(u_4 - u_1)}{\cancel{m}(u_3 - u_2)} \Rightarrow$$

$$\left.\begin{array}{l} \Rightarrow \eta = 1 - \dfrac{u_4 - u_1}{u_3 - u_2} \quad G.I. \\ \text{Si } G.P. \Rightarrow u_i - u_j = c_v(T_i - T_j) \end{array}\right\} \Rightarrow$$

$$\Rightarrow \eta = 1 - \frac{T_4 - T_1}{T_3 - T_2}$$

$$T_2 V_2^{\kappa-1} = T_1 V_1^{\kappa-1} \Rightarrow T_2 = T_1 \left(\frac{V_1}{V_2}\right)^{\kappa-1} = T_1 r^{\kappa-1}$$

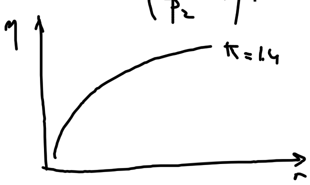
$$\frac{P_2}{T_2} = \frac{P_3}{T_3} \Rightarrow T_3 = \frac{P_3}{P_2} T_2 = \frac{P_3}{P_2} T_1 r^{\kappa-1}$$

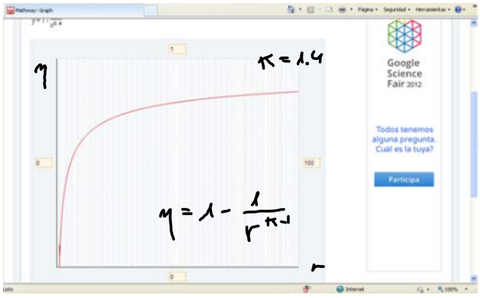
$$T_4 V_4^{\kappa-1} = T_3 V_3^{\kappa-1} \Rightarrow T_4 = T_3 \left(\frac{V_3}{V_4}\right)^{\kappa-1} \Rightarrow$$

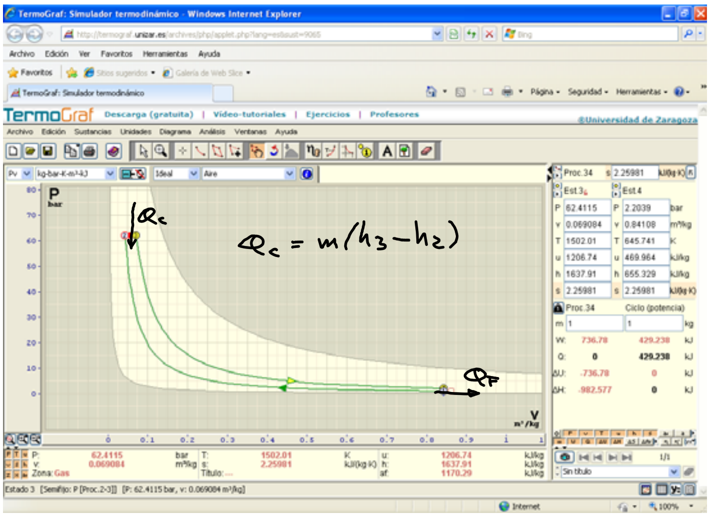
$$\Rightarrow T_4 = \frac{P_3}{P_2} T_1 r^{\kappa-1} r^{1-\kappa} = \frac{P_3}{P_2} T_1$$

$$\eta = 1 - \frac{\frac{P_3}{P_2}\cancel{T_1} - \cancel{T_1}}{\frac{P_3}{P_2}\cancel{T_1} r^{\kappa-1} - \cancel{T_1} r^{\kappa-1}} = 1 - \frac{\frac{P_3}{P_2} - 1}{\left(\frac{P_3}{P_2} - 1\right) r^{\kappa-1}} \Rightarrow$$

$$\Rightarrow \eta = 1 - \frac{1}{r^{\kappa-1}}$$







$$\eta = \frac{W}{Q_c} \rightarrow \eta = \frac{m(h_3-h_2) - m(u_1-u_4)}{m(h_3-h_2)} \Rightarrow$$

$$\Rightarrow \eta = 1 - \frac{u_1-u_4}{h_3-h_2} \rightarrow \text{G.I.}$$

Si G.P. $\Rightarrow$ $\eta = 1 - \dfrac{c_v(T_1-T_4)}{c_p(T_3-T_2)} \Rightarrow$

$$\Rightarrow \eta = 1 - \frac{T_1-T_4}{\kappa(T_3-T_2)}$$

$$T_2 V_2^{\kappa-1} = T_1 V_1^{\kappa-1} \Rightarrow T_2 = T_1 r^{\kappa-1}$$

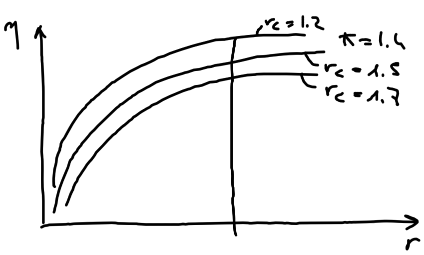
$$\frac{V_2}{T_2} = \frac{V_3}{T_3} \Rightarrow T_3 = T_2 \frac{V_3}{V_2} = T_2 r_c = T_1 r^{\kappa-1} r_c$$

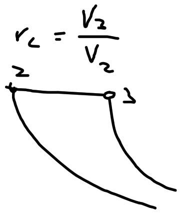
$$T_3 V_3^{\kappa-1} = T_4 V_4^{\kappa-1} \Rightarrow T_4 = T_3 \left(\frac{V_3}{V_4}\right)^{\kappa-1} = T_3 \left(\frac{V_3}{V_2}\frac{V_2}{V_4}\right)^{\kappa-1} = \ldots$$

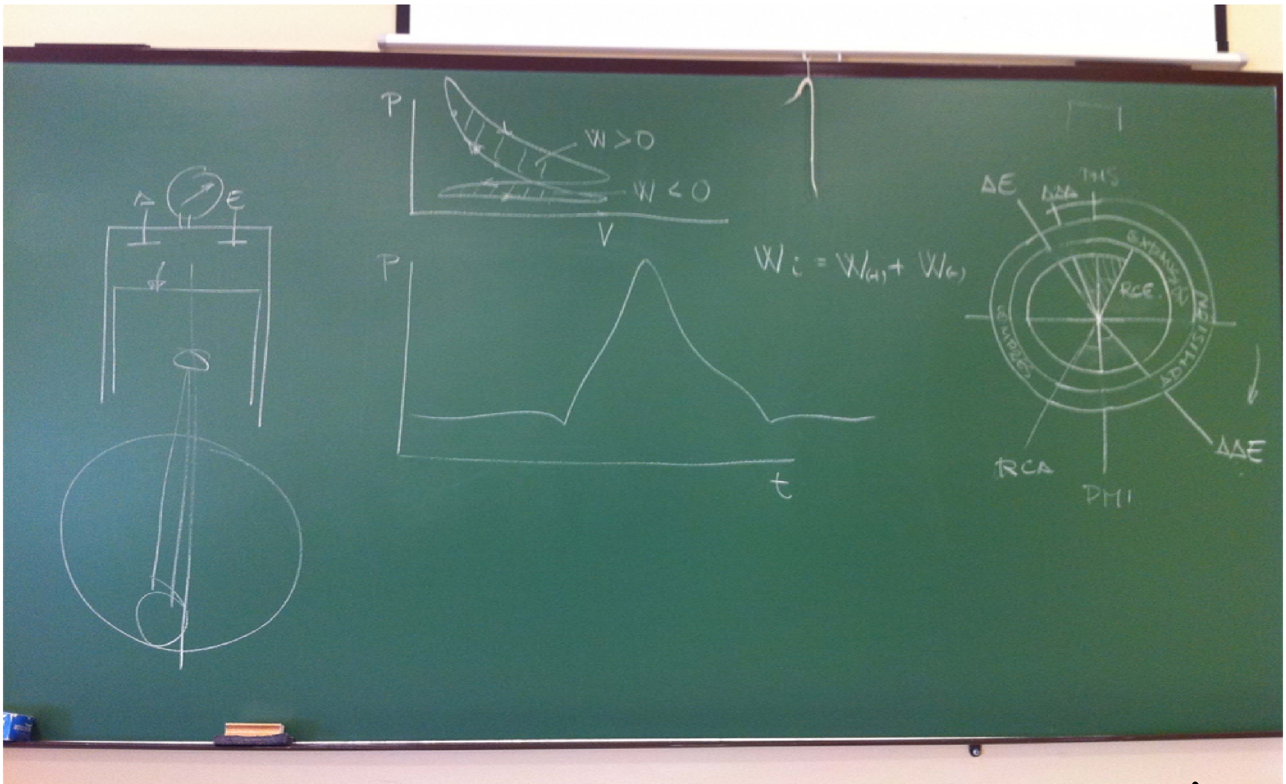
$$\ldots = T_4 = T_3 r_c^{\kappa-1} r^{1-\kappa} = T_1 r^{\kappa-1} r_c r_c^{\kappa-1} r^{1-\kappa} = T_1 r_c^{\kappa}$$

$$\eta = 1 - \frac{T_1 - T_1 r_c^{\kappa}}{\kappa(T_1 r^{\kappa-1} r_c - T_1 r^{\kappa-1})} \Rightarrow$$

$$\Rightarrow \eta = 1 - \frac{1 - r_c^{\kappa}}{\kappa r^{\kappa-1}(r_c - 1)}$$







Hoy ha tocado pizarra analógica. La pizarra digital tiene muchas ventajas pero la analógica presenta una que es fundamental:

¡NO SE CUELGA!