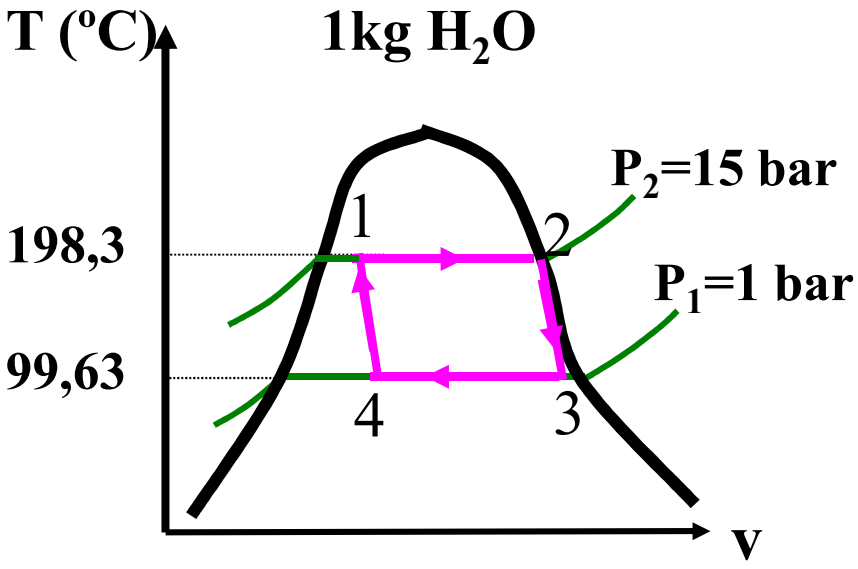
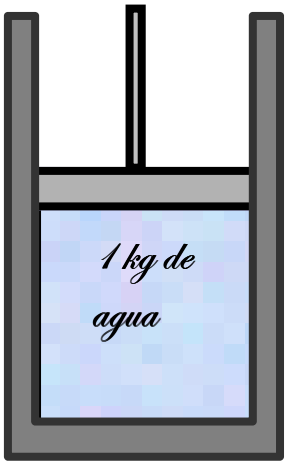
PROBLEMA- 1

Ciclo de Carnot, $x_1 = 0{,}25$, $x_3 = 0{,}849$

- Evaluar Q, W y eficiencia térmica





$$Q_{AB} = \Delta U_{AB} + W_{AB}$$

$$W_{AB} = \int_A^B P\,dV$$

Proceso 1-2:

$$v_1 = v_{1f} + x_1 (v_{1g} - v_{1f}) = 33{,}815 \cdot 10^{-3}\ m^3/kg$$

$$h_1 = h_{1f} + x_1 (h_{1g} - h_{1f}) = 1331{,}6\ kJ/kg$$

$$W_{12} = m\, P_2 (v_2 - v_1) = 1 \cdot 15 \cdot (131{,}8 - 33{,}815) \cdot 10^2 = 147\ kJ$$

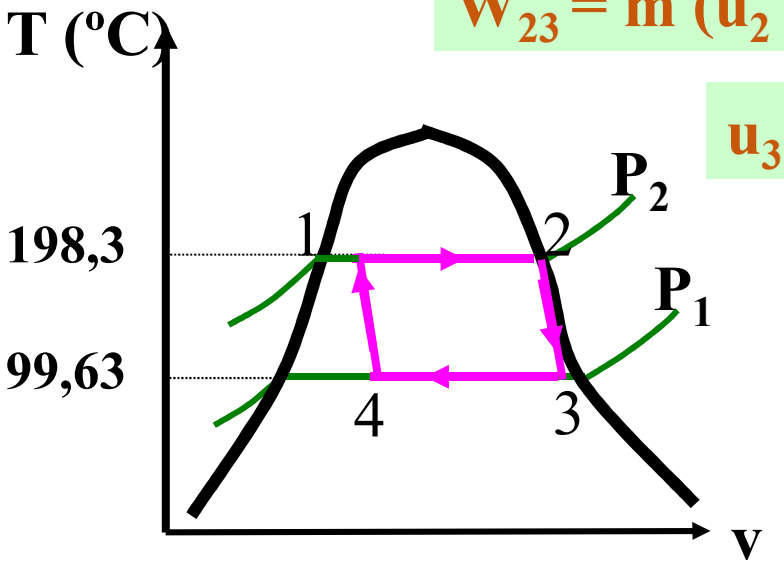
$$Q_{12} = m (u_2 - u_1) + W_{12} = m (h_2 - h_1) = 1 \cdot (2792{,}2 - 1331{,}6) = 1460{,}5\ kJ$$

Proceso 2-3

$Q_{23} = 0$

$W_{23} = m\,(u_2 - u_3) = 1 \cdot\ (2594{,}5 - 2190{,}7) = 403{,}8\ kJ$

$u_3 = u_{3f} + x_3\,(u_{3g} - u_{3f}) = 2190{,}7\ kJ/kg$



Proceso 3-4

$W_{34} = m\,P_3\,(v_4 - v_3) = -\,86{,}68\ kJ$

$v_3 = v_{3f} + x_3\,(v_{3g} - v_{3f}) = 1{,}438\ m^3/kg$

Ciclo de Carnot

$$\left|\frac{Q_{ced}}{Q_{apo}}\right| = \frac{T_F}{T_C} \Rightarrow \frac{Q_{34}}{Q_{12}} = \frac{373}{471}$$

$|Q_{34}| = 1156{,}6\ kJ/kg$

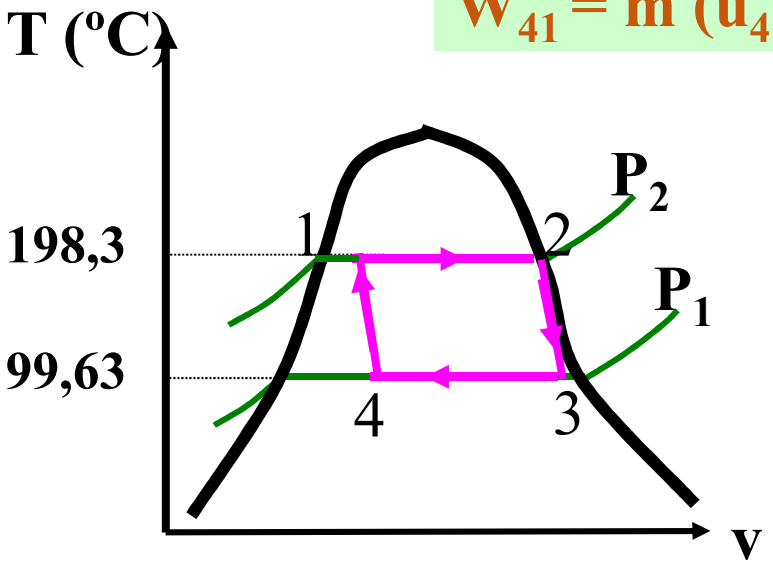
$Q_{34} = m\,(h_4 - h_3)$ ⇒ $h_4 = 1177{,}9\ kJ/kg$

$x_4 = (h_4 - h_{4f}) / (h_{4g} - h_{4f}) = 0{,}337$

$v_4 = v_{4f} + x_4\,(v_{4g} - v_{4f}) = 0{,}5716\ m^3/kg$

Proceso 4-1

$Q_{41} = 0$



$W_{41} = m\,(u_4 - u_1) = 1 \cdot (1121{,}3 - 1281{,}0) = -159{,}7\ kJ$

$u_1 = u_{1f} + x_1\,(u_{1g} - u_{1f}) = 1281{,}0\ kJ/kg$

$u_4 = u_{4f} + x_4\,(u_{4g} - u_{4f}) = 1121{,}3\ kJ/kg$

$W_{neto} = W_{12} + W_{23} + W_{34} + W_{41} = 304{,}4\ kJ$

Eficiencia

$$\eta = \frac{W_{neto}}{Q_{apo}} = 0{,}208$$

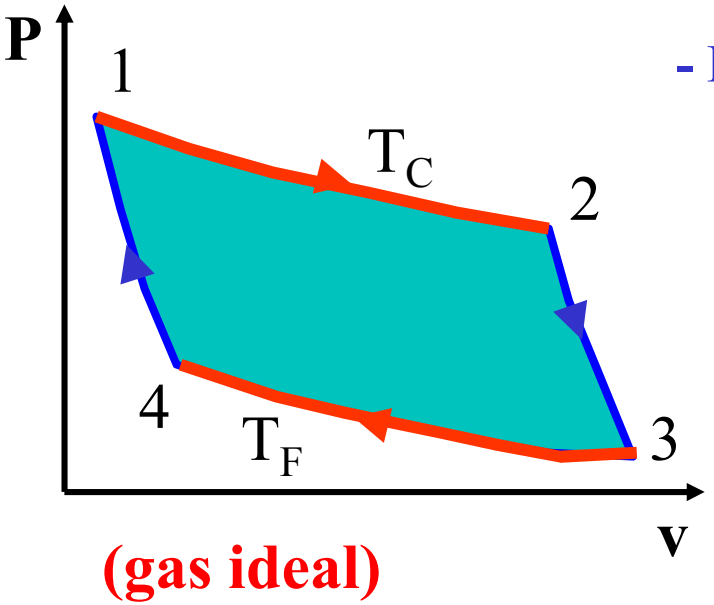
Eficiencia

$$\eta = 1 - \frac{T_C}{T_F} = 0{,}208$$

PROBLEMA- 2

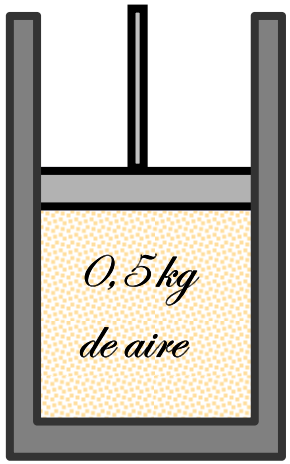
Ciclo de Carnot, P_1= 7 bar, V_1= 0,12 m^3

η= 0,5, Q_{12}= 40 kJ



(gas ideal)

- Evaluar Q, W y temperaturas de los focos



$$Q_{AB} = \Delta U_{AB} + W_{AB}$$

$$W_{AB} = \int_A^B PdV$$

$$T_1 = T_C = P_1 V_1/(mR) = 585{,}4\ K$$

$$T_F/T_C = 1 - \eta = 0{,}5 \Rightarrow T_F = 292{,}7\ K$$

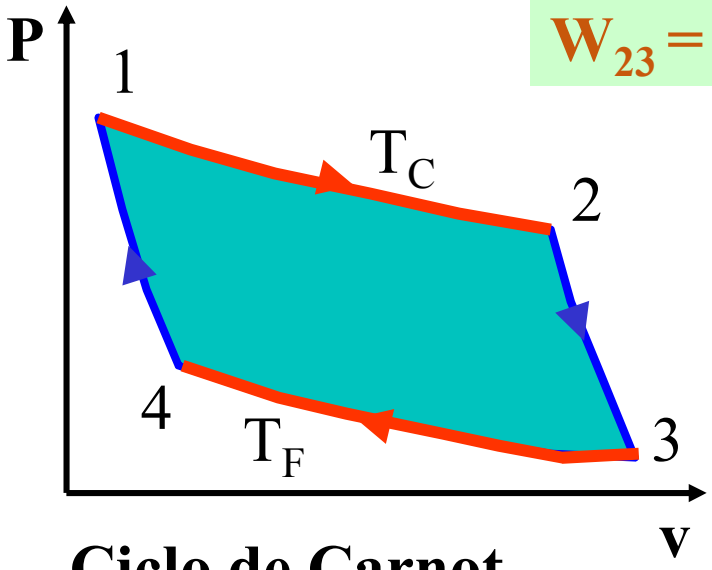
Proceso 1-2:

$$Q_{12} = \cancel{\Delta U_{12}}^{\,0} + W_{12}$$

$$W_{12} = Q_{12} = m\,R\,T_C \ln(V_2/V_1) = 40\ kJ \Rightarrow V_2 = 0{,}193\ m^3$$

Proceso 2-3: $Q_{23} = 0$

$$W_{23} = m\,(u_2 - u_3) = 0{,}5\,(423{,}7 - 208{,}8) = 107{,}5\ kJ$$



Ciclo de Carnot

Proceso 3-4: $Q_{34} = \Delta U_{34} + W_{34}$ ($\Delta U_{34} = 0$)

$$\frac{|Q_{ced}|}{Q_{apo}} = \frac{T_F}{T_C} \rightarrow \frac{|Q_{34}|}{Q_{12}} = \frac{292{,}7}{585{,}4}$$

$$|Q_{34}| = 20\ kJ \rightarrow Q_{34} = W_{34} = -\,20\ kJ$$

Proceso 4-1: $Q_{41} = 0$

$$W_{41} = m\,(u_4 - u_1) = 0{,}5\,(208{,}8 - 423{,}7) = -\,107{,}5\ kJ$$

Se puede comprobar:

$$\eta = \frac{W_{neto}}{Q_{apo}} = \frac{40+107{,}5-20-107{,}5}{40} = 0{,}5$$