FISICA 2 - EXAMEN 05/12/2013

Ej 1: $P_A = 150$ kPa

$V_A = 2 \times 10^{-3}\ m^3$

$T_A = 200$ K

$$\frac{P_A V_A}{T_A} = nR = 1,5 \frac{(kPa)(\ell)}{K}$$

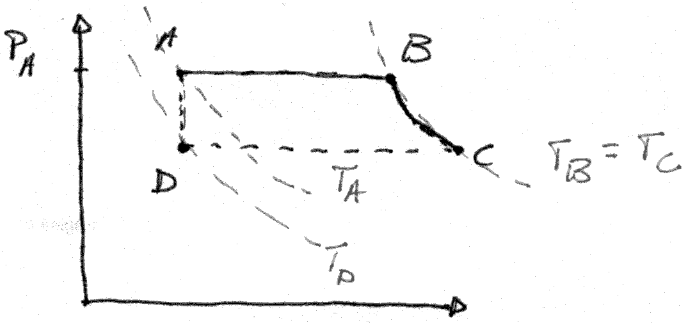
$T_B = 60$ K , $P_c = 120$ kPa

a) PROCESOS A-B , C-D a P CTE

BC , T = CTE

DA $\Rightarrow$ $P = \alpha T$ $\alpha = \frac{nR}{V} = \text{CTE}$

DA $\rightarrow$ V CTE !



A - B $\Rightarrow$ $\frac{V_A}{T_A} = \frac{V_B}{T_B}$ $\Rightarrow$ $\boxed{V_B = 3 V_A = 6 \ell}$

B - C $\Rightarrow$ $P_B V_B = P_c V_c$ $\Rightarrow$ $\boxed{V_c = 1,25 V_B = 3,75 V_A = 7,5 \ell}$

C - D $\Rightarrow$ $\frac{V_c}{T_c} = \frac{V_D}{T_A}$ $\Rightarrow$ $V_D = \frac{T_A}{T_c} V_c$ $\Rightarrow$ $V_D = V_A$

D - A $\Rightarrow$ $\frac{P_D}{T_D} = \frac{P_A}{T_A}$ $\Rightarrow$ $T_D = \frac{P_D}{P_A} T_A$ $\Rightarrow$ $\boxed{\begin{aligned} T_D &= 0,8 T_A \\ &= 160 K \end{aligned}}$

b) Ciclo horario $\Rightarrow$ $W < 0$ $\Rightarrow$ Maq. Térmica

$\eta = 1 - \frac{Q_L}{Q_H}$ $Q_L = \sum_{<0} Q_i$; $Q_H = \sum_{>0} Q_i$

$\boxed{Q_{AB} = n C_p (T_B - T_A) = 2100 J}$

$Q_{BC} = -W = \int_{V_B}^{V_c} P\,dV = nR T_B \ln \frac{V_c}{V_B}$ $\Rightarrow$ $\boxed{Q_{BC} = 200 J}$

$Q_{CD} = n C_p (T_D - T_c)$ $\Rightarrow$ $\boxed{Q_{CD} = -2310}$

$\boxed{DA: Q_{DA} = n C_v (T_A - T_D) = 150 J}$

$|Q_L| = 2310$

$|Q_H| = 2450$

$\boxed{\eta = 5,7\%}$

$\eta_c = 1 - \frac{T_L}{T_H} = 1 - \frac{160}{600} \Rightarrow \boxed{\eta_c = 73,3\%}$

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Ej 2: $v = \lambda f$ $\quad v = \sqrt{\frac{F}{\mu}}$ $\quad F = F_0 + \beta(L - L_0)$

(cuerda)

a)

$\Delta L = \alpha L_0 (T - T_0)$ (barra) ; $\Delta L = L - L_0$

Si $T = 20°C \Rightarrow L = L_0 = 1\ m$, y $\lambda_n = \frac{2L}{n}$

$n = 1$, (modo fundamental) $\quad f_n = \frac{n}{2L}\sqrt{\frac{F}{\mu}}$;

$f_0 = \frac{1}{2L_0}\sqrt{\frac{F_0}{\mu}} \Rightarrow \boxed{F_0 = \mu(2L_0 f_0)^2} \Rightarrow \boxed{F_0 = 929,3\ N}$

b) $\Delta L = \alpha L_0 (T - T_0) \Rightarrow \Delta L = 6 \times 10^{-2}\ m$

$T = 80 \quad L_0 = 1$

$T_0 = 20 \quad \alpha = 10^{-3}$

$L' = L_0 + \Delta L \Rightarrow f_2 = \frac{2}{2L'}\sqrt{\frac{F'}{\mu}}$

$F' = F_0 + \beta \Delta L \Rightarrow F' = 1019,3 \Rightarrow \boxed{f_2 = 869,5\ Hz}$

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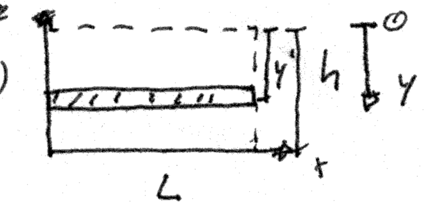
Ej 3: Fuerza hidrostática sobre una pared vertical.

a)



$F_{hid} = \int P(y)\, dA = L \int_0^h P_0(y')\, dy'$

$P(y') = P_0 + \rho g y' \Rightarrow \boxed{F_{hid} = L P_0 h + \rho g L \frac{h^2}{2}}$ *

b) Como la atmósfera está tb del otro lado del tapón,

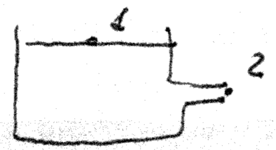
$F_{fric} = (P_0 - P(h')) \cdot A_{tapón}$; $A_{tapón} = \frac{\pi d^2}{4}$; $d = 4cm$

$h' = 6.\ m$

$F_{fie} = \rho g h' \frac{\pi d^2}{4} \Rightarrow \boxed{F_{fric} = 73,8\ N}$

$\boxed{\text{a)} * F_{hid} = 52,35 \times 10^6\ N}$

c) $\frac{\Delta m}{\Delta t} = \rho v_s A_{tap}$



$P_1 + \frac{1}{2}\rho v_1^2 + \rho g h' = P_2 + \frac{1}{2}\rho v_2^2$ *

$v_1 A_1 = v_2 A_2 \Rightarrow v_1 << A_2$ pq $A_1 >> A_2$!

$P_1 = P_2 = P_0$ $\boxed{v_s = v_2 = \sqrt{2gh'}} = 10{,}8\ m/s$

$\Delta t = \frac{\Delta m}{\rho A_{tap}\sqrt{2gh'}} \Rightarrow \boxed{\Delta t = 73{,}4\ seg}$

Ej 4: a) Expansión libre, recipiente adiabático
$dW = 0$ $dQ = 0$

$\Rightarrow \Delta U = 0$; como es un gas ideal $T_1 = T_2$!

$P_1 V_1 = P_2 V_2 \Rightarrow P_2 = \frac{P_1}{2}$; $P_1 = \frac{RT_1}{V_1} \Rightarrow \boxed{P_1 = 2{,}49\ MPa}$

$V_2 = 2V_1$ $\boxed{P_2 = 1{,}25\ MPa}$ (Proc. Irreversible)

b) Compresión adiabática reversible.

$P_3 V_3^{\gamma} = P_2 V_2^{\gamma} \Rightarrow P_3 = P_2\left(\frac{V_2}{V_3}\right)^{\gamma} = \frac{P_1}{2} 2^{\gamma} = P_1 2^{\gamma-1}$

$\gamma = \frac{C_P}{C_V} = \frac{5/2}{3/2} = \frac{5}{3} \Rightarrow \boxed{P_3 = 4\ MPa}$ $T_3 = \frac{P_3 V_3}{nR}$

$\boxed{T_3 = 477{,}6\,K}$

c) $W_{ad} = -\int_{V_3}^{V_2} P\,dV = -CTE \int V^{-\gamma}dV = -\frac{CTE}{1-\gamma}\left(V_3^{1-\gamma} - V_2^{1-\gamma}\right)$

$W_{ad} = \frac{nR}{\gamma-1}(T_3 - T_2) \Rightarrow \boxed{W_{ad} = 2213\ J > 0}$

d) $\Delta S_U = \Delta S_{gas} + \Delta S_{res}$

$\Delta S_{gas} = n C_V \ln\left(\frac{T_{amb}}{T_4}\right) + nR\cancelto{0}{\ln}\left(\frac{V_4}{V_1}\right) \Rightarrow \boxed{\Delta S_{gas} = -0{,}035\ \frac{J}{K}}$

$\Delta S_R = -\frac{Q}{T_{amb}}$; $Q = nC_V(T_4 - T_3) \Rightarrow \boxed{Q = -2{,}3\ kJ}$

$\Delta S_R = 7{,}85\ J/K \Rightarrow \boxed{\Delta S_U = 7{,}82\ J/K}$