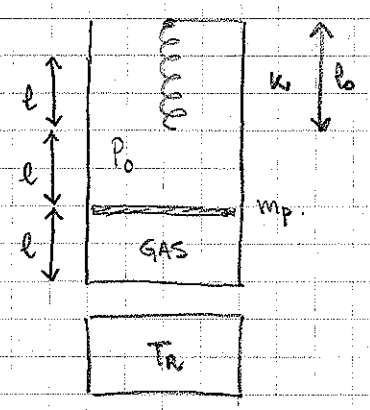
EXAMEN F2 29/07/2016.

PROB 1:



GAS DIATÓMICO $C_p = \frac{7}{2}R$ $C_V = \frac{5}{2}R$ $S = 200\,cm^2 = 0,02\,m^2$

$P_1 = P_0 + \frac{m_p g}{S}$

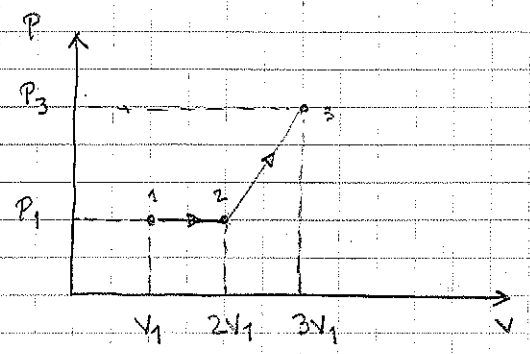
$P_1 = 200\,kPa$

$T_1 = 300\,K$

$V_1 = 0,0015\,m^3$

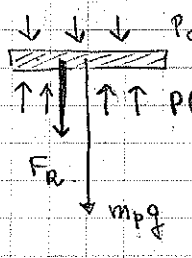
$k = 100\,kN/m$ $l_0 = 14\,cm = 0,14\,m$

A)



$P_2 = P_1$ Proceso $2 \to 3$ $P(V) = P_1 + \frac{k}{S^2}(V - V_2)$

EQUILIBRIO PROCESO $2 \to 3$



$F_R = k\Delta x = \frac{k(V - V_2)}{S}$

$\Sigma F = 0 \to P_0 S + F_R + m_p g = P(V)S$

$P_3 = P(V_3) = P_1 + \frac{k}{S^2}(V_3 - V_2) = 200 + \frac{100}{4 \times 10^{-4}} \times 0,0015 = 575\,kPa$

$T_3 = \frac{P_3 V_3}{nR} = \frac{P_3 V_3}{\left(\frac{P_1 V_1}{T_1}\right)} = \frac{P_3 V_3}{P_1 V_1} T_1 = 2587,5\,K \longrightarrow T_R > T_3$

$nR = \frac{P_1 V_1}{T_1} = 1\,J/K$

B) $\Delta S_u = \Delta S_g + \Delta S_F$

$\Delta S_g = nC_V \ln\left(\frac{T_3}{T_1}\right) + nR \ln\left(\frac{V_3}{V_1}\right) = 1,0 \times \frac{5}{2} \ln\left(\frac{2587,5}{300}\right) + 1,0 \ln\left(\frac{3}{1}\right) =$

$\Delta S_g = 5,39 + 1,10 = 6,49\,J/K$

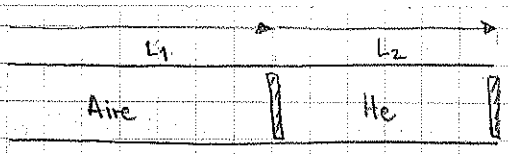
$\Delta S_F = -\frac{|Q_R|}{T_R} = -2,55\,J/K.$

$\Delta S_u = 3,9\,J/K$ PROCESO IRREVERSIBLE !!

$Q_R = W + \Delta U = P_1(V_2 - V_1) + \frac{(P_3 + P_2)(V_3 - V_2)}{2} + nC_V(T_3 - T_1)$

$Q_R = 200 \times 1,5 + \frac{775 \times 1,5}{2} + 1,0 \times \frac{5}{2}(2587,5 - 300) = 6600\,J$

PROB 2 :



v_s (aire) = 343 m/s

v_s (helio) = 1029 m/s

$\nu = 523\ Hz$ / $\Delta p(x_1, t) = 0\ \forall t$

A) Aire: $\Delta p(L_1, t) = 0\ \forall t \longrightarrow k_{n_1} L_1 = n_1 \pi \longrightarrow (\lambda_{n_1}(max) \rightarrow n_1 = 1)\ \frac{2\pi}{\lambda_1} L_1 = \pi$

Helio: $\Delta p(L_2, t) = 0\ \forall t$

$\lambda_1 = 2L_1$

$\lambda_2 = 2L_2$ (mismo razonamiento)

$\lambda_1 = \frac{v_s}{\nu} = 0{,}656\ m \longrightarrow L_1 = 0{,}33\ m$

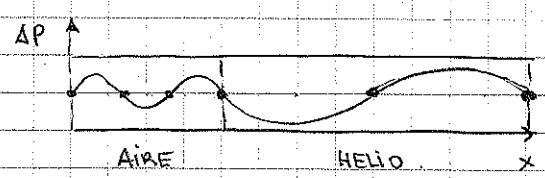
$\lambda_2 = \frac{v_s}{\nu} = 1{,}97\ m \longrightarrow L_2 = 0{,}98\ m$

B) $L_1 = 0{,}4\ m$ $\quad \frac{2}{\lambda_1} L_1 = n_1 \pi \longrightarrow \frac{2\nu}{v_{SA}} L_1 = n_1$

$L_2 = 0{,}8\ m$ $\quad \frac{2\nu}{v_{SH}} L_2 = n_2$

$\Big\rangle \ \frac{n_1}{n_2} = \frac{v_{SH}}{v_{SA}} \frac{L_1}{L_2} = \frac{3}{2}$

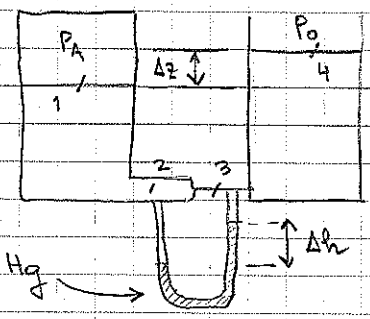
$\nu_{min} \longrightarrow$ mínimo $n_1, n_2 \longrightarrow \nu_{min} = \frac{3}{2} \frac{v_{SA}}{L_1} = 1286\ Hz$



EN TOTAL 6 NODOS $\longrightarrow$ 2 NODOS EN AIRE
1 NODO EN HELIO

c) $\nu'_A = \nu (1 - v_0/v_s)$ // $\nu'_D = \nu (1 + v_0/v_s) \longrightarrow \nu'_D - \nu'_A = \frac{2v_0}{v_s} \nu \longrightarrow v_0 = \frac{\Delta\nu' \ v_s}{2 \ \nu} = 2{,}7\ m/s$ ($v_s = 343\ m/s$)

PROB 3 :



$P_A > P_0$

$D_A = 3D_B$

$\Delta z = 10\ m$

$\Delta h = 0{,}10\ cm$

$P_2 + \rho_A g \Delta h = P_3 + \rho_H g \Delta h$

$P_2 - P_3 = (\rho_H - \rho_A) g \Delta h$

$P_2 - P_3 = 12{,}35\ KPa$

BERNOULLI : (1-2) $\quad P_1 + \rho g z_A = P_2 + \rho \frac{v_2^2}{2}$ $\qquad$ CONT : $D_2^2 v_2 = D_3^2 v_3$

(4-3) $\quad P_4 + \rho g z_B = P_3 + \rho \frac{v_3^2}{2}$ $\qquad$ $v_2 = v_3/9 \longrightarrow v_3^2 - v_2^2 = \frac{80}{81} v_3^2$

RESTANDO (4-3) (1-2) : $P_4 - P_1 + \rho g \Delta z = P_3 - P_2 + \frac{\rho}{2}(v_3^2 - v_2^2)$

BERNOULLI (2-3) : $P_2 + \rho \frac{v_2^2}{2} = P_3 + \rho \frac{v_3^2}{2} \longrightarrow \rho/2 \ \frac{80}{81} v_3^2 = P_2 - P_3 \longrightarrow v_3 = 5{,}0\ m/s$

$P_A = P_1 = P_4 + \rho g \Delta z - P_3 + P_2 - \rho/2 (v_3^2 - v_2^2) = P_0 + \rho g \Delta z = 199\ KPa$