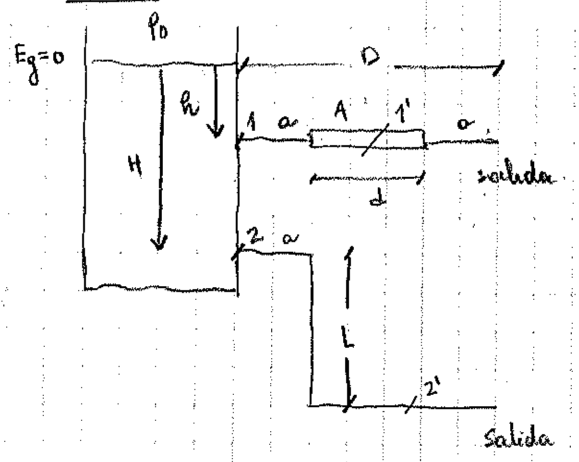
EXAMEN 16/02/2016
F2

PROB 1



a)

$$\begin{cases} P_0 + \rho\dfrac{v_0^2}{2} = -\rho g h + \rho\dfrac{v_1^2}{2} + P_1 & (v_0 << v_1) \\ P_1 + \rho\dfrac{v_1^2}{2} = P_1' + \rho\dfrac{v_1'^2}{2} \;/\; a v_1 = A v_1' & (P_1 = P_0 \quad v_1 = \sqrt{2gh} \end{cases}$$

$$P_1' = P_0 \longrightarrow P_1' = P_0 + \rho g h\left(1 - a^2/A^2\right)$$

$$\begin{cases} P_0 + \rho\dfrac{v_0^2}{2} = -\rho g H + \rho\dfrac{v_2^2}{2} + P_2 & (v_0 << v_2) \\ P_2 + \rho\dfrac{v_2^2}{2} + \rho g L = P_2' + \rho\dfrac{v_2'^2}{2} & (v_2 = v_2' \;;\; P_2' = P_0) \end{cases}$$

$$P_2 = P_0 - \rho g L \qquad v_2 = \sqrt{2g(H+L)}$$

b) ① Recorre $(D-d)$ con v_1 y d con v_1' $\longrightarrow$ $t_{11} = \dfrac{D-d}{\sqrt{2gh}}$, $t_{12} = \dfrac{d}{a/A\sqrt{2gh}}$

$$t_{1T} = \frac{D + (A/a - 1)d}{\sqrt{2gh}}$$

② Recorre $(D+L)$ con v_2 $\longrightarrow$ $t_2 = \dfrac{D+L}{\sqrt{2g(H+L)}}$

PROB. 3

a) $y_1(x,t) = y_0 \cos(kx_1 - \omega t)$

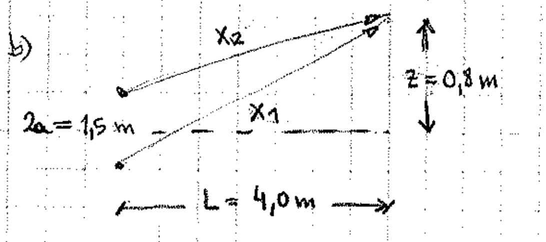
$y_2(x,t) = y_0 \cos(kx_2 - \omega t)$ $\Big\rangle$ $y_T = 2y_0 \cos\left[\dfrac{k(x_1+x_2)}{2} - \omega t\right] \cos\left[\dfrac{k(x_1-x_2)}{2}\right]$

$P(x_p,t) \propto y_T^2(x_p,t) \longrightarrow$ si $P(x_p,t) = 0 \;\forall t \longrightarrow 0 = y_T^2 = 4y_0^2 \cos^2\left[\dfrac{k(x_1-x_2)}{2}\right] \cos\left[\dfrac{k(x_1+x_2)}{2} - \omega t\right]$

$$0 = \cos^2\left[\frac{k(x_1-x_2)}{2}\right] = \frac{1}{2}\left\{1 + \cos\left[k(x_1-x_2)\right]\right\} = 0 \longrightarrow \cos\left[k(x_1-x_2)\right] = -1$$

$$k(x_1-x_2) = (2n+1)\pi \;/\; n = 0,1,2\ldots \qquad \frac{2\pi}{\lambda}(x_1-x_2) = (2n+1)\pi \longrightarrow \boxed{x_1 - x_2 = \frac{(2n+1)}{2}\lambda}$$

b)



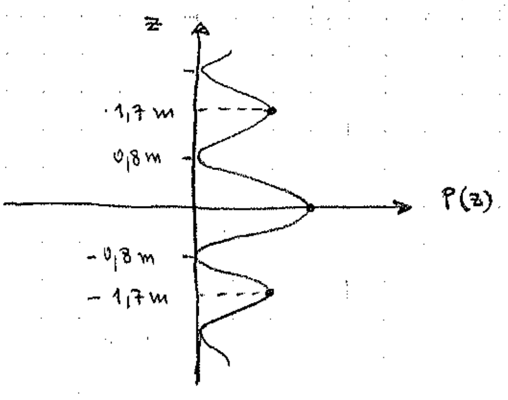
$$x_1 - x_2 = \sqrt{L^2 + (z+a)^2} - \sqrt{L^2 + (z-a)^2} = \frac{(2n+1)\lambda}{2} \quad n = 0,1,2\ldots$$

$$\lambda = \frac{2}{(2n+1)}(4{,}2898 - 4{,}0003) = \frac{0{,}579}{(2n+1)} = \lambda_n$$

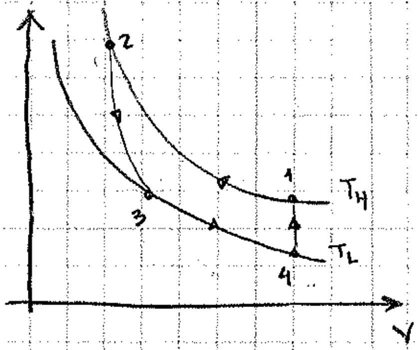
$f_n = v_s/\lambda_n = 592{,}4\,(2n+1)$ Hz $\quad n = 0,1 \ldots 16$

c) $x_1' - x_2' = 4{,}6907 - 4{,}1113 = 0{,}5794\,\text{m} \cong \lambda_0$

la potencia se atenúa xq' el sonido no es una onda plana. Es una onda esférica.



Prob 2.



$T_H = 300K$ $P_2 = 1{,}0MPa$

$T_L = 150K$ $\frac{V_1}{V_2} = 10$

a) $P_1 = \frac{nRT_H}{V_1}$ $P_4 = \frac{nRT_L}{V_4}$ $(V_1 = V_4) \longrightarrow P_1 = 2P_4$

$P_1V_1 = P_2V_2 \longrightarrow P_1 = \frac{V_2}{V_1}P_2 \longrightarrow P_1 = 100kPa$; $P_4 = 50kPa$

$P_2V_2^\gamma = P_3V_3^\gamma$

$P_4^\gamma V_4^\gamma = P_3^\gamma V_3^\gamma$

$\frac{P_4^\gamma}{P_2}10^\gamma = P_3^{\gamma-1} \longrightarrow P_3 = \left(\frac{(50\times10^3)^\gamma 10^\gamma}{1\times10^6}\right)^{\frac{1}{\gamma-1}} \longrightarrow P_3 = 177kPa$ $(\gamma = 5/3)$.

b) $W_T = W_{12} + W_{23} + W_{34} = nRT_H \ln\left(\frac{V_1}{V_2}\right) - nC_V(T_2 - T_3) - nRT_L \ln\left({}^{V_4}/_{V_3}\right)$

$W_{23} = \Delta U$

$V_2/V_1 = 10$; $\frac{V_4}{V_3} = \frac{P_3}{P_4} = \frac{177}{50}$

$W_T = R\times300\ln10 - \frac{3}{2}R(T_H - T_L) - R\times150\ln\left({}^{177}/_{50}\right) = 2296 \ J/mol$

c) $COP_R = \frac{q_L}{W_T} = \frac{R\times150\ln(177/50)}{2296 \ J/mol} = \frac{1577}{2296} = 0{,}687$ // $COP_{CARNOT} = \frac{T_L}{T_H - T_L} = 1 > COP_R$

d) $\Delta S_u = \Delta S_{GAS} + \Delta S_L + \Delta S_H = -\frac{|q_L|}{T_L} - \frac{|q_{41}|}{T_H} + \frac{|q_{12}|}{T_H} = -\frac{1577}{150} - \frac{1871}{300} + \frac{5743}{300}$

$\Delta S_{GAS} = 0$

$|q_L| = |W_{34}|$

$|q_{41}| = C_V(T_H - T_L)$

$|q_{12}| = |W_{12}|$

$\boxed{\Delta S_u = 2{,}39 \ J/molK}$