Ej 1: $V = 20L = 20\times10^{-3}\,m^3$

$T_i^a = 20°C = 293\,K$ $\qquad T_V = 77\,K$ $\qquad$ |1

$m_a = 0{,}5\,kg$ $\qquad$ Ocurre un cambio de fase del N_2

$V^i_{N_2} = 200\times10^{-6}\,m^3$

a)

$$Q_a + Q_{N_2} = 0 \Rightarrow m_a c_a (T_a - T_i^a) = -m_{N_2} L_v^{N_2}$$

$$T_a = T_i^a - \frac{m_{N_2}}{m_a}\frac{L_v^{N_2}}{c_a} \Rightarrow \boxed{T_a = 152{,}5\,K}$$

$$m_{N_2} = \rho_{N_2}\cdot V^i_{N_2} \Rightarrow \boxed{m_{N_2} = 161{,}6\,g}$$

b) $PV = nRT$ $\qquad n = \frac{m_{N_2}}{M} \Rightarrow \boxed{n = 5{,}8\text{ moles}}$

$$P = \frac{nRT_V}{V} \Rightarrow \boxed{P = 184{,}7\,kPa}$$

c) Entrada de calor al N_2 a P cte.

$$Q_a + Q_{N_2} = 0$$

$$m_a c_a (T_{eq} - T_a) = -n C_p (T_{eq} - T_V)$$

$$(m_a c_a + n C_p)\,T_{eq} = n C_p T_V + m_a c_a T_a$$

$$T_{eq} = \frac{n C_p T_V + m_a c_a T_a}{\underbrace{m_a c_a}_{230} + \underbrace{n C_p}_{168{,}7}} \Rightarrow \boxed{T_{eq} = 120{,}6\,K}$$

$$V_f = \frac{nRT_{eq}}{P} = 31{,}5\,lt$$

d) $\Delta S_U = \Delta S_a + \Delta S_{N_2}$

$$\Delta S_U = m_a c_a \ln\left(\frac{T_{eq}}{T_{ia}}\right) + \frac{m_{N_2} L_v}{T_v} + n c_p \ln \frac{T_{eq}}{T_v}$$

$-204,2$ $\quad +419,7 \quad +75,7$

$$\boxed{\Delta S_U = 291,3 \ J/K}$$

— a —

Ej 2

$A = 50 m^2$ $\quad a = 25 cm^2 = 25 \times 10^{-4} m^2$

$H = 3 m$ $\quad a_r = \frac{2}{3} a$

$h = 1,3 m$

$L = 1 m$

a) Hidrostática ; $y = 0,6 m$

$$P_g = \rho g (H + h - y) + P_0 \Rightarrow \boxed{P_g = 137,6 kPa}$$

b) Hidrodinámico

Bernoulli entre 1 - 3 (a) salida

$$\cancel{P_0} + \rho g H + \frac{\rho v_0^2}{2} = \cancel{P_0} + \frac{\rho v_s^2}{2}$$
$v_0 \approx 0$

$$a v_s = A v_0 \Rightarrow v_0 = \frac{a}{A} v_s \Rightarrow \underline{\underline{v_0 = 5 \times 10^{-5} v_s}}$$

$$v_s \simeq \sqrt{2gH} \Rightarrow v_s = 7,7 m/s$$

$$a v_s = a_r v_r \Rightarrow v_r = \frac{3}{2} v_s \Rightarrow \boxed{v_r = 11,3 m/s}$$

$$P_g' = P_2 + \rho g (h - y')$$

$$P_0 + \rho g H + \frac{\rho v_0^2}{2} = P_2 + \frac{\rho v_r^2}{2}$$

$$P_g' = P_0 + \rho g (H + h - y') - \rho \frac{v_2^2}{2}$$

$$\boxed{P_g' = 72{,}8 \text{ kPa}} \quad ; \quad PV = nRT$$

$$T_g' = \frac{P_g' V'}{nR} \quad ; \quad V' = L^2 (L - y') \Rightarrow \boxed{T_g' = 262{,}9 \text{ K}}$$

— " —

Ej 3

$$T_2 = T_1 = \frac{Mg}{2} \qquad \mu_1 = 0{,}2 \frac{\text{Kg}}{\text{cm}} = 20 \text{ Kg/m}$$

$$f_1 = 20 \text{ Hz} \qquad \mu_2 = 1{,}0 \frac{\text{Kg}}{\text{cm}} = 100 \text{ Kg/m}$$

$$v = \sqrt{\frac{T}{\mu}}$$

$$v = \lambda f \qquad \Rightarrow \qquad \boxed{f = \frac{m}{2L} \sqrt{\frac{T}{\mu}}} \quad (1)$$

$$\lambda = \frac{2L}{m}$$

a)

$$\frac{f_2}{f_1} = \sqrt{\frac{\mu_1}{\mu_2}} \Rightarrow \boxed{f_2 = 8{,}9 \text{ Hz}}$$

b)

$$\lambda_1 = \frac{1}{f_1} v_1 = \frac{1}{20} \sqrt{\frac{10 \times 9{,}8}{2 \cdot 20}} \Rightarrow \boxed{\lambda_1 = 7{,}8 \text{ cm}}$$

Si $m_1 = m_2$ y $L_1 = L_2 \Rightarrow \boxed{\lambda_1 = \lambda_2}$

c) De la ec. (1), para subir f:

1- Aumentar la masa M
2- Reducir longitud de la cuerda
3- Reducir densidad de la cuerda
4- Aumentar el modo vibracional