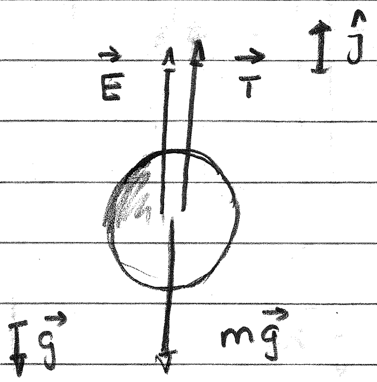
Problema 1

a)



1er cardinal esfera

$\hat{j})\quad E + T - mg = 0$

$$\rho \frac{4}{3}\pi r^3 g + T - \rho_{hierro} \cdot \frac{4}{3}\pi r^3 g = 0$$

$$\Rightarrow \quad T = (\rho_{hierro} - \rho) \cdot \frac{4}{3}\pi r^3 g$$

$$\boxed{T = 35{,}3\ N}$$

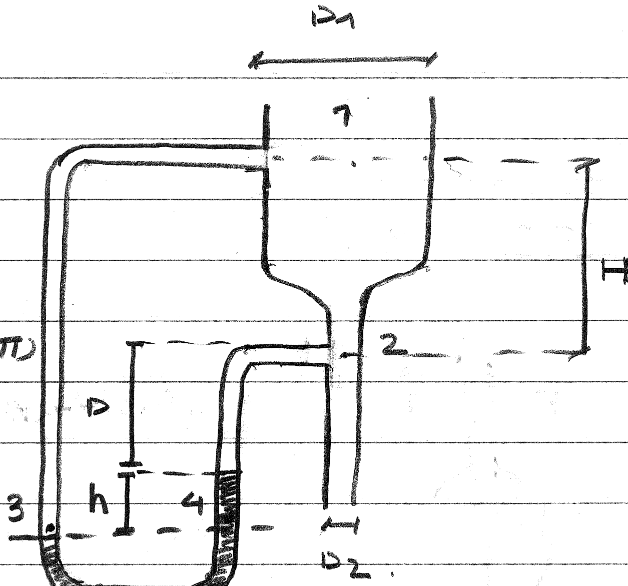
b) 1er cardinal al agua

$\hat{j})\quad -E + N - m_{agua} \cdot g = 0$

$$\Rightarrow \quad N = \underbrace{m_{agua} \cdot g}_{125\ N} + \rho \cdot \frac{4}{3}\pi r^3 g \Rightarrow \boxed{N = 130{,}2\ N}$$

Problema 2

a)



Tubo en U $\quad P_3 = P_4 \quad (I)$

$P_3 = P_1 + \rho g (H + h + D) \quad (II)$

$P_4 = P_2 + \rho g D + \rho_{mercurio}\, g\, h \quad (III)$

combinando (I) (II) y (III)

$$P_1 + \rho g (H + h + \cancel{D}) = P_2 + \cancel{\rho g D} + \rho_{mercurio}\, g\, h$$

$$\Rightarrow \quad P_1 - P_2 = (\rho_{mercurio} - \rho) g h - \rho g H \quad (\boxed{IV})$$

b)

Bernoulli entre 1-2.

$$\frac{1}{2}\rho v_1^2 + p_1 + \rho g H = \frac{1}{2}\rho v_2^2 + p_2. \quad (V)$$

continuidad 1-2

$$\frac{\pi D_1^2}{4} \cdot v_1 = \frac{\pi D_2^2}{4} v_2. \quad (VI) \Longrightarrow \quad v_2 = \left(\frac{D_1}{D_2}\right)^2 \cdot v_1.$$

Combinando (V) y (VI)

$$p_1 - P_2 = \frac{1}{2}\rho v_1^2 \left[\left(\frac{D_1}{D_2}\right)^4 - 1\right] - \rho g H \quad (\boxed{VII})$$

combinando (IV) y (VII)

$$(\rho_{mercurio} - \rho) g - \cancel{\rho g H} = \frac{1}{2}\rho v_1^2 \left[\left(\frac{D_1}{D_2}\right)^4 - 1\right] - \cancel{\rho g H}$$

$$\Rightarrow \quad v_1 = \sqrt{\frac{2(\rho_{mercurio} - \rho) g h}{\rho\left[\left(\frac{D_1}{D_2}\right)^4 - 1\right]}} \quad \Rightarrow \quad \boxed{v_1 = 0{,}47 \text{ m/s}}$$

(C) $\dot{m} = \dfrac{\pi D_1^2}{4} \rho \cdot v_1 \rightarrow \boxed{\dot{m} = 31{,}6 \dfrac{kg}{s}}$

Problema 3

$y(x,t) = (0{,}002\,m)\,\sin(\pi x).\cos(100\pi.t)$

a) De la ecuación de la onda surge $\begin{cases} k = \pi \\ \omega = 100\pi \end{cases}$

$\left.\begin{array}{l} k = \pi \\ k = \dfrac{2\pi}{\lambda} \end{array}\right\} \quad \lambda = 2m$

Para cuerda de extremos fijos $L = \dfrac{n\lambda}{2}$

$\Rightarrow \boxed{n = 3 \quad 3^{er}\text{ armónico} \quad 4 \text{ Nodos}}$

b) $\left.\begin{array}{l} \omega = 100\pi \\ \omega = \dfrac{2\pi}{T} \end{array}\right\} \quad T = 0{,}02\,s$

$V = \dfrac{\lambda}{T} = 100\,m/s$

Para 1^{er} armonico $L = \dfrac{\lambda_0}{2} \Rightarrow \lambda_0 = 2L = 6\,m.$

$\left.\begin{array}{l} f_0 = \dfrac{V}{\lambda_0} \\ \lambda_0 = 6m \end{array}\right\} \quad \boxed{f_0 = 16{,}7\ Hz}$

c) $f = cte \Rightarrow T = 0{,}02\,s$

$V^* = \sqrt{\dfrac{9T}{\mu}} = 3\sqrt{\dfrac{T}{\mu}} = 3V = 300\,m/s.$

$\lambda^* = V^*\,T = 6m \Rightarrow L = \dfrac{\lambda^*}{2} \Rightarrow \boxed{\text{Modo Fundamental} \quad 2 \text{ Nodos.}}$

Problema 4

a)

$$v_1 = \sqrt{\frac{T_1}{\mu}}$$

$$L = \lambda_1/2 \quad (n = 1)$$

$$f_1 = \frac{1}{2L}\sqrt{\frac{T_1}{\mu}}$$

$$v_2 = \sqrt{\frac{T_2}{\mu}}$$

$$L = \frac{3\lambda_2}{2} \quad (n=3)$$

$$f_2 = \frac{3}{2L}\sqrt{\frac{T_2}{\mu}}$$

Frecuencia de los pulsos f'

$$f' = f_1 - f_2$$

$$f' = \frac{1}{2L}\sqrt{\frac{T_1}{\mu}} - \frac{3}{2L}\sqrt{\frac{T_2}{\mu}}$$

$$\Rightarrow \boxed{f' = \frac{1}{2L\sqrt{\mu}} \cdot \left(\sqrt{T_1} - 3\sqrt{T_2}\right)}$$

b) $\mu = S\rho$

$$\Rightarrow S = \frac{1}{\rho}\left[\frac{1}{2Lf'}\left(\sqrt{T_1} - 3\sqrt{T_2}\right)\right]^2$$

$$\boxed{S = 1{,}41 \times 10^{-8}\ m^2}$$

c) $f_1 = \frac{1}{2L}\sqrt{\frac{T_1}{\rho S}} \Rightarrow \boxed{f_1 = 170{,}6\ Hz}$

$f_2 = \frac{3}{2L}\sqrt{\frac{T_2}{\rho S}} \Rightarrow \boxed{f_2 = 164{,}6\ Hz}$

Papiros