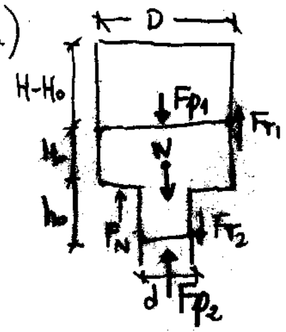
Pauta P2

a)



F_p: fuerzas de presión
F_τ: fuerzas de tensión superficial
W: peso
F_N: normal en pared del recipiente.

$$F_{p1} + F_{\tau 2} + W = F_{p2} + F_{\tau 1} + F_N$$

$$F_{p1} = p_G \cdot \frac{\pi D^2}{4} \qquad F_{\tau 1} = \tau \pi D \cos\theta \qquad W = \rho g \left(H_0 \cdot \frac{\pi D^2}{4} + h_0 \frac{\pi d^2}{4} \right)$$

$$F_{p2} = p_{atm} \cdot \frac{\pi d^2}{4} \qquad F_{\tau 2} = \tau \pi d \cos\theta \qquad F_N = \left[p_G + \rho g H_0 \right] \cdot \left(\frac{\pi D^2}{4} - \frac{\pi d^2}{4} \right)$$

$$\Rightarrow \cancel{p_G \cdot \frac{\pi D^2}{4}} + \tau \pi d \cos\theta + \cancel{\rho g H_0 \frac{\pi D^2}{4}} + \rho g h_0 \frac{\pi d^2}{4} =$$

$$p_{atm} \cdot \frac{\pi d^2}{4} + \tau \pi D \cos\theta + \cancel{p_G \frac{\pi D^2}{4}} + \cancel{\rho g H_0 \frac{\pi D^2}{4}} - p_G \frac{\pi d^2}{4} - \rho g H_0 \frac{\pi d^2}{4}$$

$$\Rightarrow \rho g (H_0 + h_0) \frac{\pi d^2}{4} + \tau \pi (d - D) \cos\theta = (p_{atm} - p_G) \frac{\pi d^2}{4}$$

$$p_G = p_{atm} - \rho g (H_0 + h_0) + \frac{4\tau}{d^2} (D - d) \cos\theta = 84985 \text{ Pa} = 0{,}84 \text{ atm}$$

b) Según la ley de gases ideales

$$P \cdot V = n R_0 T \quad \Rightarrow \quad n = \frac{PV}{R_0 T} = 0{,}00986 \text{ moles}$$

$$m = n \cdot P.A. = 0{,}32 \text{ gr.}$$

c) $$\frac{dU}{dt} = q - \frac{dW}{dt} \qquad \frac{dU}{dt} = M C_v \frac{dT}{dt}$$

Aproximación

$$\frac{dW}{dt} = \frac{d(F \cdot \Delta x)}{dt} = \frac{d(P \cdot \overbrace{A \cdot \Delta x}^{V})}{dt} = \frac{d(P \cdot V)}{dt}$$

$$= \frac{d(n R_0 T)}{dt} = n R_0 \frac{dT}{dt}$$

$$\Rightarrow \quad q = \frac{dU}{dt} - \frac{dW}{dt} = M\,C_v \frac{dT}{dt} + n\,R_o \frac{dT}{dt}$$

$$q = \left(M\,C_v + n\,R_o\right)\frac{dT}{dt}$$

$$q\,dt = (M C_v + n R_o)\, dT \quad / \int_{\text{inicio}}^{\text{fin}}$$

$$q \cdot t = (M C_v + n R_o)(T_f - T_i)$$

$$\Rightarrow \quad T_f = T_i + \frac{q \cdot t}{(M C_v + n R_o)}$$

Usando la ley de los gases nuevamente:

$$P_f \cdot V_f = n R_o T_f \quad \Rightarrow \quad P_f = \frac{n R_o T_f}{V_f}$$

pero sabemos que $P_f = p_{atm} - \rho g (H_f + h_f) + \frac{4\sigma}{d^2}(D-d)\cos\theta$

y como se conserva el volumen de líquido. $H_o \cdot \frac{\pi D^2}{4} + h_o \cdot \frac{\pi d^2}{4} = V_o$

$$V_f = H_f \cdot \frac{\pi D^2}{4} + h_f \frac{\pi d^2}{4} = V_o$$

El volumen final de gas es $(H - H_f) \cdot \frac{\pi D^2}{4}$

$$\Rightarrow \quad P_f = \frac{n R_o T_f}{(H - H_f)} \cdot \frac{4}{\pi D^2}$$

$$\Rightarrow \quad \frac{n R_o T_f}{(H - H_f)} \cdot \frac{4}{\pi D^2} = p_{atm} - \rho g \left[H_f + V_o \cdot \frac{4}{\pi d^2} - H_f \frac{D^2}{d^2}\right] + \frac{4\sigma}{d^2}(D-d)\cos\theta$$

$$\Rightarrow \quad H_f = 5{,}02 \text{ cm.}$$

$$h_f = 2{,}50 \text{ cm} \quad \Rightarrow \quad \Delta h = 2{,}50 \text{ cm.}$$