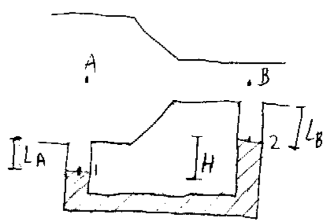
P1) a) Primero, veamos lo que ocurre en el venturímetro:



$$B = \text{Bernoulli} = \frac{V^2}{2g} + \frac{p}{\gamma} + z = cte.$$

$$B_A = B_B \Leftrightarrow \frac{V_A^2}{2g} + \frac{P_A}{\gamma} + \cancel{z_A} = \frac{V_B^2}{2g} + \frac{P_B}{\gamma} + \cancel{z_B} \Leftrightarrow \frac{P_A - P_B}{\gamma} = \frac{V_B^2 - V_A^2}{2g} \quad (*)$$

Hidrostática: $P_1 = P_2 + \gamma_{Hg} \cdot H$; $P_1 = P_A + \gamma\left(\frac{D}{2} + L_A\right)$; $P_2 = P_B + \gamma\left(\frac{d}{2} + L_B\right)$

De la primera ecuación: $P_1 - P_2 = \gamma_{Hg} H \quad (1)$

De las dos últimas: $P_1 - P_2 = P_A + \gamma\left(\frac{D}{2} + L_A\right) - P_B - \gamma\left(\frac{d}{2} + L_B\right) \quad (2)$

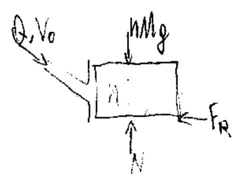
$$(1) = (2) \Leftrightarrow \gamma_{Hg} H = P_A - P_B + \gamma\left(\frac{D}{2} + L_A - \frac{d}{2} - L_B\right) \Leftrightarrow \gamma_{Hg} H = P_A - P_B + \gamma H \Leftrightarrow P_A - P_B = (\gamma_{Hg} - \gamma) H$$

Reemplazando en (*): $\frac{(\gamma_{Hg} - \gamma) H}{\gamma} = \frac{V_B^2 - V_A^2}{2g}$

Continuidad: $Q = A_A V_A = A_B V_B \Rightarrow V_A = \frac{Q}{A_A} = \frac{4Q}{\pi D^2}$; $V_B = \frac{4Q}{\pi d^2} \Rightarrow \frac{(\gamma_{Hg} - \gamma) H}{\gamma} = \frac{8Q^2}{2g\pi^2}\left(\frac{1}{d^4} - \frac{1}{D^4}\right)$

$$\Rightarrow Q = \sqrt{\left(\frac{\rho_{Hg} - \rho}{\rho}\right) \frac{\pi^2 g}{4} \frac{d^4 D^4}{(D^4 - d^4)}} = \sqrt{\left(\frac{13.600 - 1.200}{1.200}\right) \frac{\pi^2 \cdot 9{,}8}{4} \frac{0{,}05^4 \cdot 0{,}1^4}{(0{,}1^4 - 0{,}05^4)}} = 0{,}04 \, [m^3/s]$$

b)



$$TCM \hat{y}: \rho Q(\cancel{V_s}^{0} - V_e) = N - nMg \Leftrightarrow N = \rho Q V_0 \operatorname{sen}\alpha + nMg$$

$$TCM \hat{x}: \rho Q(\cancel{V_s}^{0} - V_e) = -F_R \Leftrightarrow \rho Q(0 - V_0 \cos\alpha) \Leftrightarrow -\mu(\rho Q V_0 \operatorname{sen}\alpha + nMg) = \rho Q V_0 \cos\alpha$$

En la boquilla; $Q = AV_0 \Rightarrow Q = \frac{\pi d_0^2}{4} V_0 \Leftrightarrow V_0 = \frac{4Q}{\pi d_0^2}$; $\Leftrightarrow -\mu\left(\frac{4\rho Q^2 \operatorname{sen}\alpha}{\pi d_0^2} + nMg\right) = -\frac{4\rho Q^2 \cos\alpha}{\pi d_0^2}$

$$\Rightarrow nMg = \frac{4\rho Q^2 \cos\alpha}{\mu \pi d_0^2} - \frac{4\rho Q^2 \operatorname{sen}\alpha}{\pi d_0^2} \Leftrightarrow n = \frac{4\rho Q^2}{\pi d_0^2 M g}\left(\frac{\cos\alpha}{\mu} - \operatorname{sen}\alpha\right) = \frac{4 \cdot 1.200 \cdot 0{,}04^2}{\pi \cdot 0{,}07^2 \cdot 75 \cdot 9{,}8}\left(\frac{\cos 30°}{0{,}96} - \operatorname{sen} 30°\right) = 0{,}26 \rightarrow 1$$