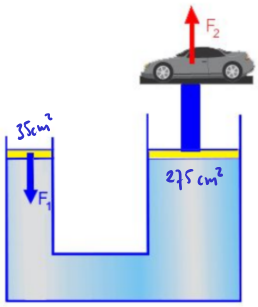
Ejercicio 6



a) $F_2 = m_2 \cdot g = 1750 \text{ kp}$. $S_2 = 275 \text{ cm}^2$

$S_1 = 35 \text{ cm}^2$

$F_1/S_1 = F_2/S_2$ ppo. de Pascal

$$F_1 = F_2 \cdot \frac{S_1}{S_2} = 1750 \text{ kp} \cdot \frac{35 \text{ cm}^2}{275 \text{ cm}^2} = 222{,}73 \text{ kp}$$

$$F_1 = 222{,}73 \cancel{\text{kp}} \cdot \frac{9{,}8 \text{ N}}{1 \cancel{\text{kp}}} = 2182{,}7 \text{ N}$$

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b) $V_1 = V_2$ $S_1 \cdot l_1 = S_2 \cdot l_2 \Rightarrow l_2 = \frac{S_1 \cdot l_1}{S_2} = \frac{35 \cancel{\text{cm}^2} \cdot 50 \text{ mm}}{275 \cancel{\text{cm}^2}} = 6{,}36 \text{ mm}$

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c) Puede ser un régimen laminar o turbulento. Se calcula un nº de Reynolds que:

En tuberías rectas: $N_{RE} = \frac{\rho \cdot v \cdot \phi}{\mu}$

$\rho \rightarrow$ densidad en g/cm^3

$v \rightarrow$ velocidad fluido en cm/s

$\phi \rightarrow$ diámetro en cm.

$\mu \rightarrow$ viscosidad en poisses $gr/(cm \cdot s)$

si $N_{RE} > 2320$ el régimen es turbulento.

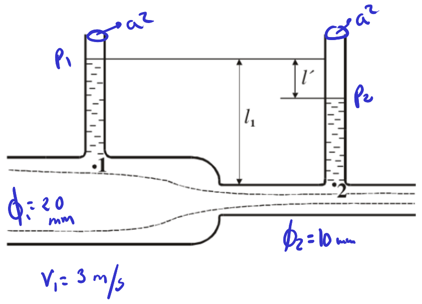
En tuberías acodadas:

$N_{RE} < 2320$ laminar

$N_{RE} \in [2320, 12400]$ depende del radio de curvatura

$N_{RE} > 1240$, turbulento.

Ejercicio 8



Bernoulli:

$$h_1 + \frac{P_1}{\rho \cdot g} + \frac{V_1^2}{2g} = h_2 + \frac{P_2}{\rho \cdot g} + \frac{V_2^2}{2g}$$

a) $Q = S \cdot v = S_1 \cdot v_1 = \pi \left(\frac{\phi_1}{2}\right)^2 \cdot v_1 = \frac{\pi}{4} \cdot (2cm)^2 \cdot 300 \, cm/s \Rightarrow$

$$Q = 942{,}5 \, cm^3/s = 942{,}5 \frac{\cancel{cm^3}}{\cancel{s}} \cdot \frac{\cancel{dm^3}}{10^3 \cancel{cm^3}} \cdot \frac{l}{\cancel{dm^3}} \cdot \frac{60 \cancel{s}}{1 min} = 56{,}54 \, l/min$$

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b) $Q_1 = Q_2 \Rightarrow S_1 \cdot v_1 = S_2 \cdot v_2 \Rightarrow \phi_1^2 \cdot v_1 = \phi_2^2 \cdot v_2$

$$V_2 = v_1 \cdot \frac{\phi_1^2}{\phi_2^2} = v_1 \cdot \left(\frac{\phi_1}{\phi_2}\right)^2 = 3m/s \cdot \left(\frac{20 mm}{10 mm}\right)^2 = 12 m/s$$

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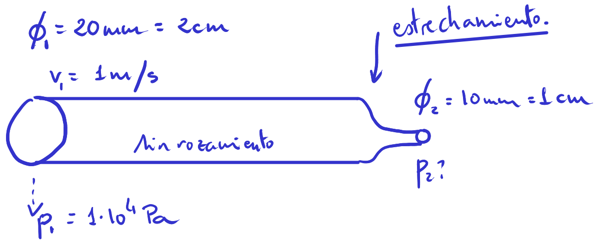
c) $h_1 = h_2$ (horizontal) $\quad \frac{P_1}{\rho \cdot g} + \frac{V_1^2}{2g} = \frac{P_2}{\rho \cdot g} + \frac{V_2^2}{2g} \Rightarrow P_1 - P_2 = \frac{V_2^2 - V_1^2}{2} \cdot \rho$

$$P_1 = \frac{m_1 \cdot g}{a^2} = \frac{m_1 \cdot g \cdot l_1}{a^2 \cdot l_1} = \frac{\rho \cdot a^2 \cdot l_1 \cdot g \cdot l_1}{a^2 \cdot l_1} = \rho \cdot g \cdot l_1 \qquad P_2 = \rho \cdot g \cdot l_2$$

$$P_1 - P_2 = \rho \cdot g \, (l_1 - l_2) = \frac{V_2^2 - V_1^2}{2} \cdot \rho \qquad l_1 - l_2 = \frac{V_2^2 - V_1^2}{2g} = \frac{(12m/s)^2 - (3m/s)^2}{2 \cdot 9{,}8 m/s^2} = 6{,}88 \, m$$

Ejercicio 9



$\rho_{ag} = 1000 \, kg/m^3 = 1 \, kg/l$

a) Ec. continuidad

$Q_1 = Q_2 \rightarrow S_1 \cdot V_1 = S_2 \cdot V_2$

$\phi_1^2 \cdot v_1 = \phi_2^2 \cdot v_2$

$$V_2 = V_1 \cdot \left(\frac{\phi_1}{\phi_2}\right)^2 = 1 m/s \cdot \left(\frac{2cm}{1cm}\right)^2 \qquad V_2 = 4 m/s$$

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iguales $h_1 = h_2$

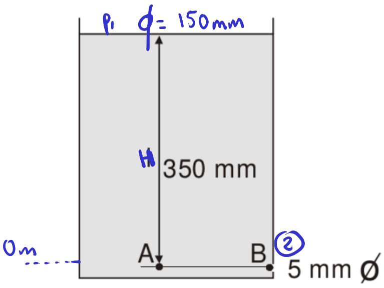
b) $\cancel{h_1} + \frac{P_1}{\rho \cdot g} + \frac{V_1^2}{2g} = \cancel{h_2} + \frac{P_2}{\rho \cdot g} + \frac{V_2^2}{2g} \Rightarrow \frac{P_2}{\rho \cdot g} = \frac{P_1}{\rho \cdot g} + \frac{V_1^2 - V_2^2}{2g}$

$$P_2 = P_1 + \frac{\rho}{2}(v_1^2 - v_2^2) = 1 \cdot 10^4 Pa + \frac{1000}{2} \frac{kg}{m^{\cancel{3}}} \cdot (1 \cancel{m^2}/s^2 - 16 \cancel{m^2}/s^2) = 1 \cdot 10^4 Pa - 7500 \frac{kg}{m \cdot s^2} = 2500 \, Pa = 2{,}5 \cdot 10^3 \, Pa$$

$$\left[\frac{kg}{m \cdot s^2}\right] = \left[\frac{kg \, m/s^2}{m^2}\right] = \left[\frac{N}{m^2}\right] = Pa$$

Pa

Ejercicio 10.



a) Velocidad en B

punto A Reposo relativo. $\boxed{V_A = 0 m/s}$

$\boxed{h_A = 0m}$ y P_A = patm + Presión columna agua

$$P_{carga} = \frac{m \cdot g}{S} = \frac{\rho \cdot V \cdot g}{S} = \frac{\rho \cdot S \cdot H \cdot g}{S} = \rho \cdot H \cdot g$$

$\boxed{P_A = patm + \rho H g}$

punto B $\boxed{P_B = patm}$, V_B? y $\boxed{h_B = 0m}$

Bernoulli: $h_A = h_B$

$$\frac{P_A}{\rho g} + \frac{\cancel{V_A^2}^{\,0}}{2g} = \frac{P_B}{\rho g} + \frac{V_B^2}{2g}$$

$$\boxed{V_B^2} = \frac{2}{\rho}(P_A - P_B) = \frac{2}{\rho}\left(\cancel{patm} + \rho g H - \cancel{patm}\right) = \frac{2}{\cancel{\rho}}\cancel{\rho} g H = \boxed{2gH}$$

se van

$$\boxed{V_B} = \sqrt{2 \cdot g \cdot H} = \sqrt{2 \cdot 9{,}8\, m/s^2 \cdot 0{,}35\, m} = \boxed{2{,}62\, m/s}$$

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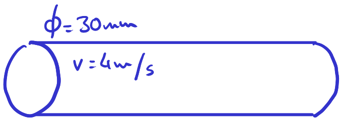
b) Caudal

$$\boxed{Q} = S_B \cdot V_B = \pi\left(\frac{\phi_B}{2}\right)^2 \cdot V_B = \pi \cdot \left(\frac{5 \cdot 10^{-3} m}{2}\right)^2 \cdot 2{,}62\, m/s = \boxed{5{,}14 \cdot 10^{-5}\, m^3/s}$$

$$\boxed{Q} = 5{,}14 \cdot 10^{-5} \frac{\cancel{m^3}}{\cancel{s}} \cdot \frac{1000\, \cancel{dm^3}}{1\, \cancel{m^3}} \cdot \frac{1\ell}{1\, \cancel{dm^3}} \cdot \frac{60\, \cancel{s}}{1\, min} = \boxed{3{,}08\, \ell/min}$$

Ejercicio 11



a) Caudal

$$\boxed{Q} = S \cdot v = \pi\left(\frac{\phi}{2}\right)^2 \cdot v = \pi \cdot \left(\frac{30 \cdot 10^{-3} m}{2}\right)^2 \cdot 4\, m/s = \boxed{2{,}83 \cdot 10^{-3}\, m^3/s}$$

$$\boxed{Q} = 2{,}83 \cdot 10^{-3}\, \cancel{m^3}/\cancel{s} \cdot \frac{1000\, \cancel{dm^3}}{1\, \cancel{m^3}} \cdot \frac{1\ell}{1\, \cancel{dm^3}} \cdot \frac{60\, \cancel{s}}{1\, min} = \boxed{169{,}65\, \ell/min}$$

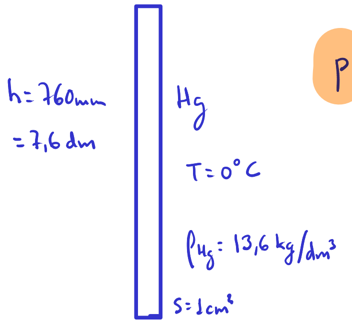
$$\boxed{Q} = 169{,}65 \frac{\ell}{min} \cdot \frac{60\, min}{1\, h} = \boxed{10{,}18 \cdot 10^3\, \ell/hora}$$

$$N_{RE} = \frac{\rho \cdot v \cdot \phi}{\mu} \rightarrow \text{todo en el sistema CGS} \quad (cm, g, s) \qquad \boxed{v = 400\, cm/s}$$

$\boxed{\phi = 3cm}$, $\boxed{\rho} = 850\, \cancel{kg}/\cancel{m^3} \cdot \frac{1 \cdot 10^3 g}{1\, \cancel{kg}} \cdot \frac{1\, \cancel{m^3}}{1 \cdot 10^6\, cm^3} = \boxed{0{,}85\, g/cm^3}$, $\boxed{\mu} = 0{,}55 \cdot 10^{-2}$ Poises $= \boxed{0{,}55 \cdot 10^{-2}\, g/cm \cdot s}$

$$\boxed{N_{RE} = \frac{\rho \cdot v \cdot \phi}{\mu}} = \frac{0{,}85\, \cancel{g}/\cancel{cm^3} \cdot 400\, \cancel{cm}/\cancel{s} \cdot 3\cancel{cm}}{0{,}55 \cdot 10^{-2}\, \cancel{g}/\cancel{cm} \cdot \cancel{s}} = \boxed{185{,}45 \cdot 10^3} > 2320 \quad \text{Régimen claramente turbulento.}$$

Ejercicio 12

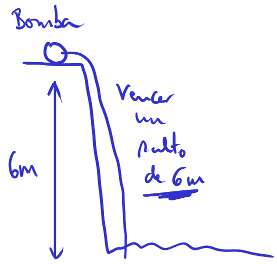


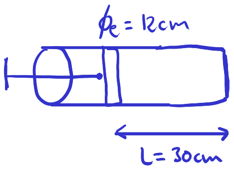
$$p = \frac{F}{S} = \frac{m \cdot g}{S} = \frac{\rho \cdot V \cdot g}{S} = \frac{\rho \cdot S \cdot h \cdot g}{S} = \rho \cdot h \cdot g$$

$$p = \rho \cdot h \cdot g = 13{,}6\ \frac{kg}{\cancel{dm^3}} \cdot 0{,}76\,m \cdot 9{,}8\,m/s^2 \cdot \frac{1000\,\cancel{dm^3}}{1\,m^3} = 101.292{,}8\ Pa = 1atm$$

$$p = 101\,298\ kg/(m \cdot s) = 101\,298\ \frac{\cancel{N}}{\cancel{m^2}} \cdot \frac{1\,kp}{9{,}8\,\cancel{N}} \cdot \frac{1\,\cancel{m^2}}{10^4\,cm^2} = 1{,}033\ kp/cm^2$$

Ejercicio 15





$f = 30$ ciclos/min

$$v = \frac{L}{t} = L \cdot f = 30\,cm \cdot 30\,cicl/min = 15\,cm/s$$

a) Caudal

$$Q = S \cdot v = \pi \left(\frac{\phi_e}{2}\right)^2 \cdot v = \pi \left(\frac{12\,cm}{2}\right)^2 \cdot 15\,cm/s = 1696{,}5\ cm^3/s$$

$$Q = 1696{,}5\ \cancel{cm^3}/s \cdot \frac{1\,m^3}{10^6\,\cancel{cm^3}} = 1{,}69 \cdot 10^{-3}\ m^3/s = 1{,}69\,\ell/s$$

b) $P_{útil} = \dot{E}p = \dot{m} \cdot g \cdot h = \rho \cdot \dot{V} g\, h$ pero es que por definición ¡ $\dot{V} = \frac{V}{t} = Q$!

$$P_{útil} = \rho \cdot Q \cdot g \cdot h = 1000\ kg/\cancel{m^3} \cdot 1{,}69 \cdot 10^{-3}\ \cancel{m^3}/s \cdot 9{,}8\,m/s^2 \cdot 6m = 99{,}75\ W$$ (*)

$$\eta = \frac{P_{útil}}{P_{bomba}} \Rightarrow P_{bomba} = \frac{P_{útil}}{\eta} = \frac{99{,}75\,W}{0.6} = 166{,}25\,W$$

$$P_{bomba} = 166{,}25\,\cancel{W} \cdot \frac{1CV}{735\,\cancel{W}} = 0{,}226\ CV$$

(*) $\left[\frac{kg \cdot m \cdot m}{s \cdot s^2}\right] = \left[\frac{kg \cdot m}{s^2}\right] \cdot [m/s] = \left[\frac{N \cdot m}{s}\right] = \left[\frac{J}{s}\right] = [W]$ estudiando las unidades.

m·g → N

F·d → J