

GABARITO

01

Questão 1:

$$\bullet \sum M_o = 0 \Rightarrow 200 \cdot 20 - F_B \cdot 50 = 0$$

$$\therefore F_B = \frac{200 \cdot 20}{50} = 400 \text{ N}$$

$$\bullet \frac{F_1}{A_1} = \frac{F_2}{A_2} \Rightarrow \frac{400}{\frac{\pi 5^2}{4}} = \frac{F}{\frac{\pi 25^2}{4}} \Rightarrow \boxed{F = 10\,000 \text{ N}}$$

Questão 2:

Eq. Manométrica:

$$P_A + \gamma_{H_2O} h_1 + \gamma_{Hg} \cdot h_2 - \gamma_{\text{óleo}} \cdot h_3 = P_B$$

$$\boxed{P_A - P_B = -132,1 \text{ kN/m}^2}$$

Questão 3:

$$\bullet P_{abs} = P_{ef} + P_{atm}, \text{ como } P_{atm} = 740 \text{ mmHg e}$$

$$P_{ef} = 3,5 \text{ atm temos:}$$

$$\boxed{760 \text{ mmHg} = 1 \text{ atm}}$$

$$P_{abs} = 3,5 + \frac{740}{760} = 4,47 \text{ atm}$$

$$\bullet \downarrow \text{atm} = 101,323 \text{ kPa} \Rightarrow 4,47 \text{ atm} \approx \underline{452,5 \text{ kPa}} \downarrow$$

$$\bullet \downarrow \text{atm} = 0,1013 \text{ MPa} \Rightarrow 4,47 \text{ atm} \approx \underline{0,452 \text{ MPa}} \downarrow$$

$$\bullet P_{\text{abs}} = 4,47 \text{ atm} = 452,5 \times 10^3 \frac{\text{N}}{\text{m}^2} \downarrow$$

$$\left. \begin{array}{l} 1 \text{ kgf} = 9,8 \text{ N} \\ 1 \text{ cm}^2 = 10^{-4} \text{ m}^2 \end{array} \right\} \Rightarrow 452,5 \times 10^3 \frac{1}{9,8} \text{ kgf} \cdot \frac{1}{10^4 \text{ cm}^2}$$

$$\therefore \underline{4,62 \frac{\text{kgf}}{\text{cm}^2}} \downarrow$$

$$\bullet P_{\text{abs}} = 4,47 \text{ atm} = 452,5 \times 10^3 \frac{\text{N}}{\text{m}^2} = \frac{452,5 \times 10^3}{9,8} \frac{\text{kgf}}{\text{m}^2}$$

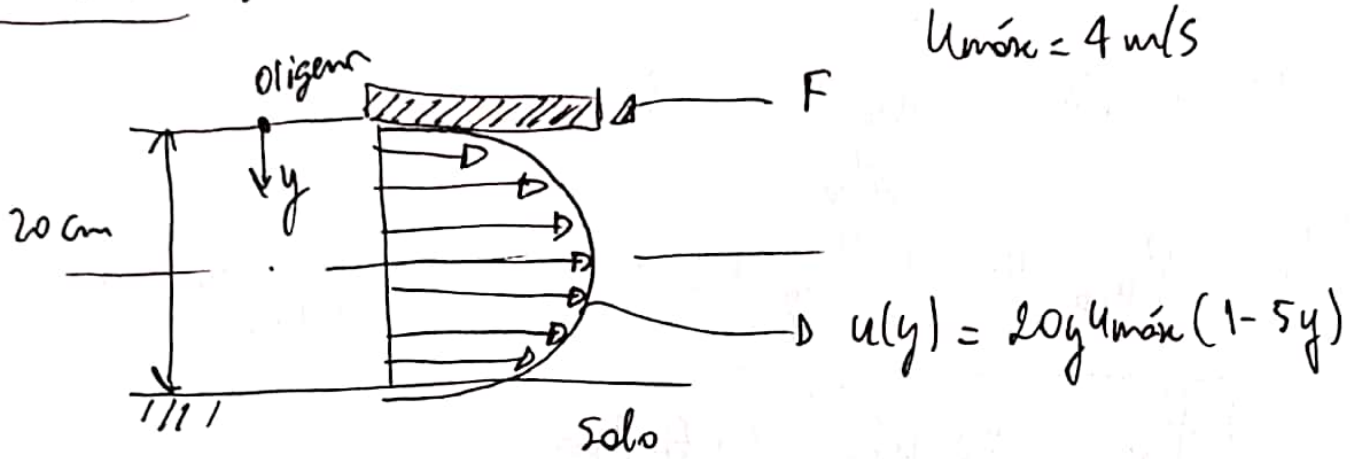
$$\approx \underline{46\,200 \text{ kgf/m}^2} \downarrow$$

$$\bullet P = \rho \cdot h \Rightarrow h = \frac{P_{\text{abs}}}{\rho_{\text{H}_2\text{O}}} = \frac{452,5 \times 10^3}{10\,000} = \underline{45,3 \text{ m}} \downarrow$$

$$\bullet P = \rho \cdot h \Rightarrow h = \frac{P_{\text{abs}}}{\rho_{\text{Hg}}} = 3,327 \text{ m} = \underline{3327 \text{ mm}} \downarrow$$

• As mudanças são válidas p/ escala efetiva! ∇

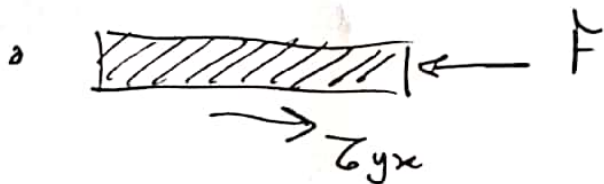
Questão 4 :



• $\tau_{xy} = \mu \left. \frac{\partial u}{\partial y} \right|_{y=0,2 \text{ m}}$

$\Rightarrow \frac{\partial}{\partial y} u(y) = \frac{\partial}{\partial y} (20y u_{\text{máx}} (1 - 5y)) = \frac{\partial}{\partial y} (80y - 400y^2)$

$= 80 - 800y \Big|_{y=0,2 \text{ m}} \Rightarrow \left. \frac{\partial u(y)}{\partial y} \right|_{y=0,2 \text{ m}} = -80 \text{ s}^{-1}$



$\tau_{yx} = \mu \left. \frac{\partial u}{\partial y} \right|_{y=0} = \frac{F}{A} = \mu \left. \frac{\partial u}{\partial y} \right|_{y=0} \Rightarrow F = \mu A \left. \frac{\partial u}{\partial y} \right|_{y=0}$

$\therefore \boxed{F = 3,2 \text{ N}}$

Questão 5:

04

• Eq. Manométrica:

$$P_{atm} + \gamma_{H_2O} \cdot 0,7 + \gamma_{Hg} \cdot 0,3 - \gamma_{H_2O} \cdot 0,7 - \gamma'_{oleo} \cdot 0,8 = P_{ar}$$

$$\boxed{P_{ar} = 34 \text{ kPa}} \text{ (efetiva)}$$

$$P_{abs} = P_{ef} + P_{atm} = 34 \text{ kPa} + \frac{740}{760} \cdot 101,23 \text{ kPa}$$

$$\boxed{P_{abs} = 132,56 \text{ kPa}}$$

• Se a pressão do ar é igual a 34 kPa temos:

$$P_{ar} + \gamma'_{oleo} \cdot 0,3 = P_M$$

$$\boxed{P_M = 36,55 \text{ kPa}} \text{ (efetiva)}$$

$$P_{abs} = 36,55 \text{ kPa} + \frac{740}{760} \cdot 101,23 \text{ kPa} = \boxed{135,11 \text{ kPa}}$$

Questão 6:

• Para F:

Equação Manométrica:

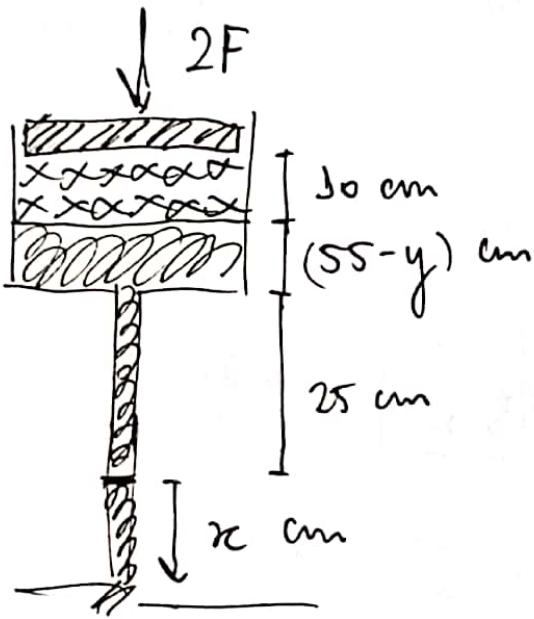
$$\frac{F}{A} + 0,1 \gamma_1 + 0,8 \gamma_2 - 0,5 \gamma_3 = 0 \Rightarrow \boxed{\gamma_3 = 73,2 \frac{\text{kN}}{\text{m}^3}}$$

obs:
projecção!

• Para 2F :

Volume deslocado no tubo = Volume deslocado no cilindro

$$A_t \cdot y = A_c \cdot x \Rightarrow \boxed{y = 0,1x} \quad (1)$$



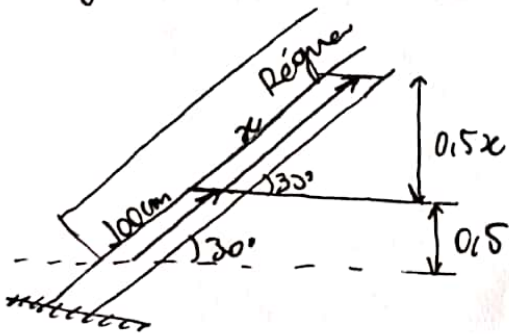
Nova eq. manométrica :

$$\frac{2F}{A} + \rho_1 y_1 + (\rho_2 - \rho_1) y_2 + \rho_3 y_2 - x \rho_3 - \rho_3 y_3 - 0,15x \rho_3 = 0 \quad (2)$$

∴ de (1) e (2) temos que

$$x = 0,28 \text{ m.}$$

Regua após 2F :



logo

$$\text{Nova leitura} \Rightarrow L = L_0 + x$$

$$L = 100 + 0,28 = 1,28 \text{ m} = \underline{128 \text{ cm}}$$

Questão 7 :

• Eq Manométrica :

$$P_{atm} + \rho_{H_2O} y_1 + \rho_{H_2O} \cdot 0,025 = P_{gás} \Rightarrow \boxed{P_{gás} = 5 \text{ kPa}} \quad \text{(efetiva)}$$

- $P_{abs} = P_{CF} + P_{atm}$
gás

$$P_{abs} = 5 \text{ kPa} + \frac{662}{760} \cdot 101,23 \text{ kPa}$$

$$P_{abs} = 93,17 \text{ kPa}$$

- Eq. manométrica

$$P_{atm} + \gamma_{H_2O} \cdot z = P_{gás}$$

$$z = \frac{P_{gás}}{\gamma_{H_2O}} = \frac{5 \text{ kPa}}{10 \frac{\text{kN}}{\text{m}^2}} = 0,5 \text{ m}$$

- Se $z = 1 \text{ m} \Rightarrow P_{gás} = \gamma_{H_2O} \cdot 1 \text{ m} = 10 \text{ kPa}$

$$\frac{P_0 V_0}{T_0} = \frac{P_1 V_1}{T_1} \Rightarrow \frac{93,17 \times 2}{293} = \frac{98,17 \times V_1}{333}$$

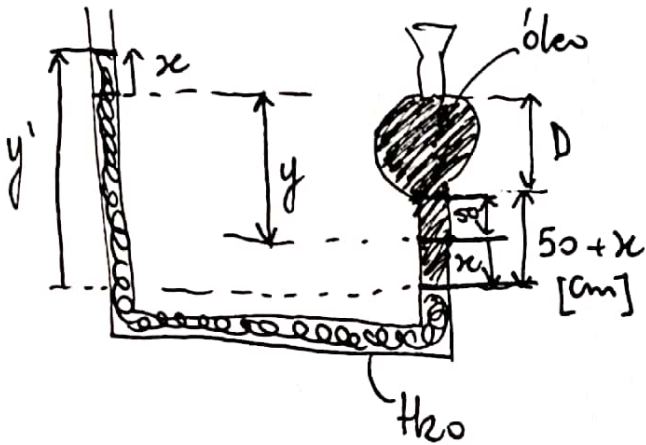
$$V_1 = 2,16 \text{ m}^3$$

Questão 8 :

- Eq. Manométrica

$$P_{atm} + \gamma_{H_2O} \cdot y - \gamma_{óleo} h_{óleo} = P_{atm} \Rightarrow y = \frac{\gamma_{óleo}}{\gamma_{H_2O}} \cdot h_{óleo} = 0,4 \text{ m}$$

• depois de introduzir óleo pelo funil temos:



$$y' = y + 2x$$

$$300 \text{ cm} = 40 + 2x$$

$$x = 30 \text{ cm} = \underline{0,3 \text{ m}} \downarrow$$

Nova Eq. manométrica:

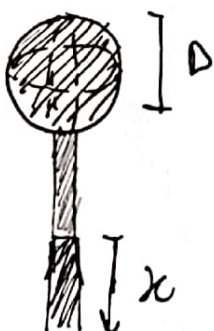
$$P_{atm} + \rho_{H_2O} y' - \rho_{oleo} h_{oleo} = P_{atm}$$

$$\rho_{H_2O} y' = \rho_{oleo} (x + 50 + D)$$

$$8000 \cdot 300 = 8000 (0,3 + 0,5 + D)$$

$$D = 45 \text{ cm} = \underline{0,45 \text{ m}} \downarrow$$

• A quantidade adicionada no esfere representa o acréscimo de x no fluido debaixo da esfera



$U_{total} = \text{Volume do esfere} + \text{Volume da parte do } x$

$$U_{total} = \frac{4}{3} \pi R^3 + A_{secao} \cdot x$$

$$U_{total} = \underline{47,83 \text{ cm}^3} \downarrow$$