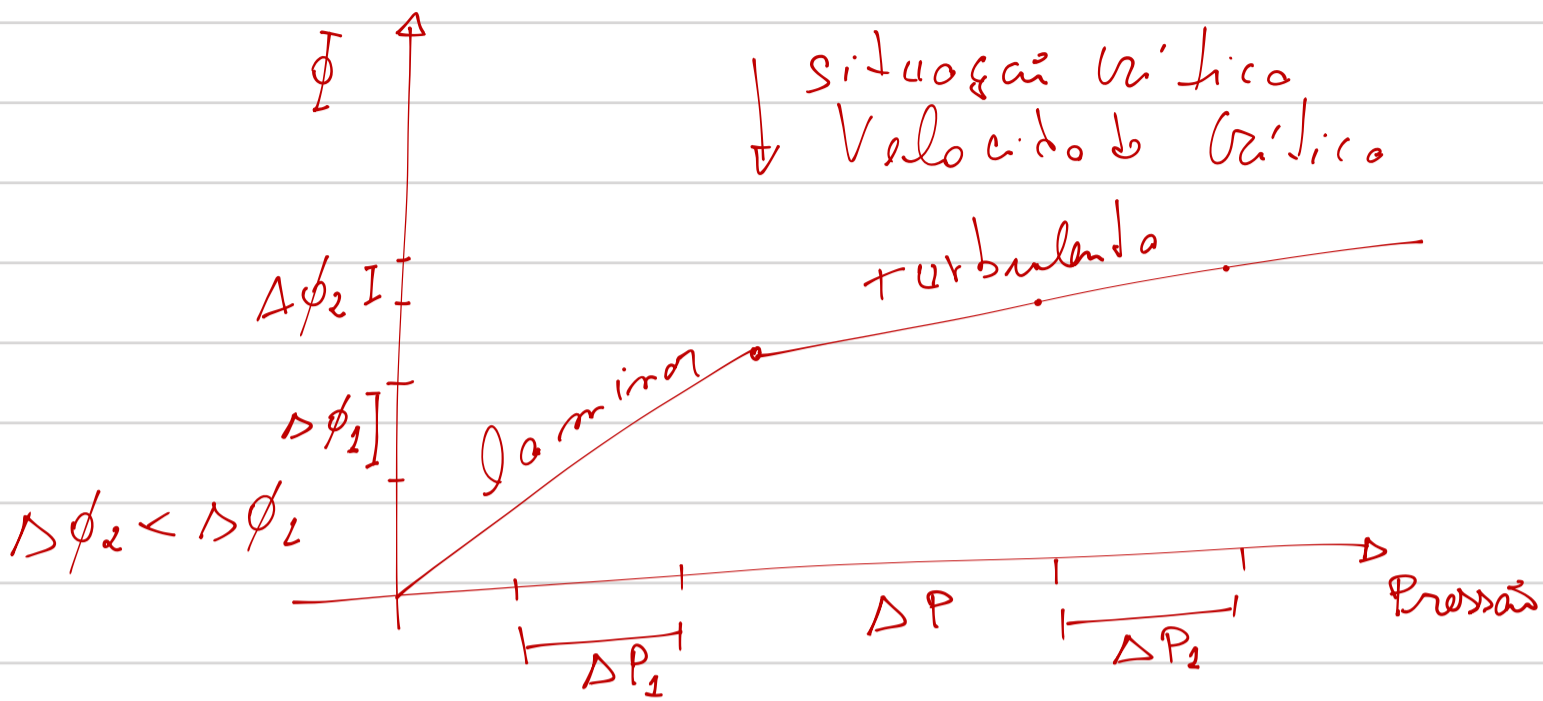


Fluxo Laminar x Turbulento



Reynold → observar uma característica importante que avalie e identifique a velocidade onde ocorre a mudança de regime laminar p/ turbulento

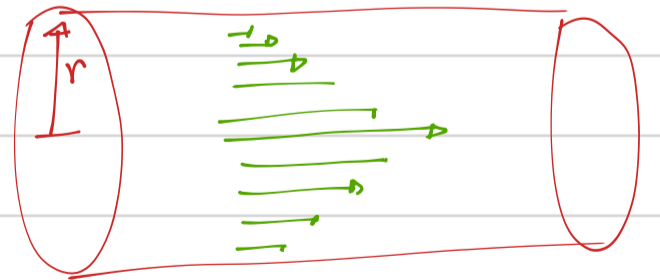
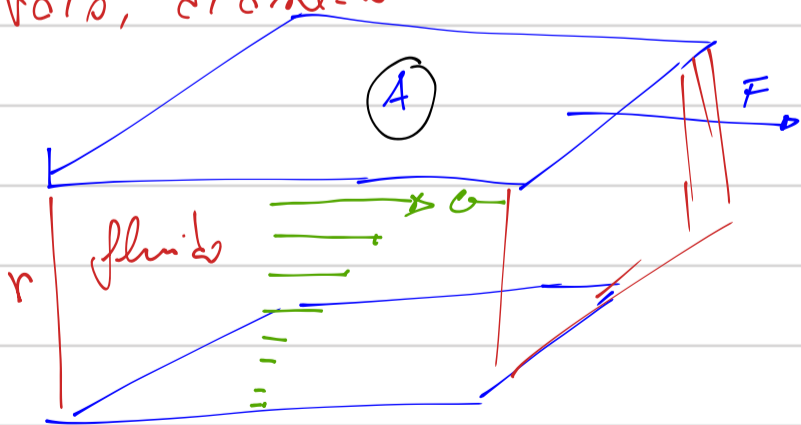
Re = número de Reynold para fluidos

$$Re = \frac{\text{Força inercial}}{\text{Força viscosa}} = \frac{F_i}{F_z}$$

$$F_i = m \cdot a$$

$$\frac{F_z}{A} = \gamma \cdot \frac{\Delta u}{\Delta y} \quad \text{anelo passado}$$

fluido → tubo
 r → raio, diâmetro



$$\frac{F_z}{A} = \gamma \frac{\Delta u}{\Delta r}$$

$$F_z = \gamma A \frac{\Delta u}{\Delta r}$$

$$F_i = m \cdot a$$

$$F_i = (\rho \cdot V) \cdot \frac{\Delta u}{\Delta t}$$

$$F_i = \rho (r \cdot A) \cdot \frac{\Delta u}{\Delta t}$$

$$Re = \frac{\rho \cdot r \cdot A \cdot \Delta u \cdot (\Delta r)}{\Delta t \cdot \gamma \cdot A \cdot \Delta u} = \frac{\rho}{\gamma} \cdot r \cdot V$$

area do tubo de

fluido sendo deslocado

$$Re = \frac{\rho \cdot r \cdot v_c}{\eta}$$

⇒ velocidade crítica é a velocidade que o fluido muda de regime (laminar → turb.)

$$v_c = \frac{Re \cdot \eta}{\rho \cdot r}$$

r pequeno v_c grande

Números de Reynolds característicos para fluidos.

Fluido newtoniano e não-newtoniano

$\eta = \text{constante}$

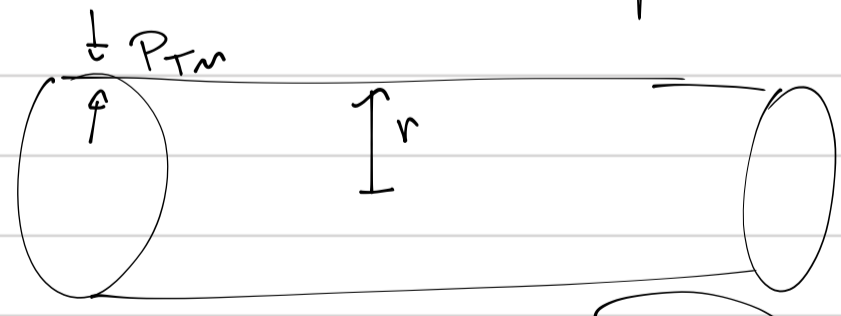
água e gases (aproximadamente)

$\eta = \text{não é constante}$

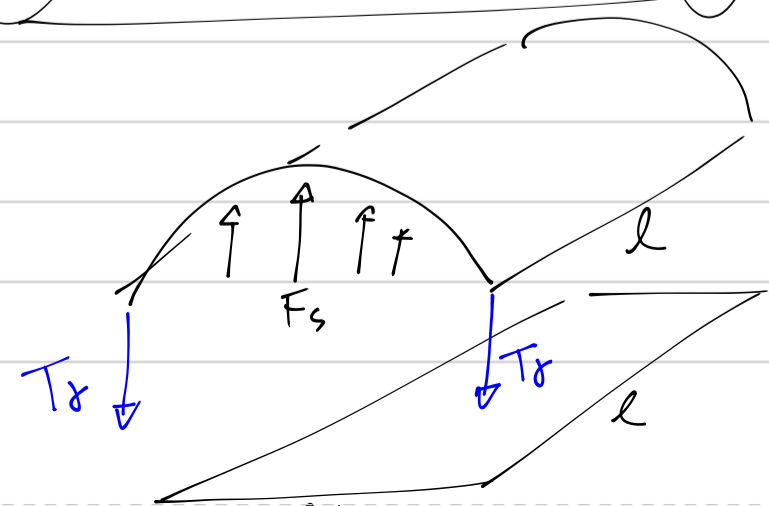
por uma força de cisalhamento aplicada $\left(\frac{F_s}{A}\right)$

$$\eta = \eta \left(\frac{F}{A}\right)$$

Lei de Laplace



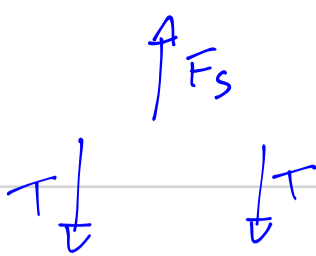
$$\frac{T_s}{r} = P_{tm}$$



$$P_{tm} = \frac{F_s}{A}$$

$$\downarrow T = T_r \cdot l$$

$$\downarrow T = T_r \cdot l$$



$$F_s = 2T$$

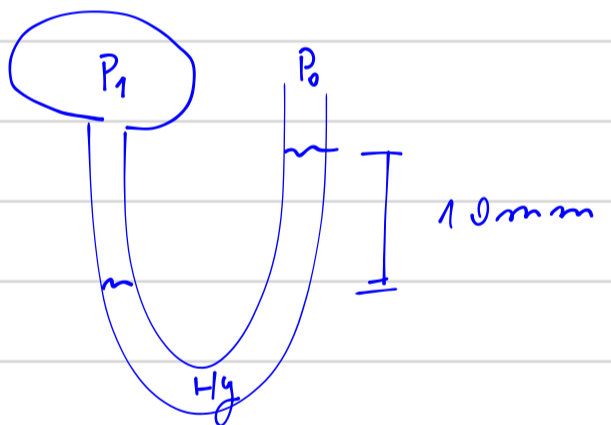
$$A \cdot P_{Tm} = 2T_r \cdot l$$

$$(\pi \cdot 2r) P_{Tm} = 2l T_r$$

$$P_{Tm} = \frac{T_r}{r}$$

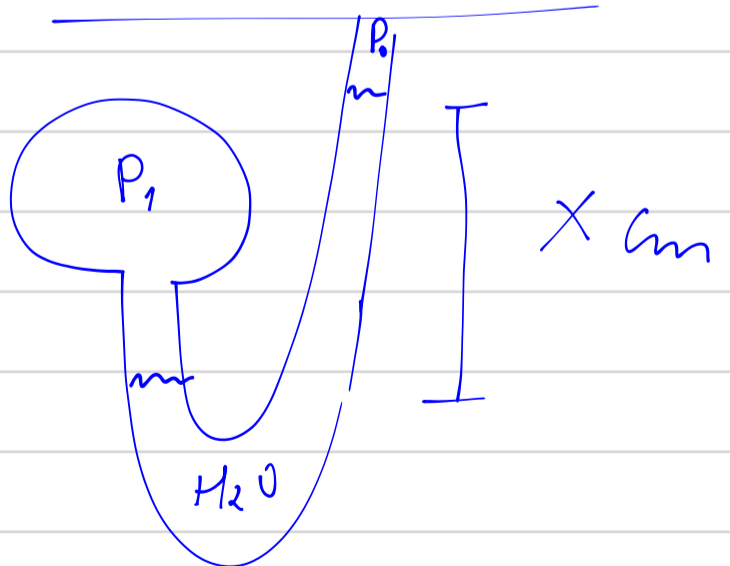
ΔP mmHg \Rightarrow tubo com manômetro de Hg
 \hookrightarrow leitura direta

$$\Delta P = P_0 - P_1 = 10 \text{ mmHg}$$



Se fosse água

$$\Delta P = X \text{ cm H}_2\text{O}$$



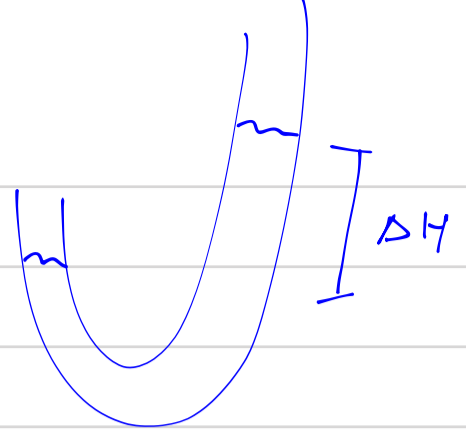
Repetir

para

e sangue

$$\rho_{\text{sangue}} = 1,04 \frac{\text{g}}{\text{cm}^3}$$

$$\begin{aligned} \Delta P (1 \text{ cm H}_2\text{O}) &= \rho \cdot g \cdot \Delta H \\ &= \frac{1 \cdot g}{\text{cm}^3} \cdot 9,8 \frac{\text{cm}}{\text{s}^2} \cdot (1 \text{ cm}) \end{aligned}$$



$$\begin{aligned} \Delta P (1 \text{ mm Hg}) &= \rho_{\text{Hg}} \cdot g \cdot \Delta H \\ &= \frac{13,6 g}{\text{cm}^3} \cdot g \cdot 1 \text{ mm} \end{aligned}$$

$$\begin{aligned} \Delta P (1 \text{ cm Sanguine}) &= \rho_{\text{sang}} \cdot g \cdot \Delta H \\ &= \frac{1,04 g}{\text{cm}^3} \cdot 1 \cdot (1 \text{ cm}) \end{aligned}$$

Monitor relógios de conversão entre
colunas de sangue (Harkavy), com colunas
de Hg em milímetros ou H₂O em cm.

$$\left\{ \begin{array}{l} P_{\text{cm H}_2\text{O}} = (?) P_{\text{cm Sanguine}} \\ P_{\text{mm Hg}} = (?) \cdot P_{\text{cm H}_2\text{O}} \end{array} \right\}$$