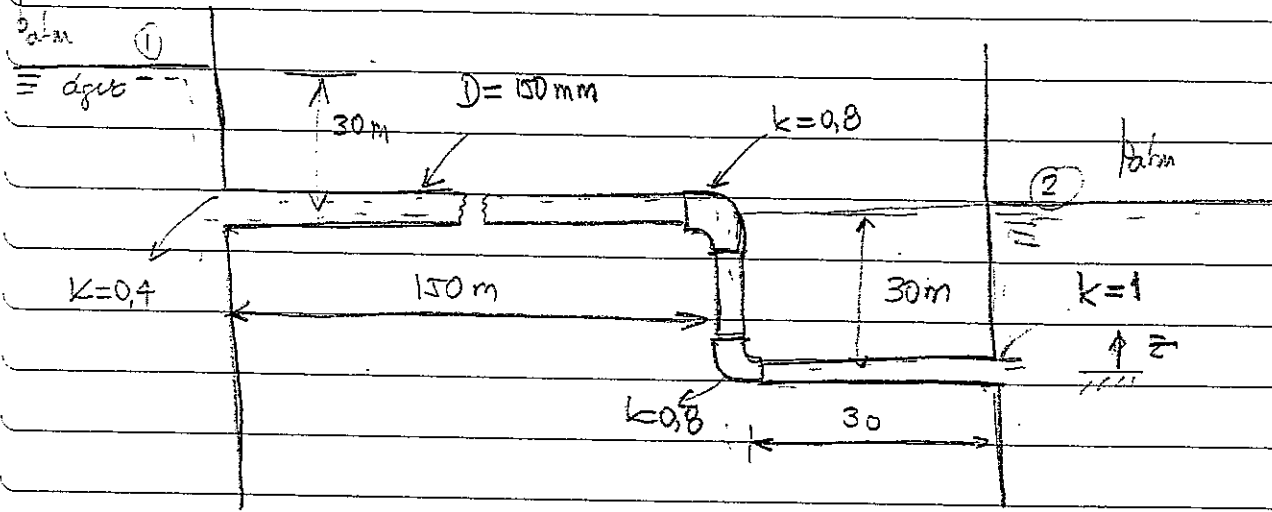


PROBLEMA 2

Prob 8.34 shawes



Qual a vazão no sistema abaixo?
 rugosidade do tubo: $0,060 \text{ mm}$

água: $\mu = 10^{-3} \text{ kg/ms}$
 $\rho = 1000 \text{ kg/m}^3$

Equação da energia:

$$\left(\frac{p_1}{\rho} + \alpha_1 \frac{\bar{V}_1^2}{2} + g z_1 \right) - \frac{W_{\text{eixo}}}{\dot{m}} - \left(\frac{p_2}{\rho} + \alpha_2 \frac{\bar{V}_2^2}{2} + g z_2 \right) = h_f + h_{\text{ext}}$$

$$h_f = f \frac{L}{D} \frac{\bar{V}^2}{2} \quad h_{\text{ext}} = k \frac{\bar{V}^2}{2}$$

hipóteses

(1) reg. permanente

(2) $\bar{V}_1 = \bar{V}_2 \neq 0$

(3) $p_1 = p_2 = p_{\text{atm}}$

$$g(z_1 - z_2) = f \frac{L}{D} \frac{\bar{V}^2}{2} + \sum K \frac{\bar{V}^2}{2}$$

$$g(z_1 - z_2) = \frac{\bar{V}^2}{2} \left(f \frac{L}{D} + \sum K \right)$$

$$\bar{V} = \left[\frac{2g(z_1 - z_2)}{f \frac{L}{D} + \sum K} \right]^{1/2}$$

$$\bar{V} = \left[\frac{2(30 - 30)(9,8)}{f \frac{150 + 30 + 30}{0,15} + (0,4 + 0,8 + 0,8 + 1)} \right]^{1/2} = \left[\frac{588}{f(1400) + 3} \right]^{1/2}$$

$$\bar{V} = \left[\frac{588}{3 + 1400f} \right]^{1/2}$$

$$Re = \frac{\rho \bar{V} D}{\mu} = \frac{(1000)(150 \times 10^{-3}) \bar{V}}{10^{-3}}$$

$$Re = (150 \times 10^3) \bar{V}$$

además que $\frac{e}{D} = \frac{0,060}{150} = 0,0004$

f	\bar{V}	Re	f nom
0,016	4,81	$7,2 \times 10^5$	0,0163
0,0163	4,77	$7,16 \times 10^5$	0,0163 converge

$$Q = \frac{\pi D^2}{4} \bar{V} = \frac{(\pi)(150 \times 10^{-3})^2}{4} (4,77) = 8,4 \times 10^{-2} \text{ m}^3/\text{s}$$

$$Q = 8,4 \times 10^{-2} \text{ m}^3/\text{s}$$