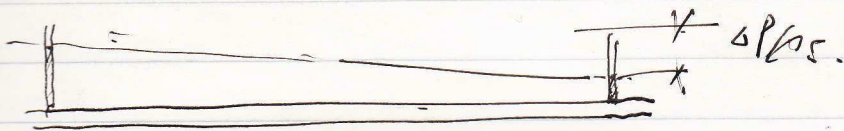


2. Water flow 100 m long pipe.
 diameter 5 cm. flow rate $Q = 0.01 \text{ m}^3/\text{s}$
 friction factor $f = \frac{\Delta P / \frac{1}{2} \rho \bar{v}^2}{L/D} = 0.04$
 Find ΔP



$$\Delta P = f \frac{L}{D} \frac{1}{2} \rho \bar{v}^2$$

$$= 0.04 \frac{100}{0.05} \times \frac{1}{2} 10^3 \left(\frac{0.01}{\frac{\pi \times 0.05^2}{4}} \right)^2$$

$$= 2045 \text{ Pa.}$$

if there is a pump need to push the flow

$$\dot{W} = \rho Q \frac{\Delta P}{\rho} = Q \Delta P = 0.01 \frac{\text{m}^3}{\text{s}} \times 2045 \times 10^3$$

$$= 20.45 \text{ kW}$$