

Problem 1

A fire fighter supports a hose as shown below. The hose has a volumetric flow rate of 60 gal/min and the nozzle reduces in diameter from 4 cm to 2 cm. What force will the fire fighter have to exert, in Newtons, to keep the hose in place?

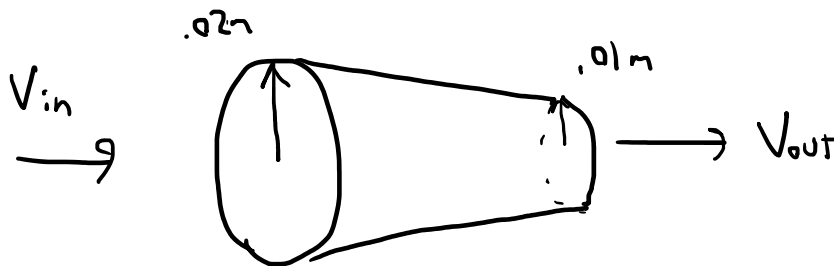


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$$60 \text{ gal/min} = .003785 \text{ m}^3/\text{s}$$

$$\rho_{\text{water}} \approx 1000 \text{ kg/m}^3$$

$$\dot{m} = 3.785 \text{ kg/s}$$



$$\rho_{\text{in}} V_{\text{in}} \underset{\substack{\uparrow \\ \pi(.02)^2}}{A_{\text{in}}}}{=} \rho_{\text{out}} V_{\text{out}} \underset{\substack{\uparrow \\ \pi(.01)^2}}{A_{\text{out}}}}{=} \dot{m}$$

$$V_{\text{in}} = 3.01 \text{ m/s}$$

$$V_{\text{out}} = 12.05 \text{ m/s}$$

$$F = \dot{m} (V_{out} - V_{in})$$

\uparrow \uparrow \uparrow
 $3.785 \frac{kg}{s}$ $12.05 m/s$ $3.01 m/s$

$$F = 34.2 N = 7.7 lbs$$