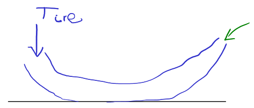
(1)

Problem 1: (1-14-58)



$p = 3.50 \cdot 10^5$ Pa, $1\text{Pa} = 1 \frac{N}{m^2}$

$1 \text{ psi} = 6.895 \cdot 10^3$ Pa

$p = 50.8$ psi (Familiar)

If only the tire pressure holds up the weight on the tire $W = gM$, $M = 80.0$ kg

$$pA = Mg \rightarrow \boxed{A = \frac{Mg}{p}}$$

$$A = \frac{80 \cdot 9.81}{3.50 \cdot 10^5} \, m^2 \approx 2.24 \cdot 10^{-3} \, m^2 = \underline{22.4 \text{ cm}^2}$$

(2)

Problem 2: (1-14-68)

Buoyant force of a 2.00 L He balloon

$$\boxed{F_B = \rho_{air} V \cdot g}$$

He: $\rho_{He} = 1.80 \cdot 10^{-1}$ kg/m³

Air: $\rho_{air} = 1.29 \cdot 10^{0}$ kg/m³

a)

$$\rightarrow F_B = \{1.29\} \frac{kg}{m^3} \, 2(10^{-3} \, m^3) \cdot 9.81 \, m/s^2$$

$$= \underline{0.025 \text{ N}}$$

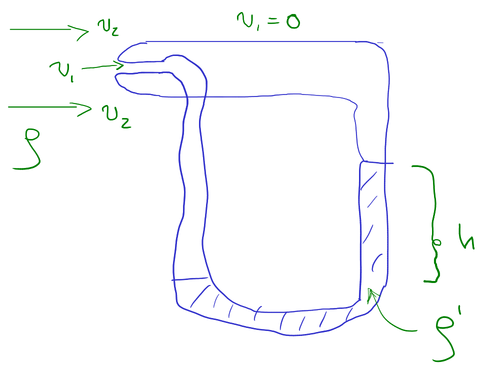
b) $M = 1.5$ g of balloon

$$F_B - W_b = F_B - \rho_{He} V g - gM = F^{Lift}$$

$$\rightarrow F^{lift} = \left(0.025 - (0.180 \cdot 0.002 + 0.0015) \cdot 9.81\right) N \simeq \underline{6.8 \cdot 10^{-3} \text{ N}}$$

(3)

Problem 3: (1-14-88)



Show that

$$v_2 = \left(\frac{2\rho' g h}{\rho}\right)$$

Bernoulli

$$P_1 + \frac{1}{2}\rho v_1^2 = P_2 + \frac{1}{2}\rho v_2^2$$

$$v_1 = 0 \rightarrow P_1 = P_2 + \frac{1}{2}\rho v_2^2 \rightarrow (P_1 - P_2) = \frac{1}{2}\rho v_2^2$$

but

$$(P_1 - P_2) \cdot A = h \cdot \rho' g A \rightarrow \frac{1}{2}\rho v_2^2 = h\rho' g$$

$$\rightarrow v_2^2 = \frac{2\rho' g h}{\rho} \rightarrow \boxed{v_2 = v = \sqrt{\left(\frac{2\rho' g h}{\rho}\right)}}$$

(4)

b) In Hg manometer if $h = 0.200$ m

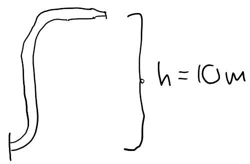
Find v for air

$$v = \sqrt{2gh\left(\frac{\rho_{Hg}}{\rho_{air}}\right)} = \sqrt{2 \cdot 9.81 \cdot 0.2 \left(\frac{1.36 \cdot 10^4}{1.29}\right)} \, m/s$$

$$= \underline{203 \, m/s}$$

Problem 4 (1-14-102)

Estimate N_R for a fire hose and a nozzle



$P_0 = 1.62 \cdot 10^6$ Pa

Flow 40.0 L/s

$d_h = 6.40$ cm

$d_n = 3.00$ cm

$$N_R = \frac{2\rho v r}{\eta}$$

$\eta_{H_2O} = 1.002 \cdot 10^{-3}$ Pa·s

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With Ex. 14.7 in the book in mind and the eq. for N_R I see we only need the equation of continuity

$$Q_1 = A_1 v_1 = A_2 v_2 = Q_2$$

$$v_1 = \frac{Q_1}{A_1} = \frac{Q_1}{\pi\left(\frac{d_h}{2}\right)^2} = \frac{0{,}040\,m^3/s}{1} \cdot \frac{1}{\pi \cdot (0.032)^2 m^2}$$

$$v_2 = v_1\left(\frac{A_1}{A_2}\right) \qquad \approx 12.4 \; m/s$$

Hose:

$$(N_R)_h = \frac{2\rho v_1 \left(\frac{d_h}{2}\right)}{\eta} = \frac{2\rho \left(\frac{Q_1}{\pi\left(\frac{d_h}{2}\right)^2}\right)\left(\frac{d_h}{2}\right)}{\eta}$$

$$= \frac{2 \cdot 10^3\,kg/m^3 \cdot 12.4\,m/s \cdot 0{,}032\,m}{1.002 \cdot 10^{-3}\,Pa \cdot s} \approx \underline{7.92 \cdot 10^5}$$

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Nozzle:

$$(N_R)_n = (N_R)_h \cdot \left(\frac{d_h}{d_n}\right) \approx \underline{1.69 \cdot 10^6}$$

So, both the flow in the hose and the nozzle could be considered turbulent