The University of Jordan / Physics Department

Solutions to chapter 10

Giancoli 7th edition

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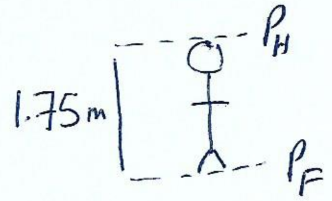
5] $m_b = 35.00\,g$

$M_W = 98.44 - 35.00 = 63.44\,g$

$M_F = 89.22 - 35.00 = 54.22\,g$

$$SG = \frac{\rho_F}{\rho_W} = \frac{M_F/V}{M_W/V} = \frac{M_F}{M_W} \simeq 0.855$$

10] $P_F = P_H + \rho_{blood}\, g h$



$P_F - P_H = \rho_{blood}\, g h$

$= (1059.5)(9.8)(1.75)$

$= 18170\ Pa$

$= 18170\ Pa \left(\frac{760\ mmHg}{1.013 \times 10^5\ Pa}\right)$

$\therefore\ P_F - P_H \approx 136.3\ mmHg.$

11] (a) $F_{top} = PA$

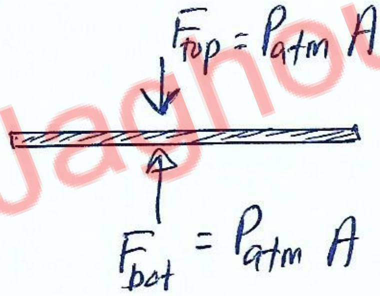
$= (1.013\times10^5 \frac{N}{m^2})(1.7\times2.6\,m^2)$

$= 447746\ N$

(b) The thickness of the table is small $\Rightarrow$ atmospheric pressure on the underside of the table is the same as its value on the top surface.

$\Rightarrow F_{bot} = PA = 447746\ N$ as in part (a).

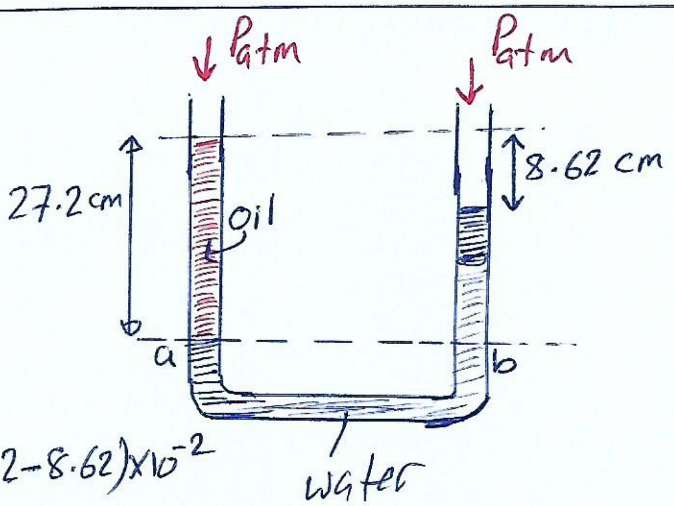
$\Rightarrow$ Net force on table due to atmospheric pressure is $\vec{F}_{top} - \vec{F}_{bot} = 0$.



18]

Points a and b have the same pressure

$P_a = P_b$

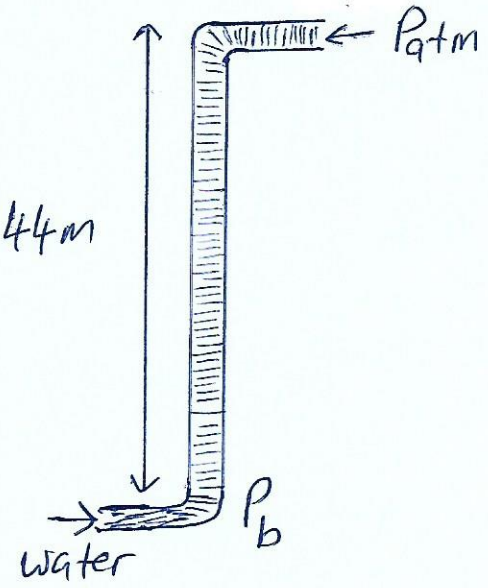


$P_{atm} + \rho_{oil}\, g(27.2\times10^{-2}) = P_{atm} + \rho_w\, g(27.2-8.62)\times10^{-2}$

$\therefore \rho_{oil}\,(27.2) = \rho_w\,(18.58)$

$\therefore \rho_{oil} = 1000\times\frac{18.58}{27.2} \simeq 683\ kg/m^3$.

20]



$$P_b = P_{atm} + \rho_w g h$$

$$\underbrace{P_b - P_{atm}}_{P_{gauge}} = \rho_w g h$$

$$P_{gauge} = (1000)(9.8)(44)$$

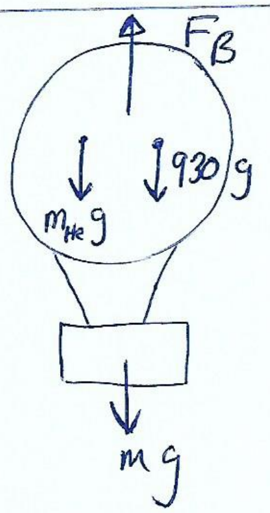
$$= 431200 \ Pa$$

$$= 431200 \ Pa \times \frac{760 \ mmHg}{1.013 \times 10^5 \ Pa}$$

$$P_{gauge} = 3235 \ mmHg$$

$$\left[= 431200 \ \cancel{Pa} \times \frac{1 atm}{1.013 \times 10^5 \ \cancel{Pa}} = 4.2 \ atm \right]$$

26] static equilibrium



$$\uparrow^{+} \quad F_B - m_{He} g - 930g - mg = 0$$

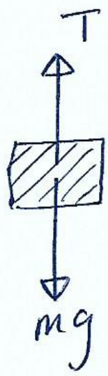
$$\rho_{air} V \cancel{g} - \rho_{He} V \cancel{g} - 930 \cancel{g} = m \cancel{g}$$

$$(\rho_{air} - \rho_{He}) \left(\frac{4}{3} \pi (7.15)^3 \right) - 930 = m$$

$$(1.29 - 0.179) \left(\frac{4}{3} \pi (7.15)^3 \right) - 930 = m$$

$$\Rightarrow m = 771 \ kg.$$

27]

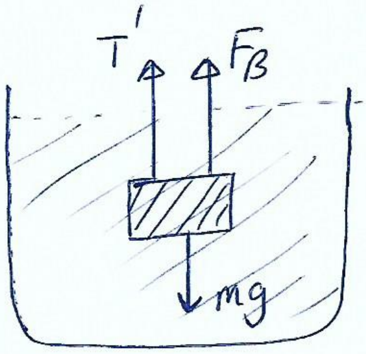


T is the true weight that the balance reads in air (we ignore the buoyant force due to air on the metal as it is too small).

static equilibrium $\Rightarrow$

$$T = mg \quad -(1)$$

[Note $\underbrace{T = 63.5\times10^{-3}g}_{\text{true weight}}$]



T' is the apparent weight read by the balance.

$$T' = 55.4\times10^{-3}g$$

static equilibrium $\Rightarrow$

$$F_B + T' - mg = 0$$

$$\therefore \quad mg - T' = F_B \quad -(2)$$

(2)/(1) $\quad \dfrac{mg - T'}{T} = \dfrac{F_B}{mg} = \dfrac{\rho_F V g}{\rho_o V g} = \dfrac{\rho_F}{\rho_o}$

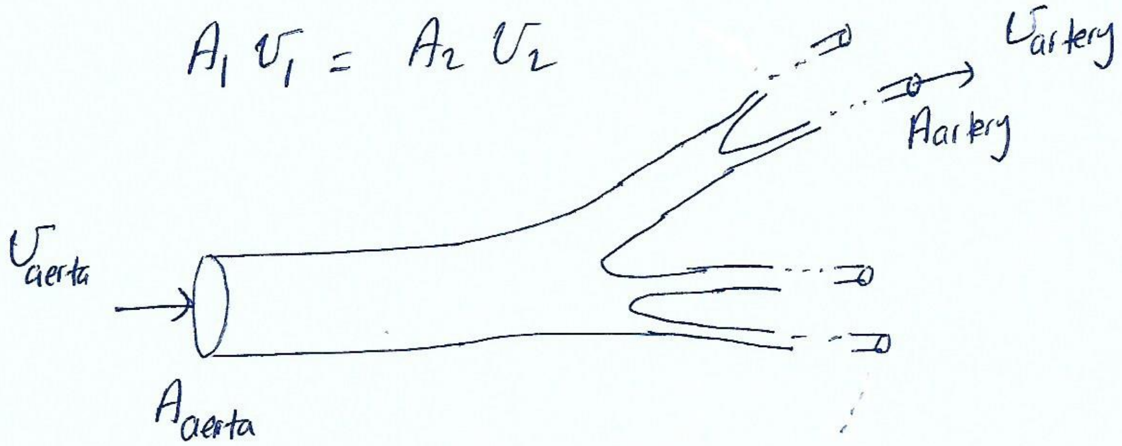
$$\Rightarrow \frac{63.5\times10^{-3}g - 55.4\times10^{-3}g}{63.5\times10^{-3}g} = \frac{1000}{\rho_o}$$

$$\Rightarrow \rho_o = 7.84\times10^{3}\ kg/m^3$$

$\Rightarrow$ it is made of iron or steel.

38] Use the continuity equation

$$A_1 v_1 = A_2 v_2$$



$$A_{aorta} v_{aorta} = A_{arteries} v_{artery}$$

total area of all arteries

$(A_{arteries} = N A_{artery})$

$$v_{artery} = \frac{A_{aorta}}{A_{arteries}} v_{artery} = \frac{\pi r_{aorta}^2}{2 \times 10^{-4}} \times 0.4$$

$$\simeq 0.9 \text{ m/s}$$

(we assumed all arteries to have the same cross sectional area.)

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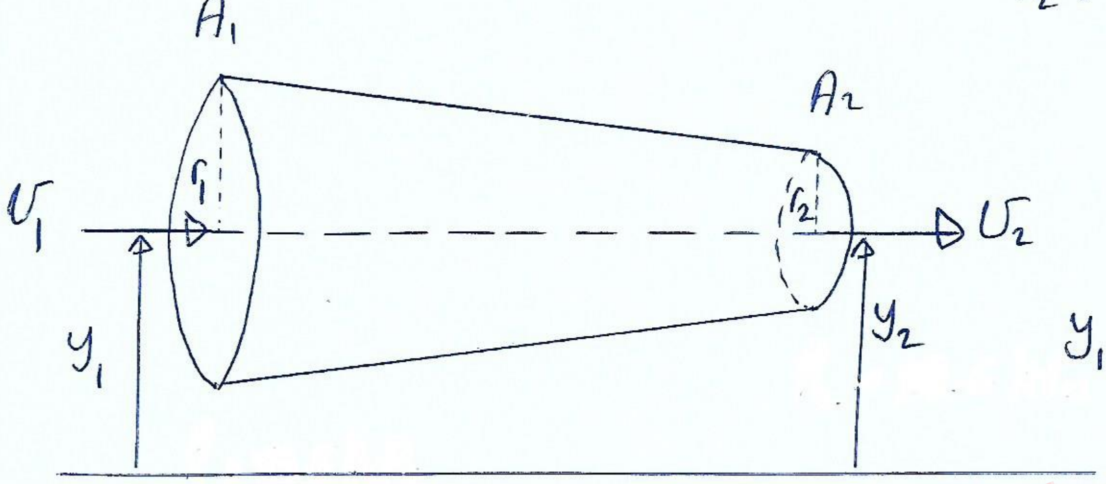
gauge pressure $\downarrow$ $P_{g1} = 33.5\ kPa$

gauge pressure $\downarrow$ $P_{g2} = 22.6\ kPa$

L6

$r_1 = 3.00$ cm

$r_2 = 2.25$ cm



$y_1 = y_2 = y$

$A_1 v_1 = A_2 v_2$ continuity eqn.

$$P_{g1} + \rho g y_1 + \frac{1}{2}\rho v_1^2 = P_{g2} + \rho g y_2 + \frac{1}{2}\rho v_2^2$$

$$P_1 - \cancel{P_{atm}} + \cancel{\rho g y} + \frac{1}{2}\rho v_1^2 = P_2 - \cancel{P_{atm}} + \cancel{\rho g y} + \frac{1}{2}\rho v_2^2$$

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

$$P_1 - P_2 = \frac{1}{2}\rho(v_2^2 - v_1^2) = \frac{1}{2}\rho\left(v_2^2 - \frac{A_2^2}{A_1^2}v_2^2\right)$$

<u>Note</u> $P_1 - P_2 = P_{g1} - P_{g2} = 33.5\times10^3 - 22.6\times10^3 = 10.9\times10^3\ Pa$

$$\therefore \frac{2}{\rho}(P_1 - P_2) = \left(1 - \frac{A_2^2}{A_1^2}\right)v_2^2$$

$$\Rightarrow v_2 = \sqrt{\frac{2(P_1-P_2)}{\rho\left(1-\frac{A_2^2}{A_1^2}\right)}} = \sqrt{\frac{2\times10.9\times10^3}{1000\left(1-\left(\frac{2.25}{3}\right)^4\right)}} \simeq 5.6\ m/s$$

$\Rightarrow$ Volume flow rate $= A_1 v_1 = A_2 v_2 = \pi r_2^2 v_2 \simeq 0.009\ m^3/s$

$\simeq 9000\ cm^3/s = 9$ Liters/s

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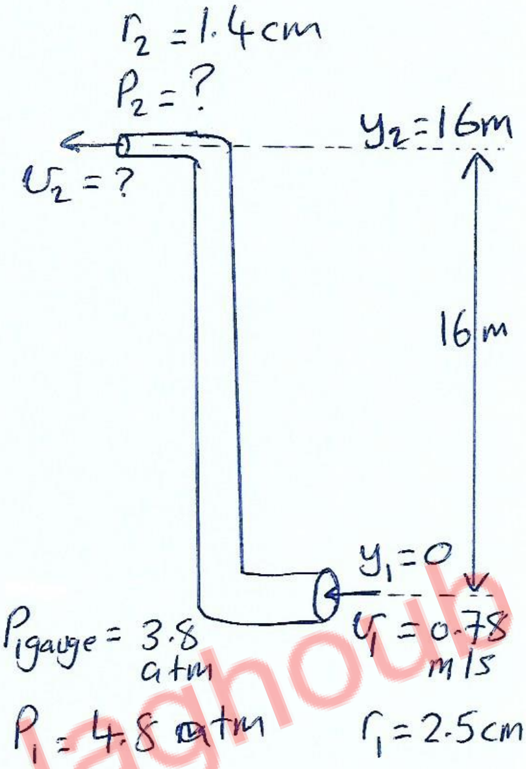
Find v_2 from continuity equation.

$$A_1 v_1 = A_2 v_2$$

$$v_2 = \frac{A_1}{A_2} v_1$$

$$= \left(\frac{r_1}{r_2}\right)^2 v_1 = \left(\frac{2.5}{1.4}\right)^2 (0.78)$$

$$v_2 \simeq 2.5 \text{ m/s}$$



Now, apply Bernoulli's eqn to find P_{2gauge}.

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$$

$$\underbrace{P_1 - P_{atm}}_{P_{1g}} + \frac{1}{2}\rho v_1^2 + \rho g (y_1 - y_2) - \frac{1}{2}\rho v_2^2 = \underbrace{P_2 - P_{atm}}_{P_{2g}}$$

$$P_{1g} + \frac{1}{2}\rho (v_1^2 - v_2^2) + \rho g(-16) = P_{2g}$$

$$3.8 \times 1.013 \times 10^5 + \frac{1}{2}(1000)\left((0.78)^2 - (2.5)^2\right) - 16(1000)(9.8) = P_{2g}$$

$$384940 - 2820.8 - 156800 = P_{2g}$$

$$225319.2 = P_{2gauge}$$

$$P_{2gauge} = 2.253192 \times 10^5 \text{ Pa}.$$

$$= 2.22 \text{ atm}.$$