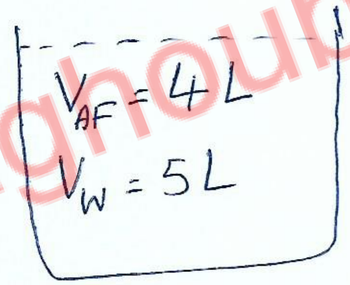
The University of Jordan / Physics Department
Giancoli, 7th edition / solutions to Extra Problems

Prof. Mahmoud Jaghoub

6] AF : antifreeze.
mix : mixture.



$$\rho_{mix} = \frac{\overbrace{m_{AF} + m_w}^{m_{mix}}}{V_{mix}}$$

$$= \frac{\rho_{AF} V_{AF} + \rho_w V_w}{V_{mix}}$$

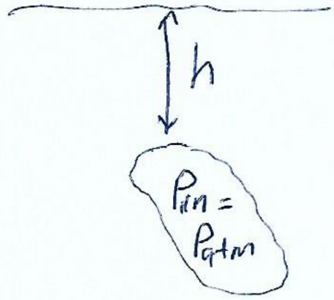
$$SG_{mix} = \frac{\rho_{mix}}{\rho_w} = \frac{SG_{AF} V_{AF} + V_w}{V_{mix}} = \frac{(0.8)(4L) + 5L}{9L}$$

$$\therefore \; SG_{mix} = \frac{8.2\,L}{9\,L} = 0.91$$

13]

Pressure inside lungs $= P_{in} = P_{atm}$

Pressure outside lungs $= P_{out}$



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

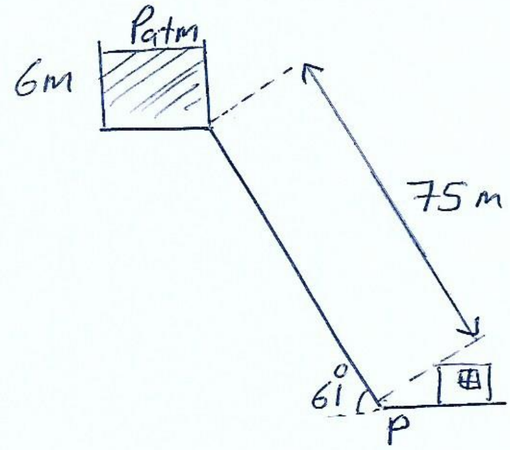
$$\Delta P = P_{out} - P_{in} = P_{atm} + \rho_w g h - P_{atm}$$

$$\Delta P = \rho_w g h$$

$$\therefore h = \frac{\Delta P}{\rho_w g} = \frac{85\,mmHg \times \frac{1.013\times10^5}{760\,mmHg}}{1000 \times 9.8}$$

$$h = 1.156\ m \sim 1.16\ m.$$

17]



(a) $P = P_{atm} + \rho g(6) + \rho g(75 \sin 61)$

$$P_{gauge} = P - P_{atm} = \rho g[6 + 75 \sin 61°]$$

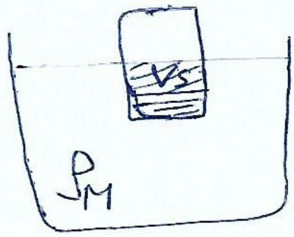
$$P_{gauge} = (1000)(9.8)[6 + 75 \sin 61]$$

$$P_{gauge} = 701645\ Pa.$$

(b) Ignoring friction forces the water cannot exceed the top of the tank by conservation of mechanical energy.

$$\therefore h_{max} = 75 \sin 61 + 6 \simeq 71.6\ m.$$

23] $\dfrac{\rho_o}{\rho_F} = \dfrac{V_s}{V}$



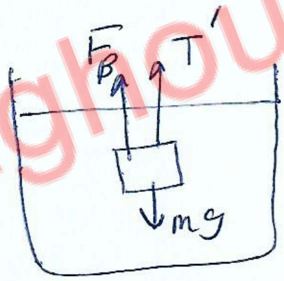
$\dfrac{V_s}{V} = \dfrac{7.8\times10^3}{13.6\times10^3} \simeq 0.57$

O: object (iron)
F: Fluid (Mercury)

$\Rightarrow$ required fraction $\dfrac{V_s}{V} = 0.57$

i.e 57% of the volume will be below the surface of the mercury.

24] $F_B + T' = mg$



$F_B = mg - T' = \rho_w V g$

$\therefore V = \dfrac{mg - T'}{\rho_w g} = \dfrac{9.28g - 6.18g}{1000g}$

Note: T' is the apparent weight in water $= 6.18g$

V is the volume of the displaced fluid = volume of the mass as it is fully under water.

$V = 0.0031 \ m^3$.

$\rho_{mass} = \dfrac{9.28 \ kg}{0.0031 \ m^3} = 2993.5 \ kg/m^3$

30] displaced volume $= 69.6\,L = 69.6\times10^{-3}\ m^3$

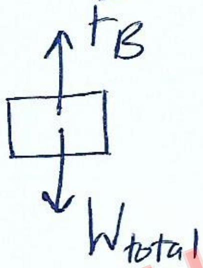
F_b = weight of displaced fluid

$F_b = \rho_w\,(69.6\times10^{-3})\,g \approx 682\ N$.

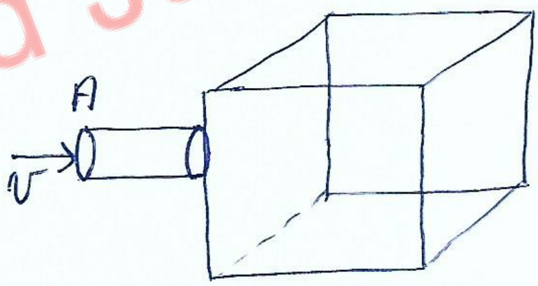
$W_{total} = m_{total}\,g = 72.8g \simeq 713\ N$.

since $W_{total} > F_B \Rightarrow$

diver will sink.



37] every 12 min a volume of air = 143.5 enters the room through the duct.



Volume of room
$= 8.2\times5\times3.5\ m^3$
$= 143.5\ m^3$

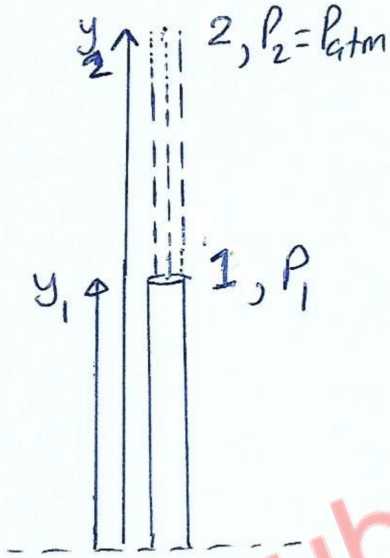
volume flow rate $= \dfrac{\Delta V}{\Delta t}$

$$\frac{\Delta V}{\Delta t} = A v$$

$$\frac{143.5\ m^3}{12\times60\ s} = 0.1993\ \frac{m^3}{s} = A v$$

$$\therefore\ v = \frac{0.1993\ m^3/s}{\pi(0.12)^2\ m^2} \simeq 4.4\ m/s$$

43] At points 1 and 2 the velocities v_1 and v_2 are zero. Pressure is needed for water to acquire velocity at point 1.



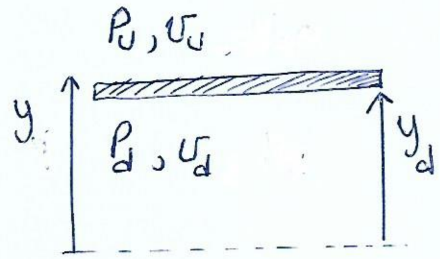
$$P_1 + \rho g y_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho v_2^2$$

$$P_1 + \rho g y_1 + 0 = P_{atm} + \rho g y_2 + 0$$

$$P_1 - P_{atm} = \rho g (y_2 - y_1)$$

$$= (1000)(9.8)(16) = 1.56 \times 10^5 \text{ Pa}.$$

44] Since $y_u \sim y_d \Rightarrow \rho g y_u = \rho g y_d$



Apply Bernoulli's eqn to upper and lower regions as shown:

$$P_U + \frac{1}{2}\rho v_u^2 + \rho g y_U = P_d + \frac{1}{2}\rho v_d^2 + \rho g y_d$$

Assume air inside house to have zero speed $\Rightarrow v_d = 0$.

while $v_U = 180 \times \frac{1000}{3600} = 50 \text{ m/s} \Rightarrow P_U < P_d$ and

so a net lifting force is $(P_d - P_U) A$

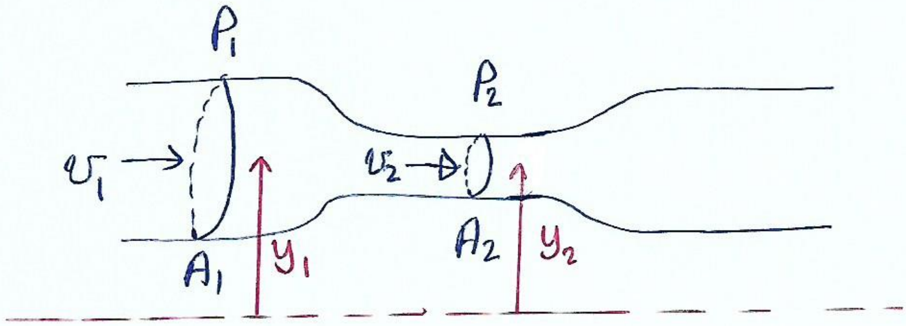
Need to find $P_d - P_U$.

$\frac{1}{2}\rho(v_U^2 - v_d^2) = P_d - P_U \Rightarrow P_d - P_U = \frac{1}{2}(1.29)(50^2 - 0) = 1612.5 \text{ Pa}$

just to lift the roof $Mg = (P_d - P_U)A = 1612.5 \times 6.2 \times 12.4$
$= 123969$ Newton.

$\Rightarrow$ weight of roof $Mg \approx 1.24 \times 10^5$ N.

50] Venturi tube is used to measure the flow speed of liquids ands gases. L6



continuity equation $\Rightarrow A_1 v_1 = A_2 v_2$ — (1)

Bernoullli's equation:

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2 \quad \text{— (2)}$$

$$y_1 = y_2 \Rightarrow \rho g y_1 = \rho g y_2$$

$$\therefore \quad P_1 - P_2 = \frac{1}{2}\rho(v_2^2 - v_1^2)$$

[NOTE: $P_1 > P_2$ as $v_1 < v_2$]

from (1) $v_2 = \frac{A_1}{A_2} v_1$

substitute for v_2 in eq. (2) we get

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

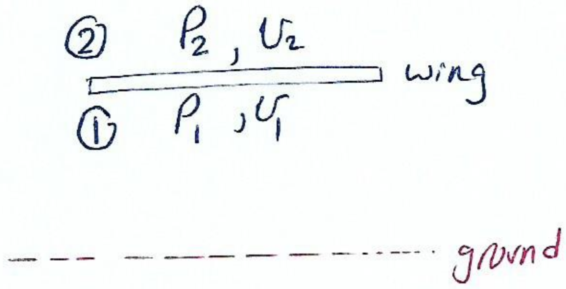
$$\therefore \quad 2A_2^2(P_1 - P_2) = \rho(A_1^2 - A_2^2)v_1^2$$

$$\Rightarrow v_1 = A_2\sqrt{\frac{2(P_1 - P_2)}{\rho(A_1^2 - A_2^2)}}$$

so, if we know A_1, A_2, P_1 and P_2 we can determine the flow speed v_1.

47] assume the heights of bottom and top surfaces of the wing to be the same.

$\Rightarrow \rho g y_1 = \rho g y_2$



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

$v_2 = 280 \text{ m/s} > v_1 = 150 \text{ m/s}$

$\Rightarrow P_2 < P_1$

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

$$= \frac{1}{2}(1.29)\left((280)^2 - (150)^2\right) = 36055.5 \text{ Pa}$$

$$\text{lifting force} = (P_1 - P_2)\underbrace{A}_{\text{wing's area}} = (P_1 - P_2)(88)$$

$\therefore$ lifting force $F_L = (36055.5)(88)$

$\approx 3.173 \times 10^6$ N.

Additional Problem

A collapsible plastic bag contains glucose solution. If the average gauge pressure in the vein is 1.33 kPa, what must be the minimum height h of the bag in order to infuse glucose into the vein?

Assume $SG_{glucose} = 1.02$

$$\Rightarrow \rho_{glucose} = 1.02 \times \rho_w = 1020\ kg/m^3.$$

$$P_{glucose} = P_{atm} + \rho_{glucose}\, g h$$

$$\underbrace{P_{glucose} - P_{atm}}_{P_{gauge}^{glucose}} = \rho_{glucose}\, g h$$

$$P_{gauge}^{glucose} = \rho_{glucose}\, g h$$

for glucose to be infused into the vein $\Rightarrow$

$$P_{gauge}^{glucose} \geq P_{gauge}^{blood}$$

$$\rho_{glucose}\, g h \geq 1.33 \times 10^3$$

$$\therefore h = \frac{1.33 \times 10^3}{1020 \times 9.8} \sim 0.133\ m.$$