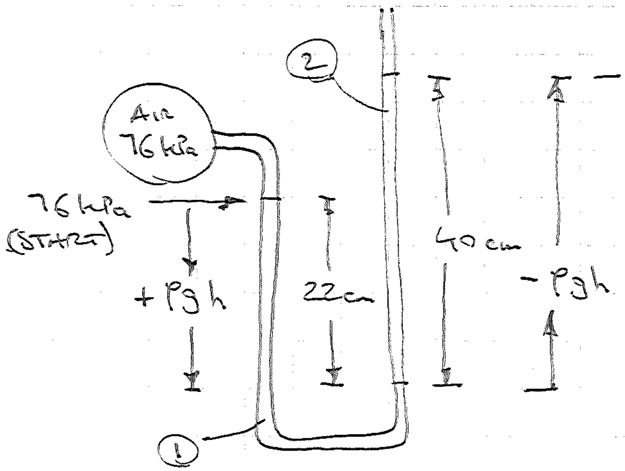
#1 (3-48).



$P_{atm} = 100 kPa$

so $P_{AIR} + \rho_1 g h_1 - \rho_2 g h_2 = P_{atm}$

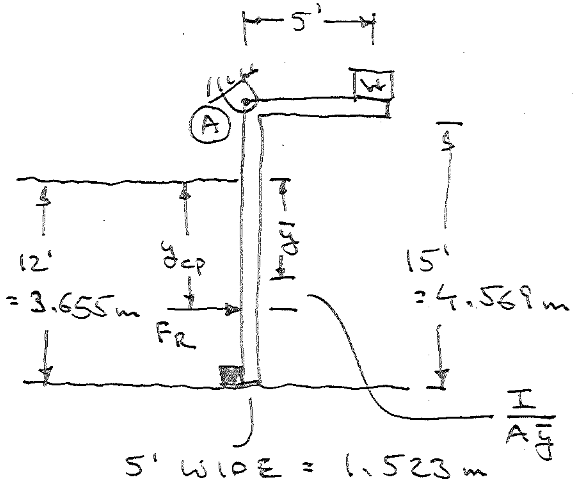
RECALL: $\rho_p = (SG)(\rho_w)$

so $P_{AIR} - P_{atm} = (SG_2)(\rho_w) g h_2 - (SG_1)(\rho_w) g h_1$

76×10^3 Pa, 100×10^3 Pa, ?, $1000 \frac{kg}{m^3}$, 40×10^{-2} m, 13.55, $1000 \frac{kg}{m^3}$, 9.81 m/s², 22×10^{-2} m.

$\boxed{\text{ANSWER: } 1.34 = SG_2}$

#2 (3-68E)



THE SUBMERGED PART OF THE GATE IS RECTANGULAR WITH:

$$A = (3.655)(1.523) = 5.566\ m^2$$

$$I = \frac{bh^3}{12} = \frac{(1.523)(3.655)^3}{12} = 6.197\ m^4$$

$$\bar{y} = \frac{3.655}{2} = 1.828\ m$$

$$P = \rho g \bar{y} = (1000)(9.81)(1.828) = 17{,}932.68\ N/m^2$$

$$F_R = PA = (17932.68)(5.566) = 99{,}813.3\ N.$$

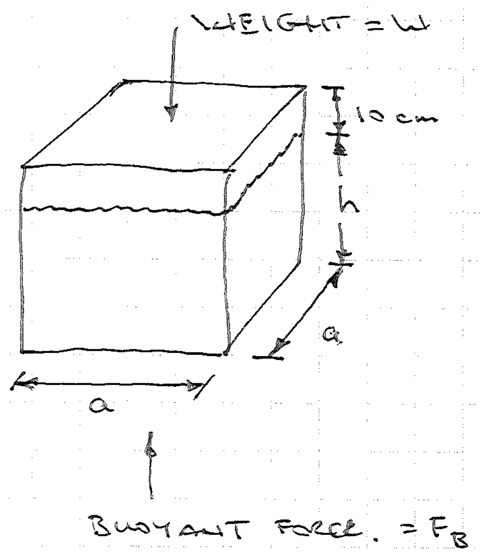
$$\frac{I}{A\bar{y}} = \frac{6.197}{(5.566)(1.828)} = 0.609\, m$$

$$\therefore\ y_{cp} = \bar{y} + \frac{I}{A\bar{y}} = 2.437\ m$$

$$\sum M_A = (F_R)\underbrace{(4.569 - (3.655 - y_{cp}))}_{3.351} - (W)(1.523) = 0$$

$$\therefore\ \underline{W = 219{,}615.5\ N} = 49{,}374\ lb$$

#3 (3-85)



$\Sigma F_y = 0$ so $W = F_B$

or $\rho_{BODY}\, g\, V_{TOTAL} = \rho_{FLUID}\, g\, V_{SUBMERGED}$

$$\therefore \quad \frac{V_{SUBMERGED}}{V_{TOTAL}} = \frac{\rho_{BODY}}{\rho_{FLUID}}$$

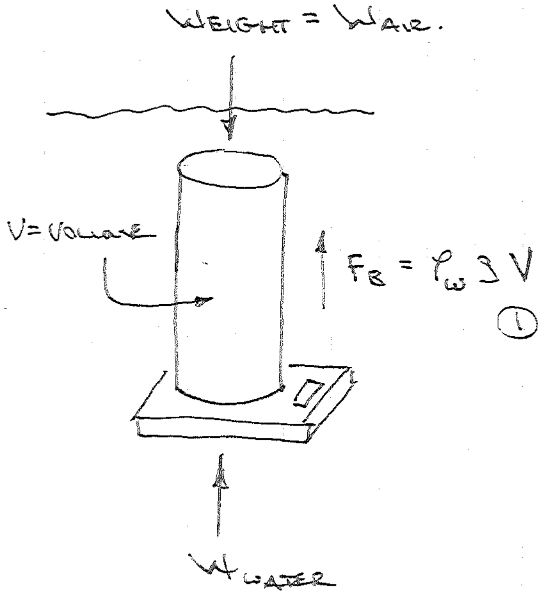
$$\frac{h \times \cancel{a} \times \cancel{a}}{(h+0.1)\times \cancel{a} \times \cancel{a}} = \frac{h}{h+0.1} = \frac{\rho_{ICE}}{\rho_{WATER}}$$

ALSO $$\frac{\rho_{ICE}}{\rho_{WATER}} = \frac{(SG_{ICE})(\cancel{\rho_w})}{(SG_{WATER})(\cancel{\rho_w})} = \frac{SG_{ICE}}{SG_{WATER}}$$

NOW $$\frac{h}{h+0.1} = \frac{0.92}{1.025}$$

$$\therefore \quad h = 0.876 \text{ m}$$

#4 (3-88)



$$\uparrow \sum F_y = W_{AIR} - W_{WATER} - F_B = 0$$

SO $F_B = W_{AIR} - W_{WATER}$

AND $\rho_w g V = \underbrace{W_{AIR} - W_{WATER}}_{\text{MEASURED SO KNOWN.}}$

① NOTE: $V = V_{FAT} + V_{MUSCLE}$

ALSO: $x_{FAT} = \dfrac{V_{FAT}}{V}$ AND $x_{MUSCLE} = \dfrac{V_{MUSCLE}}{V}$

OR $x_{MUSCLE} = (1 - x_{FAT})$

$V_{FAT} = x_{FAT} V$ $V_{MUSCLE} = (1 - x_{FAT}) V$

② ALSO: $m = m_{fat} + m_{MUSCLE}$

AND: $m = \rho V$ (IN GENERAL).

SO ② BECOMES $\rho_{BODY} V = \rho_{FAT} V_{FAT} + \rho_{MUSCLE} V_{MUSCLE}$.

OR $\rho_{BODY} V = \rho_{FAT} x_{FAT} V + \rho_{MUSCLE} (1 - x_{FAT}) V$

CANCEL V AND SOLVE FOR x_{FAT} ...

$$\rho_{BODY} = \rho_{FAT} x_{FAT} + \rho_M - \rho_M x_{FAT}$$

$$\rho_{BODY} - \rho_M = x_{FAT} (\rho_{FAT} - \rho_m)$$

$$\therefore \; x_{FAT} = \frac{\rho_{BODY} - \rho_{MUSCLE}}{\rho_{FAT} - \rho_{MUSCLE}} \quad \left(\text{OR } x_{FAT} = \frac{\rho_{MUSCLE} - \rho_{BODY}}{\rho_{MUSCLE} - \rho_{FAT}} \right)$$