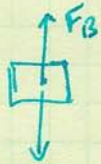
Buoyancy Example #1

2005 AP #5

$\rho_r = 650 \text{ kg/m}^3$, $A = 8.2 \text{ m}^2$, $V = 1.8 \text{ m}^3$ $\quad \rho_w = 1000 \text{ kg/m}^3$



floats so $m = \rho V$

$F_B = F_g$

$\rho_w V_w g = \rho_r V_r g$

(a) $\rho_w (A y) g = \rho_r (A h_0) g$

$y = \frac{\rho_r}{\rho_w} h_0 = \frac{650}{1000}(.22) = 0.143$

$h = h_0 - y = .22 - 0.143 =$

$\boxed{h = 0.077 \text{ m}}$

(b) Since it floats $F_B = F_g = \rho_r V_r g = 650 \frac{\text{kg}}{\text{m}^3} \cdot 1.8 \text{ m}^3 \cdot 9.8 \text{ m/s}^2$

$\boxed{F_B = 11500 \text{ N}}$

(c) at max, volume displaced = volume raft $V_w = V_r$

$F_B = F_g \Rightarrow \rho_w V_r g = mg = 1000 \cdot 1.8 \cdot 9.8 = 17640 \text{ N}$

$F_g = F_B = 17640 \text{ N} = F_{g\,raft} + N \cdot m \cdot g$

$N = \frac{17640 - F_{g\,raft}}{mg} = \frac{17640 - 11500}{75 \cdot 9.8} = 8.3 = N$

$\boxed{N = 8 \text{ people}}$