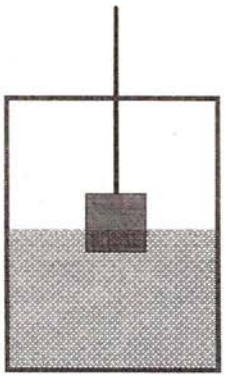
KEY

Buoyancy Sample Problem 3



A 1.5 kg block is hanging from a string and is submerged 25% in water. The density of water is 1000 kg/m^3. If the block has a bottom area of 0.01 m^2, and a height of 0.2 m...

(a) what is the volume of the block?
(b) what is the density of the block?
(c) what is the buoyant force on the block?
(d) what is the tension in the string?
(e) at what level must the water be at for the string to lose its tension completely?

(a) $V = A \cdot h = (0.01 m^2)(0.2 m) = 0.002 m^3$

(b) $\rho = \frac{m}{V} = \frac{1.5 kg}{0.002 m^3} = 750 \frac{kg}{m^3}$

(c) $F_B = \rho_w V_w g = 1000 \frac{kg}{m^3} \cdot (0.25)(0.002 m^3) \cdot 9.8 m/s^2$

$F_B = 4.9 N$

(d) $\Sigma F = 0 \Rightarrow F_B + F_T - mg = 0$

$F_T = mg - F_B = 1.5 \cdot 9.8 - 4.9$

$F_T = 9.8 N$

(e) $F_T \to 0$ so $F_B = mg$ $\quad V = Ay$

$\rho_w V_w g = mg \Rightarrow \rho_w A y = m$

$y = \frac{m}{\rho_w A} = \frac{1.5}{1000 \cdot 0.01} = 0.15$

so water must be 0.15 m up the block, or block must be $\frac{.15}{.2} = 75\%$ submerged.