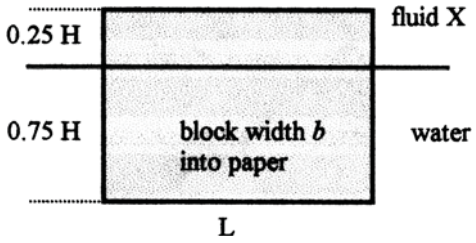
2.103 A solid block, of specific gravity 0.9, floats such that 75% of its volume is in water and 25% of its volume is in fluid X, which is layered above the water. What is the specific gravity of fluid X?



Solution: The block is sketched at right. A force balance is

$$0.9\gamma(\text{HbL}) = \gamma(0.75\text{HbL}) + \text{SG}_\text{X}\gamma(0.25\text{HbL})$$

$$0.9 - 0.75 = 0.25\text{SG}_\text{X}, \quad \boldsymbol{SG_X = 0.6} \quad \textit{Ans.}$$

2.104 The can in Fig. P2.104 floats in the position shown. What is its weight in newtons?

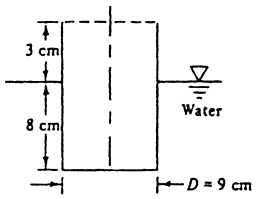


Fig. P2.104

Solution: The can weight simply equals the weight of the displaced water (neglecting the air above):

$$\text{W} = \gamma\upsilon_\text{displaced} = (9790)\frac{\pi}{4}(0.09\text{ m})^2(0.08\text{ m}) = \mathbf{5.0\ N} \quad \textit{Ans.}$$

2.105 Archimedes, when asked by King Hiero if the new crown was pure gold (SG = 19.3), found the crown weight in air to be 11.8 N and in water to be 10.9 N. Was it gold?

Solution: The buoyancy is the difference between air weight and underwater weight:

$$\text{B} = \text{W}_\text{air} - \text{W}_\text{water} = 11.8 - 10.9 = 0.9\text{ N} = \gamma_\text{water}\upsilon_\text{crown}$$

$$\text{But also} \quad \text{W}_\text{air} = (\text{SG})\gamma_\text{water}\upsilon_\text{crown}, \quad \text{so} \quad \text{W}_\text{in water} = \text{B}(\text{SG} - 1)$$

$$\text{Solve for} \quad \text{SG}_\text{crown} = 1 + \text{W}_\text{in water}/\text{B} = 1 + 10.9/0.9 = \mathbf{13.1\ (not\ pure\ gold)} \quad \textit{Ans.}$$

2.106 A spherical helium balloon is 2.5 m in diameter and has a total mass of 6.7 kg. When released into the U. S. Standard Atmosphere, at what altitude will it settle?