

- (a) A 75.0-kg man floats in freshwater with 3.00% of his volume above water when his lungs are empty, and 5.00% of his volume above water when his lungs are full. Calculate the volume of air he inhales called his lung capacity in liters. (b) Does this lung volume seem reasonable?

~~mg~~ Solution

weight of man = weight of displaced water
 $mg = \rho_w g V_w$ $V_w = \text{Volume of water displaced}$

$$mg = \rho_w g (0.97 V_{\text{man}}) \quad V_w = 0.97 V_{\text{man}}$$

$$m = \rho_w (0.97 V_{\text{man}})$$

$$V_{\text{man}} = \frac{m}{\rho_w (0.97)} = \frac{75 \text{ kg}}{0.97 \times 1000} = \underline{0.0773 \text{ m}^3}$$

when the lungs are full: 95% is submerged (5% float)

$$mg = \rho_w g V_w$$

$$V_w = 0.95 V_{\text{man}} + V_{\text{lung}}$$

$$m = \rho_w (0.95 V_{\text{man}} + V_{\text{lung}}) \quad V_{\text{man}} = \underline{0.0773 \text{ m}^3}$$

$$75 \text{ kg} = 1000 (0.95 \times 0.0773 + V_{\text{lung}})$$

$$\frac{75}{1000} = 0.073435 + V_{\text{lung}}$$

$$0.075 = 0.073435 + V_{\text{lung}}$$

$$V_{\text{lung}} = 0.075 - 0.073435$$

$$V_{\text{lung}} = \underline{0.001565 \text{ m}^3}$$

$$V_{\text{lung}} = 0.001565 \times 1000 \text{ L}$$

$$\underline{V_{\text{lung}} = 1.565 \text{ L}}$$