1.2 Alloy Composition

Using Archimedes' principle to find the composition of the alloy.

- **Buoyant Force and Volume:** Buoyant force $F_B = W_{\text{air}} - W_{\text{sol}} = 10.0 - 9.326 = 0.674$ kgf. This corresponds to a displaced mass of $m_{\text{sol}} = 0.674$ kg. Total volume of the block: $V_{\text{total}} = \frac{m_{\text{sol}}}{\rho_{\text{sol}}} = \frac{0.674}{1230} \approx 5.4797 \times 10^{-4}$ m^3.
- **System of Equations:**

$$\begin{aligned} m_{\text{Au}} + m_{\text{Cu}} &= 10.0 \quad \text{(Mass Conservation)} \\ \frac{m_{\text{Au}}}{\rho_{\text{Au}}} + \frac{m_{\text{Cu}}}{\rho_{\text{Cu}}} &= V_{\text{total}} \quad \text{(Volume Conservation)} \end{aligned}$$

- **Solving for Masses:** Substitute $m_{\text{Cu}} = 10.0 - m_{\text{Au}}$ into the volume equation:

$$\begin{aligned} \frac{m_{\text{Au}}}{19300} + \frac{10.0 - m_{\text{Au}}}{8960} &= 5.4797 \times 10^{-4} \\ m_{\text{Au}} \left(\frac{1}{19300} - \frac{1}{8960} \right) &= 5.4797 \times 10^{-4} - \frac{10.0}{8960} \\ m_{\text{Au}}(-5.9797 \times 10^{-5}) &= -5.6813 \times 10^{-4} \\ m_{\text{Au}} &\approx 9.50 \text{ kg} \end{aligned}$$

  Then, $m_{\text{Cu}} = 10.0 - 9.50 = 0.50$ kg.

- **Percentage by Mass:** Gold: $\frac{9.50}{10.0} \times 100\% = \mathbf{95}\%$. Copper: $\frac{0.50}{10.0} \times 100\% = \mathbf{5}\%$.