

4.21 This problem asks us to determine the number of niobium atoms per cubic centimeter for a 24 wt% Nb-76 wt% V solid solution. To solve this problem, employment of Equation 4.18 is necessary, using the following values:

$$C_1 = C_{\text{Nb}} = 24 \text{ wt\%}$$

$$\rho_1 = \rho_{\text{Nb}} = 8.57 \text{ g/cm}^3$$

$$\rho_2 = \rho_{\text{V}} = 6.10 \text{ g/cm}^3$$

$$A_1 = A_{\text{Nb}} = 92.91 \text{ g/mol}$$

Thus

$$\begin{aligned} N_{\text{Nb}} &= \frac{N_{\text{A}} C_{\text{Nb}}}{\frac{C_{\text{Nb}} A_{\text{Nb}}}{\rho_{\text{Nb}}} + \frac{A_{\text{Nb}} (100 - C_{\text{Nb}})}{\rho_{\text{V}}}} \\ &= \frac{(6.023 \times 10^{23} \text{ atoms/mol})(24 \text{ wt\%})}{\frac{(24 \text{ wt\%})(92.91 \text{ g/mol})}{8.57 \text{ g/cm}^3} + \frac{92.91 \text{ g/mol}}{6.10 \text{ g/cm}^3} (100 - 24 \text{ wt\%})} \\ &= 1.02 \times 10^{22} \text{ atoms/cm}^3 \end{aligned}$$