

4.22 This problem asks that we derive Equation 4.19, using other equations given in the chapter. The number of atoms of component 1 per cubic centimeter is just equal to the atom fraction of component 1 (c_1') times the total number of atoms per cubic centimeter in the alloy (N). Thus, using the equivalent of Equation 4.2, we may write

$$N_1 = c_1' N = \frac{c_1' N_A \rho_{\text{ave}}}{A_{\text{ave}}}$$

Realizing that

$$c_1' = \frac{C_1'}{100}$$

and

$$C_2' = 100 - C_1'$$

and substitution of the expressions for ρ_{ave} and A_{ave} , Equations 4.10b and 4.11b, respectively, leads to

$$\begin{aligned} N_1 &= \frac{c_1' N_A \rho_{\text{ave}}}{A_{\text{ave}}} \\ &= \frac{N_A C_1' \rho_1 \rho_2}{C_1' \rho_2 A_1 + (100 - C_1') \rho_1 A_2} \end{aligned}$$

And, solving for C_1'

$$C_1' = \frac{100 N_1 \rho_1 A_2}{N_A \rho_1 \rho_2 - N_1 \rho_2 A_1 + N_1 \rho_1 A_2}$$

Substitution of this expression for C_1' into Equation 4.7a, which may be written in the following form