18.D2 This problem asks that we determine the electrical conductivity of an 85 wt% Cu-15 wt% Zn alloy at –100°C using information contained in Figures 18.8 and 18.37. In order to solve this problem it is necessary to employ Equation 18.9 which is of the form

$$\rho_{\text{total}} = \rho_t + \rho_i$$

since it is assumed that the alloy is undeformed. Let us first determine the value of ρ_i at room temperature (25°C) which value will be independent of temperature. From Figure 18.8, at 25°C and for pure Cu, $\rho_t(25) = 1.75 \times 10^{-8}$ Ω-m. Now, since it is assumed that the curve in Figure 18.37 was generated also at room temperature, we may take ρ as $\rho_{\text{total}}(25)$ at 85 wt% Cu-15 wt% Zn which has a value of 4.7×10^{-8} Ω-m. Thus

$$\rho_i = \rho_{\text{total}}(25) - \rho_t(25)$$

$$= 4.7 \times 10^{-8}\ \Omega\text{-m} - 1.75 \times 10^{-8}\ \Omega\text{-m} = 2.95 \times 10^{-8}\ \Omega\text{-m}$$

Finally, we may determine the resistivity at –100°C, $\rho_{\text{total}}(-100)$, by taking the resistivity of pure Cu at –100°C from Figure 18.8, which gives us $\rho_t(-100) = 0.90 \times 10^{-8}$ Ω-m. Therefore

$$\rho_{\text{total}}(-100) = \rho_i + \rho_t(-100)$$

$$= 2.95 \times 10^{-8}\ \Omega\text{-m} + 0.90 \times 10^{-8}\ \Omega\text{-m} = 3.85 \times 10^{-8}\ \Omega\text{-m}$$

And, using Equation 18.4 the conductivity is calculated as

$$\sigma = \frac{1}{\rho} = \frac{1}{3.85 \times 10^{-8}\ \Omega - \text{m}} = 2.60 \times 10^{7}\ (\Omega\text{-m})^{-1}$$