18.11 (a) The number of free electrons per cubic meter for aluminum at room temperature may be computed using Equation 18.8 as

$$n = \frac{\sigma}{|e| \mu_e}$$
$$= \frac{3.8 \times 10^7 (\Omega - m)^{-1}}{(1.602 \times 10^{-19} \text{ C})(0.0012 \text{ m}^2/\text{V-s})}$$
$$= 1.98 \times 10^{29} \text{ m}^{-3}$$

(b) In order to calculate the number of free electrons per aluminum atom, we must first determine the number of copper atoms per cubic meter, N_{Al} . From Equation 4.2 (and using the atomic weight and density values for Al found inside the front cover—viz. 26.98 g/mol and 2.71 g/cm³)

$$N_{\rm Al} = \frac{N_{\rm A} \,\rho'}{A_{\rm Al}}$$

$$= \frac{(6.023 \text{ x } 10^{23} \text{ atoms/mol})(2.71 \text{ g/cm}^3)(10^6 \text{ cm}^3/\text{m}^3)}{26.98 \text{ g/mol}}$$

$$= 6.03 \text{ x} 10^{28} \text{ m}^{-3}$$

(*Note*: in the above expression, density is represented by ρ' in order to avoid confusion with resistivity which is designated by ρ .) And, finally, the number of free electrons per aluminum atom is just n/N_{A1}

$$\frac{n}{N_{\rm Al}} = \frac{1.98 \text{ x } 10^{29} \text{ m}^{-3}}{6.03 \text{ x } 10^{28} \text{ m}^{-3}} = 3.28$$

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