

17. (a) The volume per cubic meter of sodium occupied by the sodium ions is

$$V_{\text{Na}} = \frac{(971 \text{ kg})(6.022 \times 10^{23} / \text{mol})(4\pi/3)(98 \times 10^{-12} \text{ m})^3}{(23 \text{ g/mol})} = 0.100 \text{ m}^3 ,$$

so the fraction available for conduction electrons is $1 - (V_{\text{Na}}/1.00 \text{ m}^3) = 1 - 0.100 = 0.900$.

- (b) For copper,

$$V_{\text{Cu}} = \frac{(8960 \text{ kg})(6.022 \times 10^{23} / \text{mol})(4\pi/3)(135 \times 10^{-12} \text{ m})^3}{63.5 \text{ g/mol}} = 0.876 \text{ m}^3 .$$

Thus, the fraction is $1 - (V_{\text{Cu}}/1.00 \text{ m}^3) = 1 - 0.876 = 0.124$.

- (c) Sodium, because the electrons occupy a greater portion of the space available.