23. Let N be the number of atoms per unit volume and n be the number of free electrons per unit volume. Then, the number of free electrons per atom is n/N. We use the result of Exercise 11 to find n: $E_F = An^{2/3}$, where $A = 3.65 \times 10^{-19}\,\mathrm{m^2 \cdot eV}$. Thus,

$$n = \left(\frac{E_F}{A}\right)^{3/2} = \left(\frac{11.6\,\mathrm{eV}}{3.65 \times 10^{-19}\,\mathrm{m^2 \cdot eV}}\right)^{3/2} = 1.79 \times 10^{29}\,\mathrm{m^{-3}}\ .$$

If M is the mass of a single aluminum atom and d is the mass density of aluminum, then $N = d/M$. Now, $M = (27.0\,\mathrm{g/mol})/(6.022 \times 10^{23}\,\mathrm{mol^{-1}}) = 4.48 \times 10^{-23}\,\mathrm{g}$, so $N = (2.70\,\mathrm{g/cm^3})/(4.48 \times 10^{-23}\,\mathrm{g}) = 6.03 \times 10^{22}\,\mathrm{cm^{-3}} = 6.03 \times 10^{28}\,\mathrm{m^{-3}}$. Thus, the number of free electrons per atom is

$$\frac{n}{N} = \frac{1.79 \times 10^{29}\,\mathrm{m^{-3}}}{6.03 \times 10^{28}\,\mathrm{m^{-3}}} = 2.97\ .$$