Example 2.9 A piece of silicon doped with arsenic ($N_d = 10^{17}$ cm^{-3}) is 100 μm long, 10 μm wide and 1 μm thick. Calculate the resistance of this sample when contacted at each end.

Solution The resistivity of the silicon equals:

$$\rho = \frac{1}{qn\mu_n} = \frac{1}{1.6\times10^{-19}\times10^{17}\times727} = 0.086\,\Omega\text{cm}$$

where the mobility was obtained from Table 2.7.3.

The resistance then equals:

$$R = \rho\frac{L}{Wt} = 0.086\times\frac{100\times10^{-4}}{10\times10^{-4}\times10^{-4}} = 8.6\,\text{k}\Omega$$

An alternate approach is to first calculate the sheet resistance, R_s:

$$R_s = \frac{\rho}{t} = \frac{0.086}{10^{-4}} = 860\,\Omega/\text{square}$$

From which one then obtains the resistance:

$$R = R_s\frac{L}{W} = 860\times\frac{100\times10^{-4}}{10\times10^{-4}} = 8.6\,\text{k}\Omega$$