18.3 This problem asks that we compute, for a plain carbon steel wire 3 mm in diameter, the maximum length such that the resistance will not exceed 20 Ω. From Table 18.1 for a plain carbon steel $\sigma = 0.6 \times 10^7\ (\Omega\text{-m})^{-1}$. If $d$ is the diameter then, combining Equations 18.2 and 18.4 leads to

$$l = R\sigma A = R\sigma\pi\left(\frac{d}{2}\right)^2$$

$$= (20\ \Omega)\left[0.6\ \times 10^7\ (\Omega - \text{m})^{-1}\right](\pi)\left(\frac{3\ \times 10^{-3}\ \text{m}}{2}\right)^2 = 848\ \text{m}$$