6.38 We are asked to compute how much elongation a metal specimen will experience when a true stress of 415 MPa is applied, given the value of n and that a given true stress produces a specific true strain. Solution of this problem requires that we utilize Equation 6.19. It is first necessary to solve for K from the given true stress and strain. Rearrangement of this equation yields

$$K = \frac{\sigma_T}{(\varepsilon_T)^n} = \frac{345 \text{ MPa}}{(0.02)^{0.22}} = 816 \text{ MPa } (118,000 \text{ psi})$$

Next we must solve for the true strain produced when a true stress of 415 MPa is applied, also using Equation 6.19. Thus

$$\varepsilon_T = \left(\frac{\sigma_T}{K}\right)^{1/n} = \left(\frac{415 \text{ MPa}}{816 \text{ MPa}}\right)^{1/0.22} = 0.0463 = \ln\left(\frac{l_i}{l_0}\right)$$

Now, solving for l_i gives

$$l_i = l_0 e^{0.0463} = (500 \text{ mm}) e^{0.0463} = 523.7 \text{ mm } (20.948 \text{ in.})$$

And finally, the elongation Δl is just

$$\Delta l = l_i - l_0 = 523.7 \text{ mm} - 500 \text{ mm} = 23.7 \text{ mm } (0.948 \text{ in.})$$