

21. Since the mass density of the material do not change, the volume remains the same. If  $L_0$  is the original length,  $L$  is the new length,  $A_0$  is the original cross-sectional area, and  $A$  is the new cross-sectional area, then  $L_0A_0 = LA$  and  $A = L_0A_0/L = L_0A_0/3L_0 = A_0/3$ . The new resistance is

$$R = \frac{\rho L}{A} = \frac{\rho 3L_0}{A_0/3} = 9 \frac{\rho L_0}{A_0} = 9R_0,$$

where  $R_0$  is the original resistance. Thus,  $R = 9(6.0 \, \Omega) = 54 \, \Omega$ .