Ch.9 Prob 74

$R_o = 5.0\,\Omega \qquad L_n = 2L_o$

What is the resistance of the new wire?

The volume of the wire is unchanged, so

$$V_o = A_o L_o = A_n L_n = V_n$$

$$A_n = \frac{A_o L_o}{L_n}$$

But $L_n = 2L_o$, so $A_n = \frac{A_o L_o}{2L_o} = \frac{A_o}{2}$

The formula for resistance gives

$$R_o = \frac{\rho L_o}{A_o} \quad \text{and} \quad R_n = \frac{\rho L_n}{A_n}$$

↓ substitute in relationships for A_n & L_n

$$R_n = \frac{\rho (2L_o)}{(A_o/2)} = 4\,\frac{\rho L_o}{A_o}$$

But $\frac{\rho L_o}{A_o}$ is the original resistance of the wire

$$\therefore \quad R_n = 4R_o = 4(5.0\,\Omega) = \boxed{20\,\Omega}$$