Answer on Question #46026-Physics-Electromagnetism

A wire with resistance of 8.0Ω is drawn out through a die so that its new length is three times its original length. Find the resistance of the longer wire assuming that the resistivity and density of the material are unaffected by the drawing process.

Solution

The electrical resistivity ρ is defined as

$$\rho = R\frac{A}{l},$$

where R is the electrical resistance, l is the length, A is the cross-sectional area.

Thus, the resistance is

$$R = \rho\frac{l}{A}.$$

The ratio of resistances is

$$\frac{R_2}{R_1} = \frac{l_2 A_1}{l_1 A_2}.$$

The volume of wire is

$$V = Al = const.$$

Thus,

$$l_1 A_1 = l_2 A_2.$$

From given,

$$3l_1 = l_2 \rightarrow A_1 = 3A_2.$$

So,

$$\frac{R_2}{R_1} = \frac{3l_1 \cdot 3A_2}{l_1 \cdot A_2} = 9.$$

Then,

$$R_2 = 9R_1 = 9 \cdot 8.0\Omega = 72\Omega.$$

Answer: 72Ω.