

## Answer on Question#40194, Physics, Electric Circuits

### Question:

a piece of wire 10.0 meters long and 0.500 millimetre in diameter has a resistance of 2.5 ohms. What length of the wire of the same material 0.300 millimetre in diameter will have a resistance of 3.00 ohms?

### Answer:

The resistance of a given object depends primarily on two factors: What material it is made of, and its shape. For a given material, the resistance is inversely proportional to the cross-sectional area. Also, for a given material, the resistance is proportional to the length. The resistance  $R$  of a conductor of uniform cross section, therefore, can be computed as

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

where  $l$  is the length of the conductor, measured in metres [m],  $A$  is the cross-section area of the conductor measured in square metres [m<sup>2</sup>], and  $\rho$  (rho) is the electrical resistivity (also called specific electrical resistance) of the material, measured in ohm-metres ( $\Omega \cdot \text{m}$ ).

Therefore:

$$R_1 = \frac{\rho l_1}{A_1}$$

$$R_2 = \frac{\rho l_2}{A_2}$$

Or:

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

Finally:

$$l_2 = l_1 \frac{R_2 A_2}{R_1 A_1} = l_1 \frac{R_2 d_2^2}{R_1 d_1^2} = 10 \frac{3 \cdot 0.5^2}{2.5 \cdot 0.3^2} = 4.32 \text{ m}$$

Answer: 4.32 m