Answer on Question #47746, Physics, Electric Circuits

A tightly coiled spring having 75 coils, each 3.50 cm in diameter is made of insulated metal wire which is 3.25 mm in diameter. An ohm meter connected across its opposite ends reads 1.74 ohm. What is the resistivity of the metal?

Solution:

The electrical resistivity ρ is defined as:

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

where

R = 1.74 Ω is the electrical resistance of a uniform specimen of the material (measured in ohms, Ω)

l is the length of the piece of material (measured in metres, m)

A is the cross-sectional area of the specimen (measured in square metres, m^2).

The length is

$$l = 75 \cdot \pi \cdot D$$

The cross-sectional area is

$$A = \frac{\pi d^2}{4}$$

Thus,

$$\rho = R\frac{A}{l} = R\frac{\pi d^2}{4}\frac{1}{75\pi D} = \frac{Rd^2}{4 \cdot 75D} = \frac{1.74 \cdot 3.25^2 \cdot 10^{-6}}{4 \cdot 75 \cdot 3.50 \cdot 10^{-2}} = 1.75 \cdot 10^{-6}\ \text{ohm} \cdot \text{m}$$

Answer: $\rho = 1.75 \cdot 10^{-6}\ \text{ohm} \cdot \text{m}$