Answer on Question 51533, Physics, Electromagnetism

Question:

A nichrome wire is $1.0m$ long and $1.0mm^2$ in cross-sectional area. It carries a current of $4.0A$ when a potential difference of $2.0V$ is applied between its ends. Calculate conductivity of the wire:

a) $2M\Omega^{-1} \cdot m^{-1}$

b) $4k\Omega^{-1} \cdot m^{-1}$

c) $2m\Omega^{-1} \cdot m^{-1}$

d) $4\Omega^{-1} \cdot m^{-1}$

Solution:

Conductivity is defined as the inverse of resistivity ρ:

$$\sigma = \frac{1}{\rho}$$

As we know, resistivity defined as:

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

where R is the resistance of the wire, A is the cross-sectional area of the wire and l is the length of the wire.

In order to find the resistance of the wire we use the Ohm's law and obtain:

$$R = \frac{V}{I}$$

Then, we can rewrite our formula for the resistivity:

$$\rho = \frac{V}{I} \cdot \frac{A}{l}$$

Substituting the resistivity into the formula for the conductivity we finally get:

$$\sigma = \frac{1}{\rho} = \frac{I \cdot l}{V \cdot A} = \frac{4.0A \cdot 1.0m}{2.0V \cdot 1.0 \cdot 10^{-6}m^2} = 2.0 \cdot 10^6\Omega^{-1} \cdot m^{-1} = 2.0M\Omega^{-1} \cdot m^{-1}$$

Answer:

a) $2M\Omega^{-1} \cdot m^{-1}$