Answer on Question #45788, Physics, Electric Circuits

A nichrome wire is 1.0 m long and 1.0 mm² in cross-sectional area. It carries a current of 4.0 A when a potential difference of 2 V is applied between its ends. Calculate the conductivity of the wire.

a. $(2M\Omega m)^{-1}$
b. $(4k\Omega m)^{-1}$
c. $(2m\Omega m)^{-1}$
d. $(4\Omega m)^{-1}$

Solution:

The electrical resistivity ρ is defined as:

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

where
R 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, m²).
Conductivity σ is defined as the inverse of resistivity:

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

The resistance is

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

where V is the potential difference across the two points in volts and I is the current flowing between the two points in amperes.
Thus,

$$\sigma = \frac{Il}{VA}$$

$$\sigma = \frac{4.0 \cdot 1.0}{2 \cdot 1.0 \cdot 10^{-6}} = 2 \cdot 10^6 = 2\ M\Omega m^{-1}$$

Answer: a. $(2M\Omega m)^{-1}$