Answer on Question #55897, Physics / Electromagnetism

19 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.

Solution:

The conductivity of a wire can be expressed as

$$\sigma = \frac{L}{RA}$$

where

L = length = 1.0 m

A= cross sectional area = $1.0*10^{-6}$ m^2.

The resistance is

$$R = \frac{V}{i} = \frac{2\ \text{V}}{4.0\ A} = 0.5\ \Omega$$

Thus,

$$\sigma = \frac{1.0}{0.5 \cdot 1.0 \cdot 10^{-6}} = 2 \cdot 10^6\ (\Omega\text{m})^{-1}$$

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

20 The current I in a conductor as a function of time t is given as

$$I(t) = 5t^2 - 3t + 10$$

where current is in ampres A and t is in seconds s. What quantity of charge moves across a section through the conductor during the interval t=2s to t=5s?

Solution:

The current I is the time rate of transfer of charge across a cross section, so here we have

$$q = \int_{t_1}^{t_2} I(t)dt$$

Thus,

$$q = \int_2^5 (5t^2 - 3t + 10)dt = \left(\frac{5}{3}t^3 - \frac{3}{2}t^2 + 10t\right)\Big|_2^5$$

$$= \frac{5 \cdot 5^3}{3} - \frac{3 \cdot 5^2}{2} + 10 \cdot 5 - \left(\frac{5 \cdot 2^3}{3} - \frac{3 \cdot 2^2}{2} + 10 \cdot 2\right) = 193.5\ \text{C}$$

Answer: $193.5\ \text{C}$