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Física 3 - Ing. Luis Mijangos

HT 3

Problem 1 The definition of resistivity $\rho = E/J$ where assume E and J are in the same direction thus the vector part cancels. It seems that the Electric field is naturally exists inside a conductor, however if you have any measurement devices such as Voltmeter, you do not see any Voltage developed across the two terminals thus no Electric field (E = V/l). Please explain.

La falta de voltaje puede explicarse por definición. Primero la resistividad es muy pequeña en un conductor, es decir, no afecta en gran manera. Por otro lado, no hay diferencia de potencial, entonces no hay corriente y por lo tanto, los electrones no se están moviendo. Es por esto que que no hay campo eléctrico.

Problem 2 A cylindrical wire of length L and cross-sectional area A has a resistance R. Now if we double the length and triple the Cross-sectional area what could be the new resistance.

Sabemos que:

$$R = \frac{\rho L}{A} \tag{1}$$

Según el problema, tenemos $2L$ y $3A$, entonces:

$$\begin{aligned} R' &= \frac{\rho(2L)}{3A} \qquad (2)\\ &= \frac{2\rho L}{3A} \qquad (3)\\ &= \frac{2}{3}R \qquad (4) \end{aligned}$$

La nueva resistencia es $R' = \frac{2}{3}R$.

(5)

Problema 3 A wire with resistivity $\rho = 1{,}72 \times 10^{-8}\Omega m$ has cross sectional area $=$ $1{,}5 \times 10^{-7}m^2$. The current passing in this wire is 1.5 Ampere. Find the (a) Electric field developed along this wire (b) Potential difference of 100 metre apart and (c) the Resistance of 100 meter wire.

(a) El campo eléctrico

Sabemos:

$$J = \sigma E \quad \frac{1}{\rho} \qquad J = \frac{I}{A} \tag{1}$$

Entonces tenemos que:

$$\frac{I}{A} = \frac{1}{\rho}E \quad \Longrightarrow E = \rho\frac{I}{A} \tag{2}$$

Evaluando E:

$$E = (1{,}72 \times 10^{-8}\Omega m) * \frac{(1{,}5A)}{(1{,}5 \times 10^{-7}m^2)} = 0{,}172\frac{\Omega A}{m} \tag{3}$$

(b) Diferencia de potencial de 100 metros

Tenemos la ecuación:

$$R = \rho\frac{L}{A} = (1{,}72 \times 10^{-8}\Omega m)\frac{(100m)}{(1{,}5 \times 10^{-7}m^2)} = 11{,}47\Omega \tag{4}$$

Entonces tenemos que:

$$\Delta V = IR \tag{5}$$

$$V = (1{,}5A)(11{,}47\Omega) = 17{,}2V \tag{6}$$

(c) Resistencia de 100 metros de la cuerda

Tenemos la ecuación:

$$R = \rho\frac{L}{A} = (1{,}72 \times 10^{-8}\Omega m)\frac{(100m)}{(1{,}5 \times 10^{-7}m^2)} = 11{,}47\Omega \tag{7}$$

Problem 4 A Copper wire with linear resistivity coefficient is $0{,}00393C^{\circ -1}$ has a resistance at 0°C is 1Ω. What could be the resistance at 100°C. What could be percentage of increase of applied voltage $V(= IR)$ for the same currents in the circuit for this two temperatures.

Para encontrar la resistencia en 100°, sabemos que:

$$\rho(T) = \rho_0[1 + \alpha\Delta T] \tag{1}$$

$$\Longrightarrow \frac{L}{A}\rho(t) = \frac{L}{A}\rho_0[1 + \alpha\Delta T] \tag{2}$$

$$\Longrightarrow R(T) = R_0[1 + \alpha\Delta T] \tag{3}$$

$$R(100^\circ) = (1\Omega)[1 + (0{,}00393C^{\circ -1})(100^\circ - 0^\circ)] \tag{4}$$

$$R(100^\circ) = 1{,}393\Omega \tag{5}$$

Para encontrar el porcetaje que se incrementa el voltaje aplicado:

Se aplica una regla de 3:

$$\frac{\Delta V_0}{R_0} = \frac{\Delta V_{100}}{R_{100}} \tag{1}$$

$$\frac{R_{100}}{R_0} = \frac{\Delta V_{100}}{V_0} \tag{2}$$

$$\frac{R_{100}}{R_0} = \frac{1{,}393\Omega}{1\Omega} \tag{3}$$

$$\frac{R_{100}}{R_0} = 1{,}393 \tag{4}$$

Entonces:

$$\%\Delta = 1{,}393 - 1 = 0{,}393 = 39{,}2\,\% \tag{5}$$