Answer on Question #46033 – Physics – Electromagnetism

Question.

A copper wire has resistance of 2.0Ω at 0oC and 2.26Ω at 30oC. What is its resistance at50oC?

Given:

$R_1 = 2\ \Omega$

$T_1 = 0℃$

$R_2 = 2.26\ \Omega$

$T_2 = 30℃$

$T_3 = 50℃$

Find:

$R_3 = ?$

Solution.

As we know the resistance's dependence of temperature is expressed the following:

$$R = R_0[1 + \alpha(T - T_0)]$$

So, we must find the temperature coefficient α:

$$\alpha = \frac{1}{R_0}\frac{R - R_0}{T - T_0}$$

We can find the temperature coefficient α for this material, because we know R_1, T_1, R_2, T_2:

$$\alpha = \frac{1}{R_1}\frac{R_2 - R_1}{T_2 - T_1}$$

Therefore, we can define the resistance at any temperature:

$$R_3 = R_1[1 + \alpha(T_3 - T_1)] = R_1\left[1 + \frac{R_2 - R_1}{R_1}\frac{T_3 - T_1}{T_2 - T_1}\right. = R_1 + (R_2 - R_1)\frac{T_3 - T_1}{T_2 - T_1}$$

Calculate:

$$R_3 = 2 + 0.26\frac{50}{30} = 2 + 0.433 = 2.433\ \Omega$$

Answer.

$$R_3 = R_1 + (R_2 - R_1)\frac{T_3 - T_1}{T_2 - T_1} = 2.433\ \Omega$$