Answer on Question 59050, Physics, Electric Circuits

Question:

A copper wire has resistance of 2.0 Ω at 0℃ and 2.26 Ω at 30℃. What is its resistance at 50℃?

a) 2.43 Ω

b) 3.34 Ω

c) 1.52 Ω

d) 5.31 Ω

Solution:

As we know, the resistance change linearly with temperature (if the temperature T_1 does not vary too much):

$$R_1 = R_0[1 + \alpha(T_1 - T_0)],$$

here, α is the temperature coefficient of resistance for copper, $R_1 = 2.26\ \Omega$ is the resistance at the temperature $T_1 = 30℃$, $R_0 = 2.0\ \Omega$ is the resistance at the temperature $T_0 = 0℃$.

So, from this formula we can find the temperature coefficient of resistance for copper:

$$\alpha = \frac{1}{R_0} \cdot \frac{R_1 - R_0}{T_1 - T_0} = \frac{1}{2.0\ \Omega} \cdot \frac{2.26\ \Omega - 2.0\ \Omega}{30℃ - 0℃} = 4.3 \cdot 10^{-3}℃^{-1}.$$

As we know the temperature coefficient of resistance for copper, we can calculate the resistance at the temperature 50℃ from the same formula:

$$R_2 = R_0[1 + \alpha(T_2 - T_0)] = 2.0\ \Omega \cdot \left(1 + 4.3 \cdot 10^{-3}℃^{-1} \cdot (50℃ - 0℃)\right) = 2.43\ \Omega.$$

Answer:

a) 2.43 Ω