Answer on Question #45851 – Physics – Electric Circuits

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

2.43Ω
3.34Ω
1.52Ω
5.31Ω

Solution:
$R_0 = 2.0\Omega -$ initial resistance;
$T_0 = 0°C -$ initial temperature;
$R_1 = 2.26\Omega -$ resistance at temperature $T_1 = 30°C$
$R_2 -$ resistance at temperature $T_2 = 50°C$
$\alpha -$ temperature coefficient of resistance;

An intuitive approach to temperature dependence leads one to expect a fractional change in resistance which is proportional to the temperature change:

$$R_1 = R_0(1 + \alpha(T_1 - T_0))$$
$$R_1 = R_0 + R_0\alpha(T_1 - T_0)$$
$$\alpha = \frac{R_1 - R_0}{R_0(T_1 - T_0)} \quad (1)$$

Formula for the resistance at temperature $T_2 = 50°C$.

$$R_2 = R_0\big(1 + \alpha(T_2 - T_0)\big) \quad (2)$$
$$(1)\text{in}(2):$$
$$R_2 = R_0\left(1 + \frac{R_1 - R_0}{R_0(T_1 - T_0)}(T_2 - T_0)\right) =$$
$$= 2.0\Omega\left(1 + \frac{2.26\Omega - 2.0\Omega}{2.0\Omega(30°C - 0°C)}(50°C - 0°C)\right) = 2.43\ \Omega$$

Answer: 2.43Ω