

## Answer Question #65353 – Physics – Electric Circuit

A Tungsten filament for a light bulb is found to have a resistance of  $0.25\ \Omega$  when measured at a temperature of  $20^\circ\text{C}$ . When the light bulb has been on for a substantial period of time, the filament has heated up and the resistance is found to be  $3.50\ \Omega$ . What is the temperature of the heated filament? Tungsten's temperature coefficient of resistivity is  $4.5 \cdot 10^{-3}$  per degree C, and do not consider thermal expansion of the filament.

**Solution.** Temperature dependence of electrical resistance of tungsten filament bulbs excluding thermal expansion, it is possible to find a formula

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

where  $R = 3.5\Omega$  – resistance at temperature  $T$ ,  $R_0 = 0.25\Omega$  – resistance at temperature  $T_0 = 20^\circ\text{C}$ ,  $\alpha = 4.5 \cdot 10^{-3}$  per degree C – temperature coefficient of resistance.

Therefore

$$\frac{R}{R_0} = 1 + \alpha(T - T_0) \rightarrow T = T_0 + \frac{1}{\alpha} \left( \frac{R}{R_0} - 1 \right) \approx 2909^\circ\text{C}.$$

**Answer.**  $2909^\circ\text{C}$ .