Answer on Question #54321, Physics / Electric Circuits

The temperature at which the tungsten filament of a 12V and 36W lamp operates is 1730 °C. If the temperature coefficient of resistance of tungsten is 6 x 10^{-3} /K, find the resistance of the lamp at a room temperature of 20 °C.

Solution:

We know that power is

$$P = V * I$$

Therefore,

$$I = P/V = 36/12 = 3 A$$

The resistance at 1730 °C is

$$R = V/I = 12/3 = 4\ Ohm$$

Resistance values for conductors at any temperature other than the standard temperature (usually specified at 20 Celsius) on the specific resistance table must be determined through yet another formula:

$$R = R_{ref}\left[1 + \alpha(T - T_{ref})\right]$$

where

R = conductor resistance at temperature T

R$_{ref}$= conductor resistance at reference temperature (20 °C)

α = temperature coefficient of resistance for the conductor material

T = conductor temperature

T$_{ref}$ = reference temperature

Therefore

$$4 = R_{ref}[1 + (6 * 10^{-3})(1730 - 20)]$$

$$R_{ref} = \frac{4}{1 + (0.006)(1710)} = 0.355\ Ohms$$

Answer: 0.355 Ohms