

Interactive Problem Set 15, SP212 Spring 2013

Topic: 26.5 - 26.7 Resistance, Ohm's Law, Power

IPS 15 One long but interesting multi-part problem about a typical light bulb. I'll just enumerate below the question. Most incandescent lightbulbs are made of tungsten which is a type of metal. Here are some specs for our light bulb,

- length of tungsten filament $l = 53.3$ cm (Note: two stages of coiling pack this length over a visual length of about 2 cm!!!).
- Designed for a 120 V source.
- $T = 2900$ K at operating temperature.
- Power output of 60.0 W at operating temperature.
- Resistivity of tungsten at $T_0 = 293$ K (room temperature) is $\rho = 5.25 \times 10^{-8}$ Ωm .
- Temperature coefficient of resistivity is $\alpha = 4.5 \times 10^{-3}$ K^{-1} .

1. What is the filament's resistance at operating temperature, R ?
2. What is the current through the filament at operating temperature?
3. What is the filament's resistance at room temperature, R_0 ?
4. What is the current surge when the bulb is turned on?
5. What is the radius of the filament?

Note: The photosphere of the Sun has a peak power output in the visible at about 6000 K. This is why incandescent bulbs are inefficient: the lower operating temperature of the filament creates peak output in the infrared.

Prep for next class: WPC Chapter 27.