Problems

1. Using $P=V^2/R$, calculate the hot resistance of the filament of a 60 W, 100 W and 200 W light bulb.

2. For these three bulbs, determine the current through each of the filaments when the light bulb is on.

3. The filament resistance when the light bulb is on is 15 times greater than its room temperature resistance. Determine the room temperature filament resistance of the three bulbs above.

4. The diameter of the filament of a 60 W, 100 W and 200 W bulb are 0.0046 cm, 0.0064 cm and 0.0102 cm respectively. Using the equation $R=\rho L/A$ and the fact that the room temperature resistivity of tungsten is 5.7×10^{-6} ohm-cm, determine the length of the filament of each of the three bulbs above.

5. Using the information determined above, calculate the temperature of the filament of each of these bulbs using the Stefan-Boltzmann law, assuming that the emissivity ε of tungsten is 0.3. Recall that the law is $P/S=\varepsilon\sigma T^4$, where S is the surface area of the filament, and the Stefan-Boltzmann constant σ is 5.67×10^{-12} W/(cm^2-K^4). Assume that the power dissipated in the filament as heat is all reemitted as radiation.

6. The lowest 2 wattages of a 3 way bulb are 25 W and 75 W. Determine the resistance of the filament when it is on at the highest wattage setting of the bulb.

7. Some people claim that if you are going to turn a lamp back on within one hour or so, then it is better to keep the lamp on (and not turn it off and then on again an hour later) because most of the energy is used when you first turn it on. Is this true? Is it more energy efficient to always turn off a light when you leave a room?