Reading Assignment:

Cheng: Chapter 5, plus my notes on Conduction, Metals, and Joule Heating (web site)
Cartoon Guide: Chapters 15-16

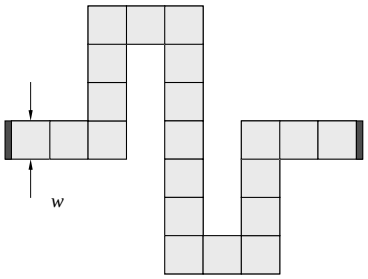
Homework #4 Due: Friday 23 October 2009

1) Do Problem P.5-8 in Cheng

2) Do Problem P.5-10 in Cheng

3) Do Problem P.5-14 in Cheng

4) Consider the meander-line resistor shown (top view) at right. The device is to be fabricated using an evaporated film of nichrome with $\rho = 100\,\mu\Omega\cdot\text{cm}$. Find:
   a. The required film thickness in order to achieve a sheet resistance of $r_{sh} = 50\,\Omega/\square$.
   b. The total resistance of the structure,
   c. The minimum line width w that will keep the current density below a critical value of 10^5 A/cm^2 if the maximum applied voltage is 10 V.



5) Suppose you want to install a hot tub in your back yard, requiring a wiring run of about 10 meters from the electrical entrance to your house. The hot tub requires a 220V, 50A circuit. What is the minimum wire gauge you should use to meet the requirement of <2% voltage drop?

6) A ¼ Watt resistor is surrounded by still air at room temperature (20 °C). The resistor is approximately cylindrical with a length of 20 mm and a radius of 1 mm. How hot will it get if operated at the maximum rated power level, assuming a convection coefficient of $h = 500$ W/m$^2\,^\circ$C? Express your answer in both Celsius and Fahrenheit.

7) Calculate the steady-state temperature of the tungsten filament in a 60 Watt light bulb during normal operation in a room-temperature environment, assuming that the effective surface area of radiation is a cylinder of length $L = 53.3$ cm and diameter $d = 46\mu m$ and emissivity $e = 0.35$.