PHYS 161
Summer 2012
Homework Assignment #4
Due June 29

#1 An electrical conductor designed to carry large currents has a circular cross section $3.00\,mm$ in diameter and is $12.0\,m$ long. The resistance between its ends is $0.250\,\Omega$. (a) What is the resistivity of the material? (b) If the electric-field magnitude in the conductor is $1.75\,V/m$, what is the total current? (c) If the material has 8.5×10^{28} free electrons per cubic meter, find the average drift velocity under the conditions in part (b).

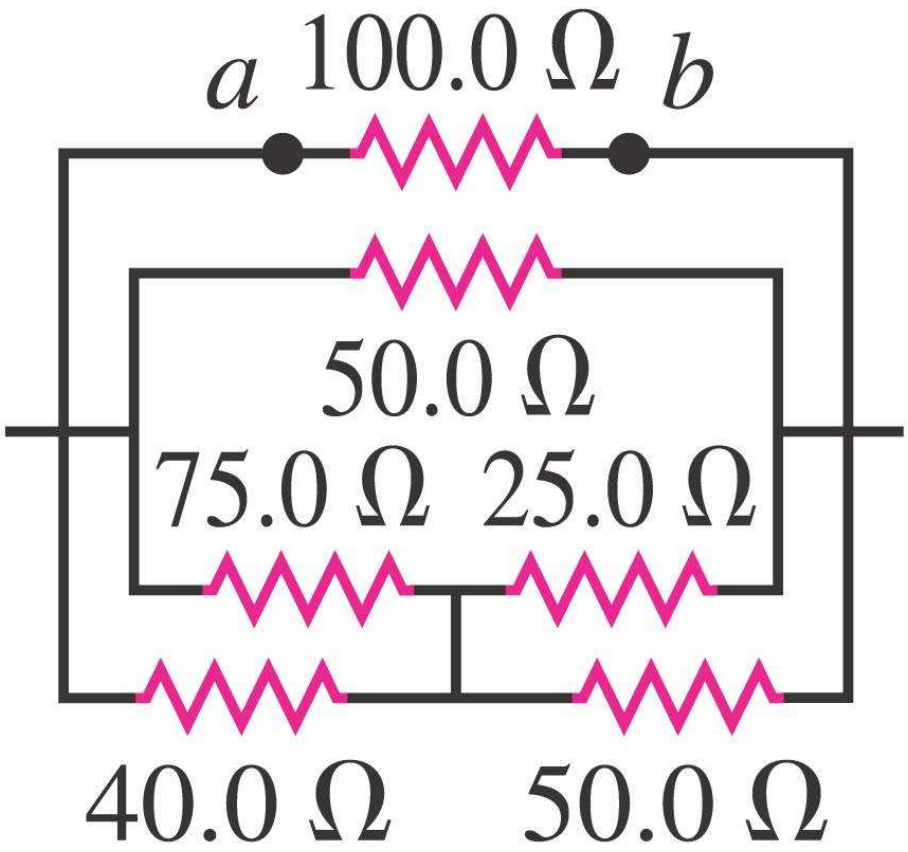
#2 A 5.00-m long length of copper wire at $20^\circ C$ has a 2.20-m long section with diameter $1.60\,mm$ and a 2.80-m-long section with diameter $0.65\,mm$. There is a current of $3.5\,mA$ in the 1.60-mm-diameter section. (a) What is the current in the 0.65-mm-diameter section? (b) What is the magnitude of E in the 1.60-mm-diameter section? (c) What is the magnitude of E in the 0.65-mm-diameter section? (d) What is the potential difference between the ends of the 5.00-m length of the wire?

#3 The average bulk resistivity of the human body (apart from surface resistance of the skin) is about $5\,\Omega \cdot m$. The conducting path between the hands can be represented approximately as a cylinder $1.3\,m$ long and $0.16\,m$ in diameter. The skin resistance can be made negligible by soaking the hands in salt water. (a) What is the resistance between the hands if the skin resistance is made negligible? (b) What potential difference between the hands is needed for a lethal shock current of $100\,mA$? (Note that your results shows that small potential differences produce dangerous currents when the skin is damp.) (c) With the current in part (b), what power is dissipated in the body?

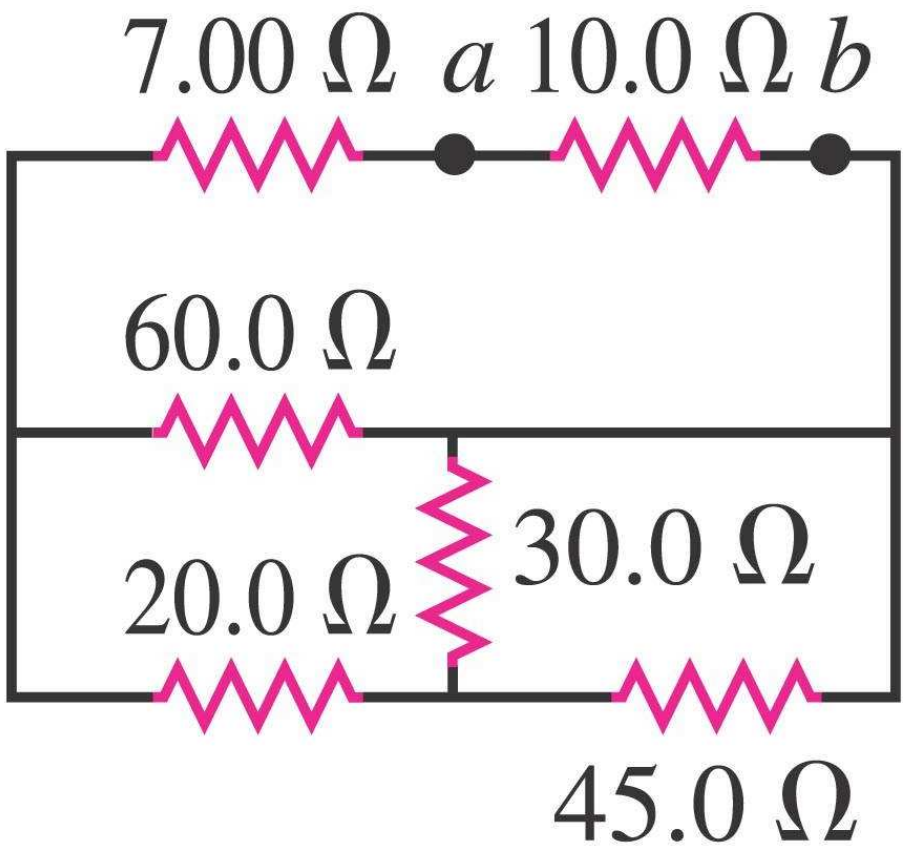
#4 A 16.0-V battery with negligible internal resistance is connected to a series combination of a 5.2-Ω resistor that obeys Ohms law and a thermistor that does not obey Ohms law but instead has a current-voltage relationship $V = \alpha I + \beta I^2$, with $\alpha = 4.0\,\Omega$ and $\beta = 1.8\,\Omega/A$. What is the current through the 5.2-Ω resistor?

#5 Two identical 2.00-Ω wires are laid side by side and soldered together so they touch each other for half of their lengths. What is the equivalent resistance of this combination?

#6 If an ohmmeter is connected between points a and b in the circuit shown, what will it read?



#7 If an ohmmeter is connected between points a and b in the circuit shown, what will it read?



#8 A triangular array of resistors is shown in Fig. E26.5. What current will this array draw from a 16.0 V battery having negligible internal resistance if we connect it across (a) ab; (b) bc; (c) ac? (d) If the battery has an internal resistance of 6.00Ω, what current will the array draw if the battery is connected across bc?