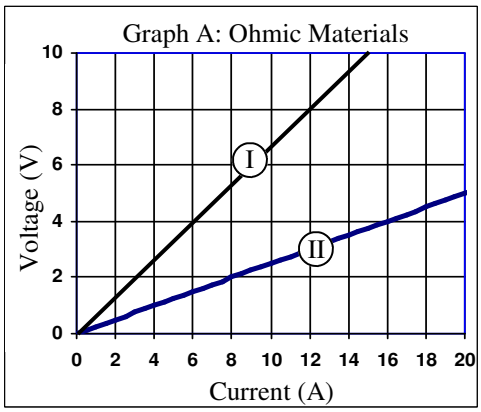
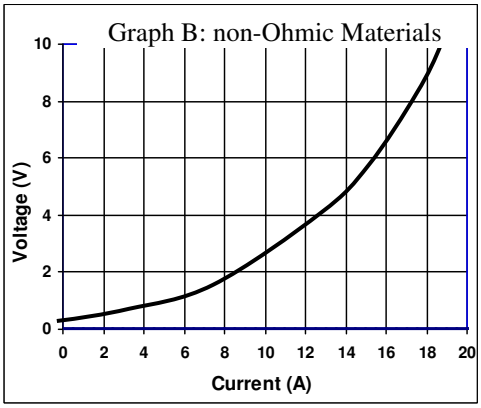
Due Mon, Jan 2

2011-12 PreAP Circuits 3

Since some of you haven't finished the lab, let's learn about resistance.

Let's learn about factors that affect resistance.





Wire length: longer wires have more resistance. Why? Longer wire = more collisions for the electrons = more resistance. It is like walking thru a low tunnel where you have to walk bending over. The longer the tunnel, the harder it is to get thru.

Temperature: material tend to have higher resistance at higher temperatures. Why? Higher temperature = molecules of the conductor moving faster = more collisions for the electrons = more resistance. Like walking thru a hall of people. If they are moving it is harder to get thru. Cold = less motion.

Wire thickness (or cross sectional area): thicker wires have less resistance. Why? Wider wire = more paths for the electrons to flow = less resistance. Like walking thru a wide hall (big cross sectional area) vs a narrow hall (small area). [A tube has a circular cross sectional area. A box has a square cross sectional area.]

Material: certain materials have better conductivity. Starting with the best conductor: Conductors: (Silver; Copper; Gold; Aluminum; Tungsten; Iron) Semiconductors: (Carbon; Silicon; Germanium); Insulators: (Air; Rubber; Paper; Plastics; Glass). So a good conductor is a bad insulator and vice versa.

So, resistance is directly proportional to wire length and temperature and inversely proportional to wire thickness (cross sectional area).

Superconductors—materials that have very low or no resistance below a certain temperature. This temperature is known as the critical temperature. A superconductor is a MUCH better conductor than even silver or copper (it's SUPER!).

Ohmic vs non-ohmic materials: Many materials follow Ohm's Law: R = V/I. As the voltage increases, the current increases at the same rate OR the resistance stays constant. A non-Ohmic materials may increase its resistance as the current increases (like many light bulbs). Graph A shows two different Ohmic materials; Graph B shows a non-Ohmic material.

1. Would the resistance increase or decrease?

   A. ____ Using a shorter wire.
   B. ____ Cooling the wire.
   C. ____ Using a thicker wire.
   D. ____ Changing from gold to silver.

2. For each of the following pairs, circle the one with the greatest resistance.

   A. A 25 Ω resistor at 5°C or at 25°C?
   B. A 5 cm long wire or a 5 meter long wire?
   C. A wire with a cross-sectional area of 3 cm^2 or 6 cm^2?
   D. Aluminum wires or Copper wires?
   E. Silver wires or wires made with a superconductor?
   F. An insulator or a conductor?

   Remember that in ANY equation that has division means slope. Ex: V = D/T so slope of distance vs time graph = Velocity. Ex: W = Fd so F = W/d and force would be the slope of a Work vs distance graph.

3. Calculate the resistance of material 1 on Graph A above.

4. Calculate the resistance of material 1 on Graph A above.

5. Material 1 or Material 2 on Graph A above:
   A. Would be a wire at a lower temperature?
   B. Would be a longer wire?

6. What moves thru the crystal lattice of a metal conductor: protons or electrons?
7. * When these electrons move thru a conductor, is there a straight and unobstructed path or are there other atoms in the way?
8. * So, is the path of an electron (and therefore electricity) a straight path or a zigzag path?
   This is why it actually takes an electron about 68 minutes to move 1 meter thru a conductor.

9. * When you open a water faucet in your house, do you have to wait for the water to come all the way from the pipe in the street or does it come out immediately?
10. When you turn on a device that uses electricity (like a light bulb or radio) does it take time for the device to come on or does it take a while to come on?

    Why? Aren't there electrons already in the metal wires? When you turn on a circuit, you just push electrons into one side, which push all the conducting valence electrons (not the inner electrons) along the wire and the electrons at the end of the wire move out. It is virtually instantaneous.

    Review Question:

11. * A projectile is shot 120 m/s at an angle of 30 degrees. Calculate the time it is in the air and its range. (*I will look for work, not just the answer.)*

Q7) other atoms (they bump along)
Q8) zigzag
Q9) immediately
Q11) t ground to ground = 12.2 sec X = 1272 m