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Resistors and Resistance

Introduction

You will be ahead of the game when it comes to the study of electricity if you understand Ohm's Law. Ohm's law can be summed up with one simple equation: **Resistance * Current = Voltage** or

V = IR volt = ampere * ohm (eq. 1)

A neat trick to remembering this formula is to think of a **V**ulture, an **I**ndian, and a **R**abbit. In the formula above the **V**ulture sees the **I**ndian standing beside the **R**abbit. If you rearrange the formula to solve for Resistance then

R = V/I ohm = volt/ampere (eq. 2)

and in this case, the **R**abbit sees the **V**ulture flying above the **I**ndian.

You can see from the last formula that Resistance is defined as the ratio of the potential difference (voltage) to current (amperage). When resistors are connected in SERIES their resistances are additive.

$$R_{total} = R_1 + R_2 + R_3 \ldots. \text{ (eq. 3)}$$

Determining total resistance for resistors in parallel is trickier:

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_N}$$

The common inexpensive resistors that you will be using in this lab are made of a carbon-clay mixture which has been heated to form a ceramic. The actual resistance (in ohms) can be controlled by varying the amount of each ingredient as well as the size of the resistor. The resistance of these resistors is indicated by a series of colored bands. The color code is interpreted below.

Color	indicated digit	Metallic band	tolerance
Black	0	Gold	5%
Brown	1	Silver	10%
Red	2	None	20%
Orange	3		
Yellow	4		
Green	5		
Blue	6		

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Violet	7		
Gray	8		
White	9		

Always read the metallic band LAST. The first two bands indicate the first two digits in the number. The third band indicates the number of zeros to add to the end of the number. The last band tells you how sure you can be about that number. The tolerance is the maximum error above or below the stated number that the actual number of ohms may be. For example:

Blue Red Orange Silver

6 2 000 10%

62000 ohms +/- 6200 ohms. So the actual resistance of that resistor may be anywhere from 55800 to 68400 ohms.

Materials

Three resistors, multi-meter, breadboard, alligator clips, battery pack

Procedure

1. Obtain 3 resistors and use the color code to determine the resistance and tolerance of each. **Record your data**
2. Use the ohmmeter to read the resistance of each resistor. **Record your data.** Are your readings within tolerance?
3. Calculate the resistance of the three resistors in series.
4. Connect the resistors in series using the breadboard and read the actual resistance with the ohmmeter. Does the reading agree with the calculated value?
5. Calculate the resistance of the three resistors in parallel.
6. Connect the resistors in parallel using the breadboard and read the actual resistance with the ohmmeter. Does the reading agree with the calculated value?

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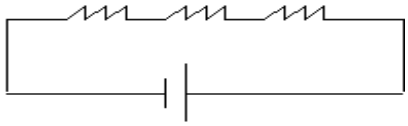
7. Using the breadboard, again connect the resistors in series. Use the alligator clips to connect the resistors to the battery pack as shown below.



8- Use this set-up to make both voltage and current readings for each resistor with the multi-meter. Use Ohm's law calculate the resistance for each resistor. (Eq. 2). How does this compare with both earlier determined resistances?

9. Connect the two larger resistances in parallel. Then connect the parallel branch in series with the smaller resistor. Draw a figure for this set-up in your lab report. Compute the resistance of the network using eq. 3 and 4. Then measure the actual resistance with the ohmmeter. How close are the two readings?

The Lab Report Don't forget to record all of your data. That means every little minute number that you happen to measure, determine or use in the course of the lab. Show all of your calculations clearly and be sure to address any questions hidden throughout the procedure with a complete sentence or clear diagram.