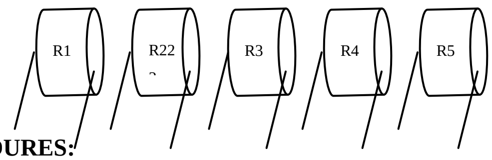
Ohm, Ohm on the Range

Name______________ Partners______________ Date completed______

Resistance is defined as the ratio of voltage to current, however, objects have resistance whether or not a voltage is applied to them. To calculate the resistance of an object we need to think about what factors affect the ease or difficulty of an electron traveling down a conductor. The **length** of an object and its resistance are directly proportional to one another. Since we know some materials like copper and silver are good conductors while others, such as plastic or ceramics, are poor, there apparently is a factor for type of material. This shows up in the term **resistivity** (ρ) measured in Ω–m. The wider the conductor is the less resistance it offers (think about it as more path ways for the e^- to choose) so **cross-sectional area** of the conductor is inversely related to resistance. Finally, **temperature** is also a factor in resistivity so resistance is seen to increase with increasing temperature.

$$\mathbf{R = \rho L / A}$$



PROCEDURES:

1. Hook up one of the power supply leads (power off!) to a terminal of the resistor coil no.1 while the other one is connected to an ammeter and then the 2nd resistor terminal. Place a voltmeter in position (parallel to the resistor) to measure total voltage. Have **each** group member check the circuit to make sure electrons are going into the black of any meter before asking me check your circuit.
2. Turn on the power supply *very* slowly and watch the ammeter until a reading of 0.3 A results. Record both the current reading and voltmeter reading in the space provided for R no. 1. Repeat for current readings of 0.6 A, 0.9 A, and 1.2 A.
3. Repeat for resistor coil nos. 2 – 5.

I (A)	V_{R1}	V_{R2}	V_{R3}	V_{R4}	V_{R5}
0.30					
0.60					
0.90					
1.20					

ANALYSIS:

4. Calculate the ***theoretical resistance*** for each coil using the equation above. The resistivities for copper and copper-nickel wire can be found in the Handbook of Chemistry and Physics and are as follows:

$$\rho_{copper} = 1.724 \times ^{-8}\ \Omega\text{–m} \quad \text{AND} \quad \rho_{copper\ nickel} = 28.0 \times ^{-8}\ \Omega\text{–m}$$

The diameters of the 1st, 3rd and 5th coils are 6.439×10^{-4} m, and the diameters of the 2nd and 4th coils are 3.211×10^{-4} m. The lengths of the 1st, 2nd, and 5th coils are 10 meters, while the 3rd, and 4th coils are 20 meters each. Be careful you calculate cross-sectional area using $A = \pi\,(d/2)^2$.

5. Plot voltage vs. current for each coil on the same set of axes (using a different color or symbol for each coil).

6. Calculate the slope of each best-fit line (which gives the ***experimental value for resistance*** of each coil).

Resistor Coil	Theoretical Resistance	Experimental Resistance	Percent Difference
No. 1			
No. 2			
No. 3			
No. 4			
No. 5			

CONCLUSION:

1. What effect on resistance would each of the following have:
   a) doubling the resistor's length?
   b) doubling its cross-sectional area?
2. What does the slope of a <u>voltage vs current</u> graph represent?
3. How well do your experimental and theoretical resistances compare?
4. Explain whether or not you resistors appear to follow ohm's law. That is, do the <u>voltage vs current</u> graphs remain linear throughout the experiment?
5. What sources of error may have been present?