

## IB Physics SL2 Resistivity Copper Wire vs. Pencil Lead (graphite)

Copper wire is a well known electrical conductor which therefore has a low resistivity of  $\rho = 1.7 \times 10^{-8} \Omega \text{ m}$ . It comes in different gauges (diameters) so we can test the resistance of different lengths and cross-sectional areas in an attempt to calculate the resistivity to see how close we come to the accepted value.

Graphite is a semi-metallic conductor and is a constituent of the lead in a pencil. Another constituent in the graphite is clay. It is the ratio of graphite to clay that determines the “hardness” of the pencil. This experiment enables you to estimate the resistivity of the graphite.

$$R = \frac{\rho L}{A}$$

$\rho$  = resistivity  
 $L$  = length  
 $A$  = cross sectional area

If you would like to do your own experiment at home, you may have a multimeter, or you may want to buy one. Some are quite affordable and you can donate yours to Nido after you graduate if you want! :) This device can do many things, but when it tests resistance, all you have to do is touch the two leads to either end of a wire or pencil lead, the meter will send a very tiny bit of current (undetectable by you) through the length of wire/lead, and detect how much is making it through to the other side in a given amount of time. **DO NOT CONNECT THE WIRE/PENCIL LEAD TO AN EXTERNAL BATTERY OR YOU WILL FRY THE METER!!**



Directions: Write down the data taken in class and organize it into a raw data table. Make sure to include the uncertainties for the lengths and the resistance measurements. We will do three trials for each wire/lead.

Then transfer the data to Loggerpro and make a graph (linear) so that the SLOPE of the straight line represents the resistivity  $\rho$  of the material. You can make one graph for copper and a separate graph for pencil lead (graphite)

Include error bars / Min / Max lines on each graph. Remember the DIFFERENCE between the respective slopes of the Min / Max lines should be an estimate of the uncertainty of each estimate resistivity.

I have given you the accepted value for the resistivity of copper. You will need to look up the same value for graphite. Now you can calculate the % error for each material.

Suggest a reasonable systematic and random error that might occur in this procedure and how this could affect the data.

Submit your lab (individually) to the RESISTIVITY assignment in Turnitin.com before the due date.