Objectives
- Collect and graph volume and mass data to find the density of copper
- Measure the length and volume of a copper wire and calculate its diameter
- Calculate percent errors for the results

Pre-lab
1. What is the equation used to calculate density?
2. How can you find the volume of a solid which has an irregular shape?
3. What is a meniscus and how does it affect volume readings?
4. How do you find the slope of a best-fit line?
5. If you plot volume (x) versus mass (y), what property of matter will the slope of the best-fit line represent?
6. A piece of copper wire is a narrow cylinder. The equation for the volume of a cylinder is
   $$V = \pi r^2 h$$
   where *V* is volume, π is a constant with the value of 3.14 or 22/7, *r* is the radius of the cylinder, and *h* is the height or length of the cylinder. Rearrange the equation to solve for the radius.
7. What is the relationship between the diameter and the radius of a cylinder?

Procedure
1. Pour about 15 mL of tap water into a 25-mL graduated cylinder. Record the actual volume to the appropriate place.
2. Obtain the mass of an empty cup to the proper place. Add about 10 g of copper shot from the other cup to the cup on the balance and record the mass.
3. Pour the copper shot from the cup on the balance into the graduated cylinder and record the new volume of water.
4. Repeat steps 2 and 3 and determine the total volume of water that is in the graduated cylinder after step 3.
5. Repeat step 4 until approximately 40 g of copper shot have been added to the graduated cylinder.
6. Keep a running total of mass of copper shot and of water.
7. Carefully drain the water from the graduated cylinder and catch the copper shot pieces on a paper towel. Dry the shot as best you can and leave it in one of the paper cups.
8. Obtain a piece of 18-gauge copper wire and a piece of 22-gauge copper wire. Use a ruler to measure the length and diameter of each wire in cm.
9. Wrap each wire around a pencil or pen to form a coil. Remove the coils from the pencil or pen and record the mass of each coil.

Post-lab
1. Make a graph plotting running total volume (mL) on the x-axis and running total mass (g) on the y-axis.
2. Draw a best-fit line. Use two points on your line of best-fit to calculate the slope of your line.
3. Calculate the percent error for your observed value of density given that the accepted density of copper is 8.92 g/cm³.
4. Use the accepted density of copper the mass of each wire to calculate the volume of each wire.
5. Use the equation for volume of a cylinder to compute the radius of the wires. Determine the diameter of each wire in cm.
6. Calculate the percent error for your diameter values given that the accepted diameters are 0.0644 cm for the 22-gauge wire and 0.102 cm for the 18-gauge wire.

You should use the following checklist to make sure that you have all that is required in your lab report:

Group Members (1)

☐ Title (1)

☐ Objectives (3)

☐ Hypothesis (1)

☐ Materials (4)

☐ Experimental Design (8)

☐ Data Tables (18)

☐ Results: *This will involve doing Post-lab #1-6 while showing all calculations!* (20)

☐ Conclusion: *Remember to give reasons for support or lack of support of your hypothesis* (2)

☐ Suggested improvements to experimental procedure (2)