Laboratory Investigation Name _____

Chemistry: Form L1.3A Date _____ Period _____

Measuring Density by Graphing

PROBLEM

How can graphing be used to help measure density?

INTRODUCTION

An object's density is its mass divided by its volume (***D = m/V***). Mass and volume are both characteristics that can be measured in the laboratory. But, like all measurements, these values will be associated with slight errors of measurement. By graphing these values and drawing the best straight line or curve, the errors are taken into account. In this laboratory exercise, you will measure the masses and volumes of several samples of pennies, and you will use graphing to determine the pennies' average density.

MATERIALS (*per group*)

Balance; graduated cylinder; paper towels; pennies (50)

PROCEDURE

1. Obtain 50 dry pennies.

2. Using a balance, measure the mass of five pennies together, and record the result in your data table.

3. Measure the volume of the pennies by water displacement as follows: (a) Fill a graduated cylinder partway with water. There should be enough water to cover the pennies. Record the initial volume of the water. (b) Put the pennies into the water in the graduate. This will cause the water level to rise. Record the final volume of the water. (c) subtract the initial volume of the water from the final volume of the water to find out how much water the pennies displaced. This is the volume of the pennies. Record your result. Then set these pennies aside on a paper towel to dry. Do *NOT* reuse them during this laboratory investigation.

4. Repeat steps 2 and 3 with 10, 15, and 20 pennies. Use only dry pennies to measure the mass in step 2. Use the same pennies whose mass you measured in step 2 to measure the volume in step 3.

5. Prepare a suitable graphing space to plot your data. Select the proper axes, origin and intervals. After you have prepared your graphing space, plot your data points with ***Volume*** on the horizontal or *X*-axis and ***Mass*** on the vertical or *Y*-axis.

6. Draw the best straight line through the points. The ***best*** straight line will have points scattered above and below it because of random errors of measurement. In this case, the best straight line should also pass through the point (0,0).

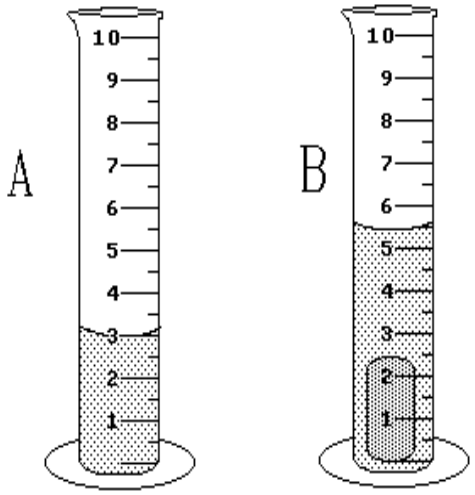

Figure 1. *(**A**) a graduated cylinder containing only water; (**B**) the water level rises after an object is dropped into the water.*

7. Find the density by finding the slope (m) of the line. Pick two points on the line. The difference between the Y-values of the points is the change in Y (ΔY). The difference between the X values of the points is the change in X (ΔX). The slope is the change in Y divided by the change in X ($m = \Delta Y/\Delta X$).

OBSERVATIONS

Number of Pennies	Mass	Volume		
		Initial	Final	Pennies
5				
10				
15				
20				

Density of the Pennies (Slope of Best Straight Line) . . . . . _____

CONCLUSIONS

1. Why is the slope of the line the density of the pennies? (*HINT:* Slope is $\Delta Y/\Delta X$. Which variables are on the Y-axis and on the X-axis?) _____

2. Why does the graph pass through the point (0,0)? _____

3. Why is it necessary to make sure the pennies are dry before measuring their masses? _____

4. The percentage error is the error of measurement divided by the magnitude (size) of what is being measured. Referring to percentage error, explain why five pennies is the smallest number of pennies measured in this laboratory exercise rather than one. _____

5. How do you measure volume by water displacement? _____

6. How can graphing be used to help measure density? _____