CHEMISTRY I LAB: DENSITY

WHAT TO TURN IN:
Hypothesis, Data Table 1, Data Table 2, Calculations, Graph, Questions #1-8

OBJECTIVES

- To measure the mass and volume of samples of two different metals
- To calculate the density of unknown metals
- To graph the combined class data and use the data to determine whether there is any constant relationship between the mass and the volume of a given substance

INTRODUCTION

Mass is a measurement of the amount of matter in a sample, while volume is a measurement of the space occupied by a sample of matter. Mass measurements are made on different types of balances. An electronic balance is commonly used because it gives fast results on a digital display.

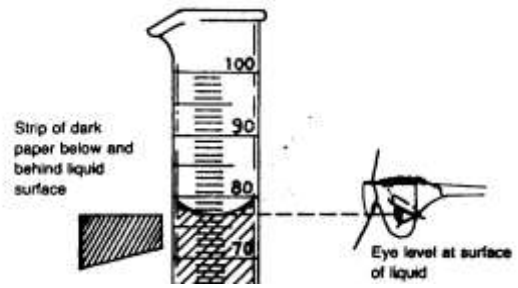
Volume measurements are made in different ways depending upon the physical state of the sample being measured. The volume of a liquid is commonly measured in a graduated cylinder. The surface of the liquid curves upward where it contacts the cylinder walls. This curved surface is called a *meniscus*. Measurement of volume in a graduated cylinder is always made by reading the mark at the bottom of the meniscus with the eye positioned at the level of the liquid surface.

The volume of a solid may be calculated from its dimensions (LxWxH), if the solid is regular and free of air space. However, if the solid is irregular or contains air space, its volume must be determined in another way, such as by *water displacement*.

PROCEDURE

1) Obtain clean, dry samples of three different metals. Write down which unknowns you have; they correspond to the answer key.
2) Measure the mass of each metal, using the maximum number of decimal places allowed by the balance. Record in Data Table 1.
3) Measure the volume of each metal separately:

a) Fill a graduated cylinder halfway with sink water.
b) Tap out any air bubbles.
c) Record initial volume to 0.1 mL in Data Table 1.
d) Tilt the cylinder gently and slide the metal into it. It must be submerged.
e) Tap out any air bubbles.
f) Record final volume to 0.1 mL in Data Table 1.



4) When finished, carefully pour out the water and metal into your hand. Dry the metal samples and give them to the teacher.

CALCULATIONS

1) Calculate the volume of *each* of the metals you tested:
VOLUME of metal = (FINAL VOLUME) – (INITIAL VOLUME) in mL
2) Calculate the density of *each* metal by **DENSITY = MASS / VOLUME**. Use the proper units and sig.figs.
   - Record your individual lab station data on the "Class Data Table."
   - Choose *one* of your unknown metals to graph. Copy down all class data pertaining to that metal.
   - Set up a graph. Be sure to title it.
   - Plot a graph of the class data using **MASS as y axis** and **VOLUME as x axis**.
   - Use a ruler to draw the "best-fit line" through the data points and (0,0).

3) Determine the slope of your line by choosing two points *directly on the line*:

$$\textbf{SLOPE} = \frac{\textbf{RISE}}{\textbf{RUN}} = \frac{y_2 - y_1}{x_2 - x_1}$$

- The slope of the line is the density of the metal (M/V). Record slope in Data Table 2.
- Look at the class density of the unknown metal you graphed, which is the slope.
- Examine your own lab group's density for the same unknown.
- Record the standard density, given by the teacher, of the unknown that you graphed.
- Calculate two percent errors:

$$\textbf{\% ERROR OF CLASS} = \frac{\textbf{STANDARD} - \textbf{CLASS DENSITY}}{\textbf{STANDARD}} \times 100$$

$$\textbf{\% ERROR OF YOUR LAB GROUP} = \frac{\textbf{STANDARD} - \textbf{GROUP DENSITY}}{\textbf{STANDARD}} \times 100$$

DATA TABLE 1: MASS, VOLUME, DENSITY DATE:_____

	METAL ____	**METAL _____**	**METAL _____**
mass (g)	_____	_____	_____
initial volume of water (mL)	_____	_____	_____
final volume of water (mL)	_____	_____	_____
volume of metal (mL)	_____	_____	_____
density of metal (g/mL)	_____	_____	_____

DATA TABLE 2: DENSITY AS A SLOPE FUNCTION DATE:_____

Which unknown metal was graphed? (A, B,C, D…)	_____
slope of the line	_____
standard density value of the graphed unknown (from teacher)	_____
class percent error	_____
lab group percent error	_____

QUESTIONS

1) Why does a pure substance always have the same density?
2) What was the unit of mass used in this lab?
3) What was the unit of volume used in this lab?
4) Describe how water displacement works.
5) What is a meniscus?
6) Can density be used as identification for substances in lab? Why or why not?
7) Which was more accurate, your own lab group data or the class data?
8) What may have caused experimental errors?