Name _____ **Honors Chemistry** **___/___/___**

Introduction to Quantitative Measurement: Density Determination

The study of chemistry involves not only observing changes in matter, but also measuring these changes. In fact, most chemical principles cannot be fully understood without obtaining and analyzing some quantitative data. The techniques of data collection, data analysis, and measurement are an important part of chemistry.

Careful attention should be given to the degree of uncertainty in your measurements. Use only those digits that are significant in your calculations in this experiment and in all of the other quantitative experiments that follow.

The **accuracy** of your methods can be reported with your results in terms of percent of error. The percent of error in calculations and measurements is a comparison of the differences between experimental results and theoretical values (as determined by scientists), expressed as a percentage. **Percent error** can be determined using the formula below.

$$\% \text{ Error} = \frac{|\text{theoretical yield} - \text{experimental yield}|}{\text{theoretical yield}} \times 100.$$

In conducting this experiment, you will make several mass and volume measurements and use these measurements to determine the density of water, an unknown liquid, and an unknown solid. You will then determine the precision of your results by calculating the percent error.

Objectives:

* Determine the density of different substances from mass and volume measurements
* Calculate the percent error in your results

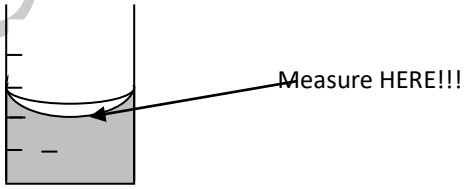
Equipment:

2 graduated cylinders (10 ml & 100 ml)	beaker 250 ml	ruler
balance	lead sinker	large aluminum solid

Procedure:

A. Density of Water

1. Measure the mass of a beaker to the nearest 0.01 g.
2. Use the balance to be sure you have added approximately 50.00 g of distilled water to the beaker.
3. Pour the water into a 100 ml graduated cylinder. Read the **bottom** of the meniscus as shown in the figure to the right. **Record volume to the tenths place**
4. Calculate the density of water.



B. Density of ethyl alcohol

1. Measure the mass of a 10.0 ml graduated cylinder.
2. Fill the graduated cylinder with approximately 7.00 ml of ethyl alcohol. Record the exact volume used **to the hundredths place**.
3. Measure the mass of the cylinder and its contents carefully and record.
4. To find the mass of the alcohol, subtract the mass of the graduated cylinder from the mass of the graduated cylinder and the alcohol.
5. Pour the alcohol in the waste container. Wash the graduated cylinder.
6. Calculate the density of the alcohol.

C. Density of a Solid by Displacement

1. Fill the 10 ml graduated cylinder with approximately 5.00 mL water. **Record its volume to the hundredths place**.
2. Carefully lower the sinker in the 10 ml graduated cylinder. Record its new volume.
3. To find the volume of the sinker subtract the volume of the water from the volume of the sinker plus the water.
4. Place the sinker on the balance and record its mass.
5. Calculate the density of the sinker.

D. Density of a Large Solid

1. Find the mass of the large solid.
2. Find the volume by measuring (in centimeters) the length, width, and height.
3. Calculate the density of the sinker.

Data Tables: USE SIGNIFICANT FIGURES IN ALL CALCULATIONS!

Part A. Theoretical values: water 1.00 g/mL

Materials	Mass (g)	Volume (mL)	Density (g/mL)	Percent Error (%)
beaker	92.08			
beaker + water	151.01			
water		58.2		

Part B. Theoretical values: ethyl alcohol 0.79 g/mL

Materials	Mass (g)	Volume (mL)	Density (g/mL)	Percent Error (%)
graduated cylinder	12.44			
cylinder + alcohol	18.39			
ethyl alcohol		5.15		

Part C. Theoretical values: lead 11.4 g/mL

Materials	Mass (g)	Volume (mL)	Density (g/mL)	Percent Error (%)
water		5.05		
water + sinker		6.77		
solid sinker	6.66			

Part D. Theoretical values: aluminum 2.70 g/mL

Length(cm)	Width (cm)	Height(cm)
6.66	3.33	1.11

Materials	Mass (g)	Volume (cm^3)	Density (g/cm^3)	Percent Error (%)
large solid object	67.70			