

Lab - Density Measurement

Objective: To become familiar with various tools of laboratory measurement. To understand the ideas of *accuracy*, *precision*, *qualitative* and *quantitative* measurement, tool uncertainty, and *significant figures*. To measure the density of four unknown materials as accurately as possible and to make a hypothesis, based on your measurements, as to what each material is.

Materials:

density samples digital scale grains of rice
 100-mL graduated cylinder tennis ball

Procedure/Data:

Making qualitative observations

- Make *qualitative* observations about your four materials. Record your answers. Predict what material each substance is.

	Qualitative observations	Prediction
Material #1		
Material #2		
Material #3		
Material #4		

Tool Precision and Uncertainty

- Whenever using lab tools to take measurements, it is important to know the limitations (precision) of your tools. Tools are made to measure to a certain precision. The scientist using the tool then makes an estimate one place beyond the precision of the tool. This is called *uncertainty*.
- Record the precision and uncertainty of the following lab tools. In the next column of the table determine the place of uncertainty that you should measure to.

	Precision	Uncertainty
Digital scale		
Graduated cylinder		

Quantitative Measurements: Measuring Volume

- Use the graduated cylinder to measure the volume of your four samples as accurately as possible. Be sure to read all measurements at the bottom of the meniscus formed by the fluid.

	vol (mL)
Material #1	
Material #2	
Material #3	
Material #4	

Quantitative Measurements: Measuring Mass

- Use a *digital scale* to measure the mass of the samples as accurately as possible.

	mass (g)
Material #1	
Material #2	
Material #3	
Material #4	

Calculating Density

- Use the formula, $D = m/V$, to determine the density of each of your samples. Be sure to follow rules for significant figures in your calculations.
- Compare your calculated densities to the actual densities of materials as they are listed in your textbook on page 261. Determine what each substance is, based on those densities. Were your hypotheses correct?
- Determine your percent error in your density calculations using the formula:

$$\% \text{ error} = \frac{|actual - experimental|}{actual} \times 100 =$$

Material	Density calculation	Density (g/ml)	Substance	Known Density (g/ml)	% Error (show work!)
#1					
#2					
#3					
#4					

Questions:

- 1.) Why do scientists use significant figures when doing calculations involving lab measurements?
- 2) Describe how you could use principles from this lab to determine if a piece of jewelry is made of real or fake gold.
- 3) What is the difference between accuracy and precision as they relate to measured values?

Extensions:

- 1.) Devise a method to determine the mass of one grain of rice. Write it down. Do it. Record your results.
- 2.) Devise a method to determine the volume of a tennis ball. (Hint: $V = \frac{4}{3} \pi r^3$) Write it down. Do it. Record your results on the back of this paper.