Precision in Volumetric Measurements Lab #17

Pre-Lab Discussion:

Scientists generally use two different methods to measure the amount of a substance. One method is to measure the volume of the substance (volumetric measurement) and the other method is to measure the mass of the substance (gravimetric measurement). In this lab, we will compare the precision of using pipets, graduated cylinders, and beakers to measure volume. We will do this by having each group make two identical measurements and comparing the results and then comparing the results of the entire class. For this comparison to work well, it is imperative that everyone record all data to the proper number of significant figures every measure. Our goals are to 1) investigate several common methods scientists use to determine volume, 2) practice and develop skills with each method, and 3) to learn something about the amount of instrumental error inherent in each device.

Research Question:

How can volume be measured in the lab and what is the relative precision of some common instruments (pipets, beakers, and graduated cylinders) used to measure volume?

Materials:

50 mL beaker	250 mL beakers
10 mL graduated cylinder	50 mL graduated cylinder
disposable pipet	electronic balance

Method:

1. Before the lab begins, create a data table that will be used to record all the measurements in this lab. Before you begin the lab, be sure the instructor approves your data table.
2. Use a disposable pipet to deliver *exactly* 8.60 mL of water to a clean, dry 10 mL graduated cylinder. Record the mass of the dry cylinder and the mass of the water in the cylinder.
3. Place the 10 mL graduated cylinder upside down to dry.
4. Use the pipet to deliver *exactly* 8.60 mL of water to your 50 mL graduated cylinder and record the mass of the dry cylinder and the mass of the water in the cylinder.
5. Place the 50 mL graduated cylinder upside down to dry.
6. Use a 50 mL beaker to measure 40 mL of water and record the mass of the dry beaker and the mass of the water in the beaker.
7. Use a 250 mL beaker to measure 40 mL of water and record the mass of the dry beaker and the mass of the water in the beaker.
8. Repeat from Step 2 so you have two data points for each piece of glassware.

Data Collection and Processing:

Record all data on the Class Data Table (on Teams). Include correct units, labels, and sig. figs.

Conclusions and Evaluations:

1. Which type of volumetric glassware (10 mL graduated cylinder, 50 mL graduated cylinder, 50 mL beaker, or 250 mL beaker) do you think is the most precise? Which is the most accurate? Explain your answer.

   _____

   _____

2. Did we test the accuracy of this most accurate piece of equipment? What evidence indicates it is the most accurate? How could we test its accuracy?

   _____

   _____

   _____

3. In previous labs, we have learned that larger sample sizes usually give more accurate results. Does the data from this lab seem to verify or refute this conclusion? Explain your answer. (Hint: think about 8.6 mL in a 50 mL or 8.6 mL in a 10 mL graduated cylinder and about how close to maximum fill level each instrument was filled.)

   _____

   _____

   _____

4. Did the measurements of the 10 mL and 50 mL graduated cylinders agree exactly? Which do you think was more accurate? Explain your answer.

   _____

   _____

   _____

5. Did the measurements of the 50 mL and 250 mL beakers agree exactly? Which do you think was more accurate? Explain your answer.

   _____

   _____

   _____

Applications:

1. What did YOU (personally) learn?

   _____

2. By whom and how can any idea, principle, or activity in this lab be used in the real world? Because there are so many real-world applications where accuracy and precision are important, give three specific examples.

   _____

   _____

   _____