Ms. Randall
Regents Chemistry
Lab activity: Measurement and Significant Figures Lab

<u>**Background:**</u>

Accuracy is whether a measurement agrees with the true value. If a measurement is accurate then it is correct. This can be difficult to determine unless it is possible to look up a result in a trusted source.

Precision is whether several measurements agree with each other. In lab activities we make several measurements in order to confirm results. Chances are good, but not certain, that if your measurements have a small range then your results are accurate, too.

Precision can also refer to the level which an instrument can measure. If you have a bathroom scale and measure the mass of a book with it you might find it weighs 7 pounds. A more precise scale might reveal that the weight of the book is actually 7.15 pounds. When a measurement is expressed with more digits it is more precise than a measurement of the same object showing fewer digits. Each measured digit is called a **significant figure**.

<u>**Objective:**</u> To learn the concept behind significant figures and how to make measurements and calculations using that concept.

<u>**Materials:**</u> metric ruler, graduated cylinders(10ml, 100ml), balance, well plate, sheet of paper, pen, aluminum cylinder, irregular object(silicon), thermometer, beaker

<u>**Pre-Lab Questions:**</u>

<u>**Estimating the Last Digit**</u> The maximum possible precision is defined as one tenth (1/10 or 0.1 times) the smallest division on the measuring instrument. On ruler 1 the hash marks go to the tenths place, which means you should estimate to the hundredths. Ruler 2 has hash marks to the ones place, so you should estimate to the tenths place.
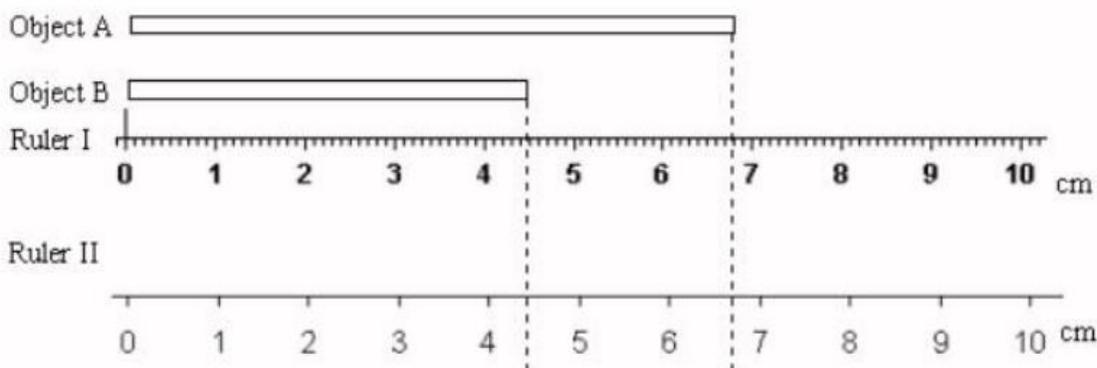
1) What is the length of Object A using Ruler 1 using significant figures?

2) What is the length of Object B using Ruler 2 using significant figures?

3) If you were to add lengths for questions 1 and 2, what would the combined length be using the correct amount of significant figures?

Procedure: For the following measurements and calculations pay close attention to the number of significant figures and use the rules for doing calculations with significant figures.

A. Please use a ruler (in cm) to measure the following items:

- Length of this paper
- Length of a well plate

Questions:

1) How many places after the decimal should each of these measurements have? Why?

2) Calculate the area of this paper in cm^2.

B. An electronic balance estimates the last digit for you, so you will not be adding an additional place after the decimal. Tare/zero the balance, add your object, and record the mass below.

- Mass of a sheet of paper
- Mass of a pencil
- Mass of an aluminum cylinder
- Mass of an irregular object

Calculate the volume of the aluminum cylinder by measuring the length and diameter (cm^3)

V=πr2h

C. There are two graduated cylinders at each lab station (10 mL / 100 mL).

- Add a random amount of water to each cylinder. Carefully read the volume in the graduated cylinders using sig figs. Record your volumes;

- Add the volumes of the two measurements together using proper significant figures.

D. Water Displacement Method for Determining Volume:

- Fill a graduated cylinder about half way with water. Then record the EXACT volume using significant figures.

- Add your irregular object to the graduated cylinder and take the new reading. You should tilt the graduated cylinder and slide the object down the side to avoid a big splash.

- Use your data to find the volume of the irregular object. Since the object is a solid the volume will be recorded as cm^3, which is equivalent to mL.

- Use the mass you recorded for the irregular object to calculate the density to the proper sig figs**.**

E. There is a thermometer at your lab station.

- Record the current temperature ($^\circ$C) to the correct number of sig figs.

- Allow the thermometer to sit in a beaker of cold water for about 1 minute. Then record the temperature with the correct number of significant figures.

- Record the difference in temperature using significant figures.

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Lab Conclusion: **Measurement and Significant Figures**

1. Write a paragraph summarizing what you have learned about the scientific concept of the lab from doing the lab. Back up your statement with details from your lab experience.

2. Will the precision of a calculation (ex. volume = L x W x H) ever be more precise than the original measurements (ex. length)? Explain your answer.

A chemistry class is asked to calculate the density of lead. The following data was gathered from each of the four lab groups.

Group	Mass (g)	Volume (cm³)	Density (g/cm³)
A	5.62	0.520	10.8
B	5.81	0.548	10.6
C	5.99	0.560	10.7
D	5.73	0.541	10.6

The accepted value for the density of lead is 11.3 g/cm³. Answer the following questions regarding the results.

4. Are the calculated density values for the class precise? Are they accurate? Explain your answer for credit.

5. The density of hydrogen at STP is 0.0899 gram per liter. Express this density to *two significant figures.*