# Significant Figures and Measurement

***Background:*** Most numbers used in chemistry are obtained from measurements. Exceptions include some defined quantities and counts. No measurement can be made exactly. The accuracy of the measurement is determined by the instrument being used. As science has progressed, its ability to make increasingly accurate measurements has increased. This lab is designed to familiarize you with the relationship between measurements and the instrument being used to make the measurement. Operations using significant figures are explored as well. Your instructor will review the rules for working with significant figures after you complete the procedures.

***Objective(s):*** To relate the accuracy of the measurement being made to the instrument being used. To develop skills in using various balances. To develop skills in using significant figures.

***Safety:*** Follow Standard Operating Procedures

***Disposal:*** None Required

**M*aterials***

| **Apparatus** | |
|---|---|
| • 3 homemade rulers<br>• rectangular block | • 3 balances having different sensitivities<br>• calculator |

***Procedure***

1. Obtain a rectangular block from the supply table and ruler 1 from your instructor.
2. Measure the length, width, and height of your block to the appropriate number of significant figures. Use your best judgment in estimating the final place value beyond the graduations on the measuring device. Record your results, including units, in Data Table 1.
3. Repeat Steps 1 and 2 using rulers 2 & 3. Your instructor will provide the rulers. Record your results in Data Table 1.
4. Using the three balances present, determine the mass of the rectangular block to the appropriate number of significant figures. Record, including units in Data Table 2

***Calculations***

1. Using the measurement obtained from each ruler, calculate the volume of the rectangular block rounding your answer to the correct number of significant figures. Record in the Calculations Table.
2. Using the recorded mass for balance #1 and the volume for ruler #1 (tool set #1) obtained in the previous step, determine the density of the block by dividing


Adapted from 40 Low- Waste, Low-Risk Chemistry Labs © 1994, 1997 J Weston Walch, Publisher

the mass by the volume.

Density = mass in grams/volume in cubic centimeters

3. Round to the correct number of significant figures.
4. Repeat calculations for each of the other two ruler and balance pairs.
5. Assuming that the density obtained using tool set #3 is the accepted value and the density obtained using tool set #1 is the observed value, calculate the absolute error (Ea) for tool set #1.

*Absolute error (Ea)* = |o-a|

0 = observed *a*= accepted

6. Using the absolute error obtained above, calculate the percentage error (%error) for density using tool set #1.

% relative error $= \frac{|o-a|}{a} \times 100\%$

7. Repeat error calculations for density for tool set #2 using set #3 again as the accepted.

**Data Table 1**

| | Unit | Ruler 1 | Ruler 2 | Ruler 3 |
|---|---|---|---|---|
| length | | | | |
| width | | | | |
| height | | | | |

**Data Table 2**

| | Unit | Balance 1 | Balance 2 | Balance 3 |
|---|---|---|---|---|
| Mass | | | | |

**Calculations Table**

| | Unit | Balance 1-Ruler 1 | Balance 2-Ruler 2 | Balance 3- Ruler 3 |
|---|---|---|---|---|
| volume before rounding | | | | |
| volume after rounding | | | | |
| density before rounding | | | | |
| density after rounding | | | | |
| absolute error (density) | | | | |
| percentage error (density) | | | | |


Adapted from 40 Low- Waste, Low-Risk Chemistry Labs © 1994, 1997 J Weston Walch, Publisher