The Measurement Challenge ~ A Density Lab

PreLab: you are to complete the **Title, Purpose, Storyboard for Part II and III only, Background Information, and copy the data tables into your lab book**

Purpose: The purpose of this laboratory activity is to take accurate measurements using a metric ruler and a balance, and to apply the rules for significant figures in mass, volume, and density calculations.

Background Information: All measurements involve some degree of error or estimation. The measurements re based on the fact that the human eye can estimate to one-tenth of the smallest mark shown on the measuring instrument. Therefore, a ruler with only 1 cm divisions shown can provide measurements that are estimated to 1/10th or 0.1 cm, while a rule with 0.1 cm divisions can provide measurements that are estimated to the 1/100th or 0.01 cm.

In this activity, the first goal is to determine the volume of a plastic block. This volume is calculated using the equation:

Volume = length x width x height

Once the solid's volume has been calculated, the mass can be predicted using the known density value of the solid. To predict the mass, rearrange the density equation shown below:

$$\text{Density} = \frac{\text{mass}}{\text{Volume}} \qquad \text{therefore… Mass = density x volume}$$

You will evaluate the accuracy of your calculations by determining the percent error. This can be calculated using the following equation:

$$\text{Percent error} = \frac{[\text{predicted mass} - \text{actual mass}]}{\text{actual mass}} \times 100$$

Success in this laboratory activity depends on your ability to take accurate measurements and to apply the rules for significant figures when calculating mass, volume, and density.

Procedure: Answer all questions in the lab notebook while completing the following parts in order.

Part I:

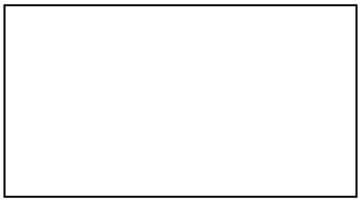
1) Obtain a metric ruler. Take a close look at the markings on the ruler. What is the distance between the smallest markings on the ruler in terms of cm?
2) It is generally accepted that scientific measurements can be estimated to one tenth of the smallest marking on the instrument, with the metric ruler provided to you, what is the most reliable estimate that can be made in terms of cm?
3) Measure the lines below and enter your answers in your lab notebook.
    a. __________________________

    b. _____________

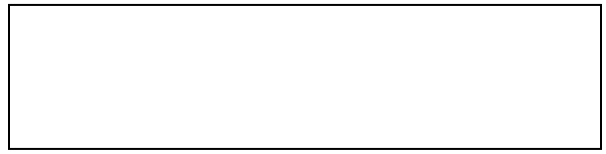
    c. _______________________________________

4) Use the metric ruler to measure the length and width of each rectangle below. Be sure to estimate to the proper place value for your ruler (see #2 above). After making these

measurements, calculate the area of each rectangle. Be sure to follow your rules for significant figures when multiplying measurements.



Rectangle #1



Rectangle #2

Part II: This part of the activity will require you to create a NEAT data table in your lab notebook. It should have four columns and eight rows. The rows should be two or three lines wide and the columns evenly spaced on the page. The row labels (in the first column) should be **block number, block color, mass (g), length (cm), width (cm), height (cm), volume (cm^3), and density (g/cm^3)**.

1) Obtain a plastic block from your teacher. Record the block number **and** color in the data table you have created in your lab notebook (see above).
2) Using a metric ruler, measure and record the dimensions of the block in the data table.
3) Calculate the volume of the block using the equation above. Paying close attention to the number of significant digits when multiplying, record this calculated value in the data table for the volume.
4) Using a laboratory balance, determine and record the mass of the block in the data table in your lab notebook.
5) Calculate the density of the block using the equation above. Paying close attention to the number of significant digits when dividing, record this calculated value in the data table for the density.
6) Repeat steps 1 – 5 for two additional blocks with different numbers and colors.

Part III:

1) Obtain a plastic block that is different from the three blocks used in part II. Record the block number and color in your lab book under the heading for part III.
2) Use the know density table below and the rearranged density equation above to determine the **predicted mass** of the plastic block. Show all of your work neatly and highlight your answer, in your lab notebook. Be sure to clearly label this mass as the **predicted mass**.

Color of the block	Density (g/cm^3)
White	0.541
Black	0.985
Milky-white	0.908
Clear	1.18
Gray	1.42

3) When the mass of the block has been calculate and a prediction made, bring the block to the front desk and an **actual mass** will be measured using the electronic balance. Record this mass and clearly label it as the **actual mass**.
4) Determine the percent error using the equation above. Pay close attention to the place value when subtracting (and round your answer) **then** the number of significant digits when dividing (when multiplying by 100, keep in mind that 100 is an exact number and has an infinite number of significant digits!!!). This is tricky so take your time!

Data Tables

Part II

Block Number			
Color of Block			
Mass (g)			
Length (cm)			
Width (cm)			
Height (cm)			
Volume (cm^3)			
Density (g/cm^3)			

Part III

Block Number	**Color of Block**