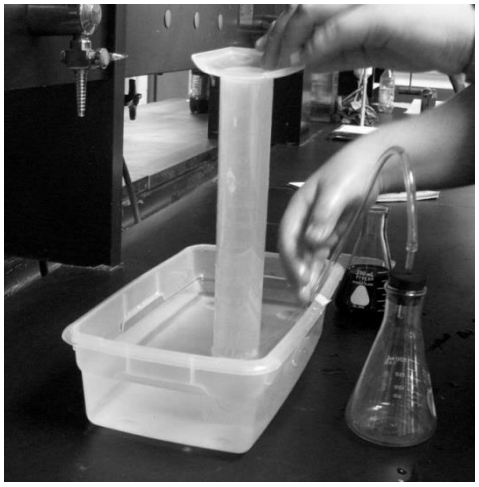
Honors Chemistry Lab #4: Double Density

Background Information: Part one of this lab investigation uses Alka Seltzer, which is a mixture of sodium bicarbonate and citric acid. When these substances come into contact in water they react to produce carbon dioxide gas, water and sodium citrate. Part two deals with the density of nine unknown materials and also incorporates percentage of error by comparing the experimental value with the accepted. Percentage error is a common computation in chemistry. The purpose of this lab is to explore an important property of matter while also practicing basic computation skills that will be used throughout this course.

$NaHCO_3$	+	$H_3C_6H_5O_7$	+	H_2O	→	CO_2	+	$NaH_2C_6H_5O_7$
Baking soda		Citric acid		Water		Carbon dioxide		Sodium citrate

Part 1 Procedure (CO_2 gas): (suggested procedures only- modify as needed)

1. Obtain two Alka Seltzer tablets and break them in half
2. Place 10 mL of water into a 125m mL or 250 mL Erlenmeyer flask
3. Find the mass of the Erlenmeyer flask with the water only
4. Weigh each 1/4 piece of tablet separately
5. Fill an appropriately sized graduated cylinder completely with water and invert into a tub of room temperature water- practice this technique
6. Place the tube from the flask into the up-turned graduated cylinder
7. Drop the tablet into the water and immediately stopper the flask- SWIRL the flask constantly
8. Collect the gas in the graduated cylinder
9. Carefully measure the volume of gas collected
10. Measure the mass of the flask and the tablet after the reaction is complete, but be sure to take the stopper and tubing off
11. Complete procedure two more times for a total of three trials



Data Table 1

	Trial 1	Trial 2	Trial 3
Mass of ¼ tablet (g)			
Mass of flask and water (g)			
Total beginning mass of tablet, flask and water (g)			
Mass of tablet, flask and water after reaction (g)			
Mass of CO_2 (g)			
Volume of CO_2 collected (mL)			
Volume of CO_2 collected (L)			
Density of CO_2 (g/mL)			
Average density of 3 trials			

Accepted Density of CO_2 = 0.00198 g/mL

Part 1 Post Lab Questions:

1. Calculate the percentage error to discuss your data results from part 1. The formula is on the bottom of page two. Use the values to discuss both the **accuracy** and **precision** of your calculations for this part of the lab.

2. Classify density as either an intensive or extensive property of matter. Explain your reasoning.

Part 2 Procedure (Density blocks): Transcribe data table 2 onto your paper.

1. Obtain a set of density blocks (each contains nine blocks). The identities of these blocks are unknown. While you might be able to infer the identities of some, you will need to use the scientific method to accurately determine all nine blocks. Find a system to obtain data on all nine blocks without confusing their identities. The data table below refers to them as blocks 1-9.
2. Measure the length, width and the height of the block using a set of precision calipers. NOTE: calipers are coated in protective grease during storage. Use a towel to wipe off the grease before you take any measurements.
3. Obtain the weight for each block and record your data.
4. Repeat steps 1-3 for all nine blocks listed in your data table and determine their identities.

Data Table 2

Block #	Mass (g)	L (cm)	W (cm)	H (cm)	Volume (cm^3)	Density (g/cm^3)	Identity of Block	% Error
1								
2								
3								
4								
5								
6								
7								
8								
9								

Accepted Density Values

Substance	Density (g/cm^3)
Acrylic	1.15
Aluminum	2.70
Brass	8.6
Copper	8.96
Oak	0.75
Pine	0.43
Polypropylene	0.93
PVC	1.40
Steel	7.9
Water	1.0

$$\% \text{ Error} = \left| \frac{\text{accepted value} - \text{experimental value}}{\text{accepted value}} \right| \times 100$$

Part 2 Post Lab Questions:

3. View the density column in the front of the classroom. Try to predict the identity of each substance/ layer from top to bottom. Make your best guesses based on the appearance and location of each layer within the column.

4. Use your percent error calculations to discuss your data results from part 2. Use the values to describe and discuss both the **accuracy** and **precision** of your calculations.

5. **Density Flow Model Demonstration**: Once you have completed parts 1 and 2, you will need to set up and conduct the density flow model demonstration. This demonstration is a bit complicated and will require you to work with other groups to carefully read through the directions for the model. Please take pictures and record video of the demonstration to augment your lab report. To answer this question, please describe each stage of the demonstration and explain why you observed each phenomenon that occurred during each stage.