Name:____________________________________ Date:_______________ Per:______

LAB 1: Is Density Periodic?

<u>Your Task</u>

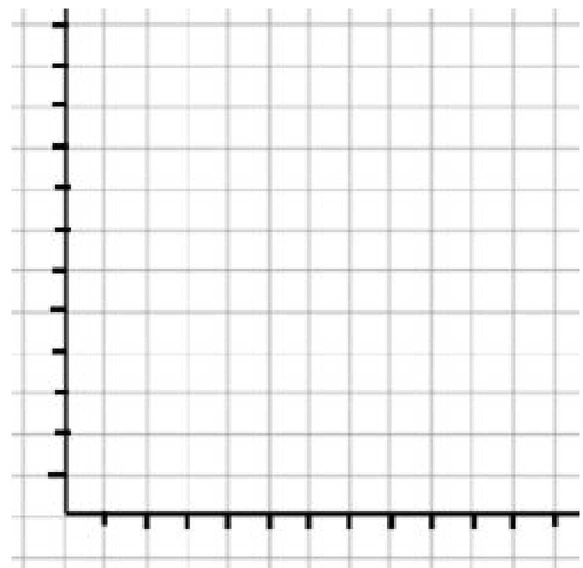
<u>Determine</u> the densities of lead, silicon, and tin. Then, use this information to <u>predict</u> the densities of the other two elements in group 14 (germanium and flerovium) based on the trend in your data.

<u>Materials</u>

You may use any of the following materials during your investigation:

- Lead shot (**about 10 g per trial**)
- Silicon shot (**about 3 g per trial**)
- Tin shot (**about 8 g per tial**)
- Tap water
- Beakers (250 ml)
- Graduated cylinders (10 ml and 25 ml)
- Electronic balance
- Weighing dishes

<u>Pre-lab questions</u>



1. One of the elements Mendeleev predicted was eka-aluminum, corresponding to a gap in the 4th period of the Group IIIA elements, between aluminum and indium. The density of aluminum is (period 3) is 2.70, indium (period 5) is 7.31, and thallium (group 6) is 11.83 g/cm^3. Make a graph with period number on the x-axis vs. density on the y-axis for each of these elements.
2. Use your graph to predict the density of eka-aluminum. What known element in the modern Periodic Table corresponds to this? (respond below)

3. How do actual and predicted density values compare? Use the following equation to calculate percent error between the predicted and actual values for the density of eka-aluminum.

$$\text{percent error} = \frac{\text{actual - predicted}}{\text{actual}} \times 100\%$$

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4. Assign group roles:
   a. **Facilitator** (makes sure group is following the procedure, recording all values in their own data tables, and that people know what they should be doing):_____________________

   b. **Mass Master** (handles samples wearing gloves, determines and record masses of samples):___________________

   c. **Volume Reader** (reads volumes on graduated cylinder, makes sure everyone records values):___________________

   d. **Safety Officer** (makes sure that groupmates are following written and verbal safety instructions):_________________

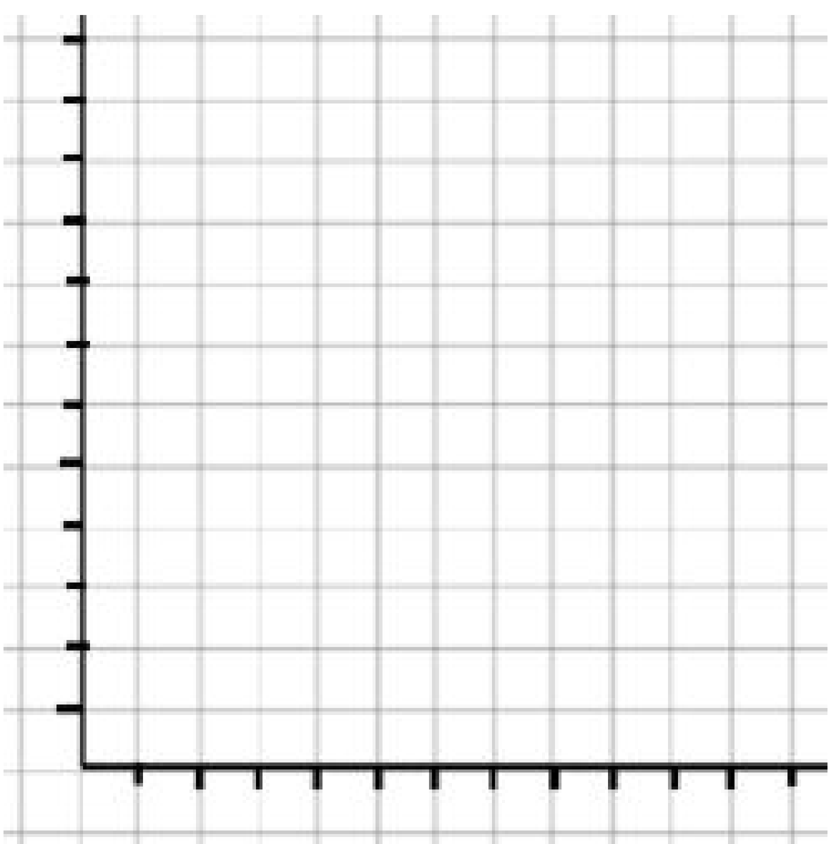
5. Raise your hand for Mr. Brow to sign off on your group roles ☐

6. As you collect data, record it in the table below. After you collect all data, solve for density.

Reminder: *Density is a measurement of mass per unit of volume. So the equation is* $d = \frac{m}{V}$ ...also $1 g/mL = 1 g/cm^3$!

Element	Sample #	Mass of (g)	Initial Volume (mL)	Final Volume (mL)	Volume of solid (mL)	Density of solid (g/cm^3)	Average density (g/cm^3)
Silicon							
Tin							
Lead							

7. Graph the period number vs. average density on the graph below. Use a Periodic Table for reference.



a. x-axis:______________________

a. y-axis:______________________

8. How close were we? Calculate percent error for all 3 elements (box answers):

a. Si (Silicon):

b. Sn (Tin):

c. Pb (Lead):

Have Mr. Brow sign off once finished

LAB 1: Is Density Periodic?

Introduction

At the time Dmitri Mendeleev proposed his periodic table for the classification of the elements in 1869, only 63 elements were known. Mendeleev arranged these 63 elements into a table of rows and columns in order of increasing atomic mass and by repeating physical properties. He also suggested that there were some missing elements that still needed to be discovered.

In Mendeleev's periodic table), carbon and silicon were placed in the same family. Carbon appeared in the 2nd row and silicon appeared in the 3rd row. Mendeleev then proposed that there should be another element in this family. Though he did not live long enough to see if this missing element be discovered, he nonetheless named the missing element eka-silicium and predicted its physical properties. The German chemist Clemens Winkler later confirmed the existence of this element in 1886 and called it germanium.

As this example from this history of chemistry illustrates, Mendeleev's periodic table gave chemists a powerful tool for predicting the properties of the elements. So, you're going to do the same thing!

Your Task

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Materials

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- Lead shot (**about 10 g per sample**)
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Safety Precautions

Lead powder is toxic by inhalation and ingestion. Using lead shot does not present a powder hazard. Do with lead powder. Silicon is flammable in powder form and is slightly toxic. Do not breathe or handl silicon powder remaining in the bottom of the reagent bottle. Wear chemical splash goggles and chem gloves if you are in charge of handling materials. Wash your hands with soap and water before leaving glassware with care (don't set it on the edges of tables!).

Procedure

1. **Mass master**: To measure out the right quantity of Si (silicon), FIRST you need to place the sample tray on the scale and zero the scale. Next, take out **between 2g and 3g** of Si. RECORD this mass in your data table TO THE NEAREST TENTH. You will be doing 3 trials per element, so make sure to record this in the "Sample #1" box for Si.

2. **Volume reader**: Fill a 25 ml graduated cylinder about half full of water. Measure the initial volume of water and RECORD this value in your data table TO THE NEAREST TENTH.

3. **Safety officer**: Use forceps/tongs/spoon to *carefully* add the Si chunks. After Si is added, measure the final volume of the water and RECORD this value in your data table TO THE NEAREST TENTH.

4. REPEAT STEP 3 for Sample #2.

5. **Volume reader**: Read the initial volume and RECORD value in data table. NOTE: You do not have to dump out the water every time.

6. REPEAT STEP 5.

7. REPEAT STEPS 6-8 for Sample #3.

8. **Facilitator**: After values for all trials are recorded, *carefully* dump out both water and Si chunks into the beaker marked **"Wet Silicon"**

9. **Mass master**: To measure out the right quantity of Sn (tin), FIRST you need to place the sample tray on the scale and zero the scale. Next, take out **between 5.5g and 8g** of Sn. RECORD this mass in your data table TO THE NEAREST TENTH. Make sure to record this in the "Sample #2" box for Sn.

10. REPEAT STEPS 4-9, only this time, you will be using Sn (tin) instead of Si (silicon).

11. **Facilitator**: After values for all trials are recorded, *carefully* dump out both water and Pb chunks into the beaker marked **"Wet Tin"**

12. **Mass master**: To measure out the right quantity of Pb (lead), FIRST you need to place the sample tray on the scale and zero the scale. Next, take out **between 7g and 10g** of Pb. RECORD this mass in your data table TO THE NEAREST TENTH. Make sure to record this in the "Sample #3" box for Pb.

13. REPEAT STEPS 4-9, only this time, you will be using Pb (lead).

14. **Facilitator**: After values for all trials are recorded, *carefully* dump out both water and Pb chunks into the beaker marked **"Wet Lead"**

15. Make sure all materials are dry and place them back in the bin. Use the data you collected to solve for density, then graph how density changes down a group.

LAB 1: Is Density Periodic? Debrief Questions

1. Do the results of our experiment help show that density is periodic? What evidence did you collect that shows this?

2. We just calculated the density for some solid elements in the periodic table, but how would could we see if this trend works with gases in the periodic table? In other words, how would you calculate density for a gas?

3. The chunks of elements we worked with today were essentially just a lot of the same type of atom clumped together. Based on the properties that you observed in the lab (density) and using your knowledge of other periodic trends, draw how you think these atoms are arranged in each element.

a.

Si (Silicon)	Sn (Tin)	Pb (Lead)

b. What evidence did you use (what periodic trends or other properties) when you drew these atomic arrangements?