Density is a Periodic Property

Purpose: To predict the density of Germanium by determining the densities of silicon, tin and lead.

Pre-lab:

1. One of the elements Mendeleev predicted was *eka*-aluminum, corresponding to a gap in the fourth period of the Group IIIA elements, between aluminum and indium. The density of aluminum (period 3) is 2.70 g/mL, that of indium (period 5) is 7.31 g/mL, and that of thallium (period 6) is 11.85 g/mL. Make a graph of density vs. period number.

2. Use your graph to predict the density of *eka*-aluminum. What known element in the modern Periodic Table corresponds to *eka*-aluminum? Look up the density of the modern element in a reference source and record its actual and predicted density values.

3. How do the actual and predicted density values compare? Calculate the percent error.
**Procedure:**

1. Obtain the beakers containing your samples: Si (silicon), Sn (tin) and Pb (lead).
2. Start with Silicon. Measure the combined mass of the beaker plus solid to the nearest 0.01 g and record the value in the Data Table.
3. Fill a 25 mL graduated cylinder half-full with water. Measure the initial volume of water and record the value to the nearest 0.1 mL in the Data Table.
4. Using forceps or tongs, carefully add about one-third of the silicon chunks to the graduated cylinder (enough to raise the water level in the cylinder by at least 1.0 mL). Add the solid slowly, so as to avoid splashing or breaking the glass cylinder.
5. Measure and record the new (final) volume of water plus solid in the graduated cylinder. Measure and record the combined mass of the labeled beaker and remaining solid in the Data Table.
6. Repeat steps 4 – 6 twice with the remaining amount of solid in the beaker. Record all initial and final mass and volume data in the Data Table. There should be a total of three sets of mass and volume data.
7. Empty the water from the graduated cylinder and carefully pour the silicon chunks onto a paper towel and allow them to dry. Do not allow any of the solid to go down the drain.
8. Rinse the graduated cylinder with water to make sure that all of the solid has been removed.
9. Using tin, measure the initial mass of the container plus solid to the nearest 0.01 g and record the value in the Data Table.
10. Repeat steps 3 – 9 using tin. Record all initial and final mass and volume data in the Data Table.
11. Finally, using lead, measure the initial mass of the container plus solid to the nearest 0.01 g and record the value in the data table.
12. Repeat steps 3 – 9 sing lead. Record all initial and final mass and volume data in the Data Table.
13. Return all solids to the appropriately labeled beaker.
Post-Lab Calculations and Analysis

1. Using the mass and volume data, calculate the density of each sample 1 – 3 for all three elements. Then, calculate the average density. Don’t forget your units!

Densities

<table>
<thead>
<tr>
<th></th>
<th>Silicon</th>
<th>Tin</th>
<th>Lead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample 2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sample 3</td>
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<td></td>
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<tr>
<td>Average</td>
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2. On a graph, plot the average density vs. period number for each element. Draw a line of best fit and predict the density of germanium.

3. Use 5.323 g/mL as the accepted density for germanium. Calculate your percent error.