CHEMISTRY

LAB: Aluminum Atoms

Target

Students will calculate the size of an atom by using a piece of aluminum foil. Students will understand how tiny atoms are by looking at how many atoms are stacked up to make that thickness of the foil.

Background

Aluminum is an element we use in the form of aluminum foil in everyday life. We want to find out just how many aluminum atoms need to be stacked up to make a piece of aluminum foil. We will assume that the aluminum atoms are stacked on top of each other directly and that the atoms behave as solid spheres during the stacking process.

Materials

Balance	Scissors	Aluminum block
Safety goggles	Aluminum foil	
Metric ruler	Graduated cylinder	

Procedure

1. Determine the mass of the aluminum block.
2. Fill the graduated cylinder about halfway with water and record the volume of water accurately in mL (note: 1 mL = 1 cm^3)
3. Tilt the cylinder to about a 45 degree angle (be careful not to spill any water) and carefully slide the aluminum block into the graduated cylinder. Set the cylinder upright and be sure that the block is completely covered with water. Record the new volume in mL to the 10ths place (ex. 4.2 mL).
4. Remove the block from the cylinder and dry it with a paper towel, pour out the water and return both the block and the cylinder to your teacher.
5. Obtain a piece of aluminum foil, and cut it if necessary to obtain a square that is approximately 15 cm x 15 cm.
6. Measure the length and width of the piece of foil exactly and record it on your data table.
7. Determine the mass of the piece of aluminum foil and record it on your data table.

Cleaning Up

1. Clean up your station and return materials to their proper places.
2. Wash your hands before leaving the laboratory.

Data

Mass of the block = _____

Volume of the block = _____

Exact length and width of Aluminum foil = _____

Mass of the aluminum foil = _____

Calculations

1. Calculate the volume of the aluminum block from the apparent change in the volume of the water in the cylinder.
2. Since both the aluminum block and the aluminum foil are pure elemental aluminum, we would expect the ratio of the mass to the volume to be the same for both. That is:

   $$\frac{\text{mass of block}}{\text{volume of block}} = \frac{\text{mass of foil}}{\text{volume of foil}}$$

   Use this relationship to find the volume of the aluminum foil.
3. Calculate the thickness of the aluminum foil. (**Hint:** Think about how you would calculate the volume of a box from its measurement. Think of the piece of aluminum foil as a very thin box.) You calculated the volume of the foil in analysis #2. Using the formula V = l x w x h… solve for h.
4. One aluminum atom has a diameter of 0.000000025 cm. How many atoms thick is the aluminum foil? (hint: Divide your result in Analysis 3 by 2.5×10^{-8}).
5. What are the possible sources for error in your experiment?
6. Look up the diameters for lithium, sodium, potassium and cesium atoms. What is the relationship between the atomic number of the element and the diameter of its atoms?

Reflection:

Remember in the conclusion you need to have 3 paragraphs.

1st paragraph - you will draw conclusions. Give a valid conclusion based on the correct interpretation of your results and explain your results reflecting back on the target.

2nd paragraph - you will evaluate procedure(s) and results including limitations, weaknesses or errors.

3rd paragraph - you will Identify weaknesses and state realistic suggestions to improve the investigation.