

Student Name: \_\_\_\_\_ Pd. \_\_\_\_ Date: \_\_\_\_\_

## Experiment 1 The Thickness of Aluminum Foil



Have you ever wondered how thick a piece of aluminum foil is? Perhaps you have even tried to measure it. But how close can you get to the exact measurement? Your ruler certainly isn't precise enough – how small is the smallest unit? An inch? A millimeter? Aluminum foil is far thinner than that! Perhaps a better unit to use to report the thickness of the foil would be the number of atoms...

So how can we determine the thickness, in atoms, of a given piece of aluminum foil?

### SAFETY

This lab requires no hazardous or corrosive materials – safety goggles, aprons, and gloves are optional. Care should be taken to avoid being injured by edged tools used for cutting aluminum foil.

### BACKGROUND

One **mole** of a substance is quantified by the following means:

1 mole =      the molecular or atomic weight of the substance in grams  
                  6.02 x 10<sup>23</sup> atoms (or molecules)  
                  22.4 liters (only gases at standard temperature and pressure)

**Density** is a unique property of each element that quantifies the amount of matter (mass) in a fixed volume. Density is calculated by dividing the mass of the sample by the volume it occupies. Recall that the formula for density is  $d = m/V$ .

The metal aluminum (which is an element), has a density of 2.7 g/cm<sup>3</sup>.

### PRE-LAB ACTIVITY

1. Write a few sentences summarizing the mole concept. You may use any print or electronic resources available to you, but you must cite your sources.
2. Use only the given information to design a procedure to determine the thickness of a square piece of aluminum foil with arbitrary dimensions along the two sides. Each of your numbered steps must be a complete sentence constructed in grammatically correct English.

## MATERIALS

The following materials are necessary for this investigation:

- Electronic balance
- Ruler
- Aluminum foil rectangle
- Piece of copper wire

## PROCEDURE

A data table is provided below.

1. Using the procedure you developed in the prelab section, determine the thickness of your sample of aluminum foil in atoms.
2. Adapt your aluminum foil procedure to determine the diameter (also in atoms) of a length of copper wire. Assume the wire is a perfect cylinder. The density of copper metal is  $8.96 \text{ g/cm}^3$ .

## DATA

Material					
Aluminum Foil					
Copper Wire					

## POST-LAB ANALYSIS

Answer the following questions in complete, grammatically correct sentences.

1. What differences were there in determining the diameter of the copper wire compared to determining the thickness of the aluminum foil?
2. The atomic radius of aluminum is 1.82 Angstroms ( $1 \text{ \AA} = 1\text{E-}10$  meters). Assuming that each atom of the aluminum metal is oriented so that it contacts six other aluminum atoms (that is, they are stacked directly on top of each other), what is the thickness of your aluminum foil sample in meters? In millimeters? In kilometers? (Express you answers in scientific notation.)

3. Copper has an atomic radius of 1.57 Angstroms. Assuming that each atom of the copper metal is oriented so that it contacts six other copper atoms (that is, they are stacked directly on top of each other), what is the thickness of your copper foil sample in meters? In millimeters? In kilometers? (Express your answers in scientific notation.)
4. In the United States and Great Britain (countries that use the English measurement system), very thin materials (like aluminum foil or plastic garbage bags) often have their thicknesses reported in **mils** (1 mil = 0.001 inches). What is the thickness of your aluminum foil sample in mils? (1 inch = 2.54 centimeters)
5. What are some of the potential sources of error in this experiment?
6. Which values were directly measured in this experiment? Which values were measured indirectly?

## CLEANUP AND DISPOSAL

Aluminum foil samples can be disposed of in the trash. Copper wire samples should be returned to the instructor for later use.



## ONGOING LEARNING

Aluminum recycling is a very common modern process. The emphasis on aluminum recycling results from a combination of factors, but largely due to two major problems – the duration of time aluminum remains in landfills, and the fact that processing raw aluminum ore (called bauxite) is far more costly (from both a materials and energy standpoint) than simply recycling existing supplies.

Using any resources available to you, write a few sentences which address the following points:

- How long does it take an aluminum can to disappear from a landfill?
- What happened to the aluminum that made up the can?
- What is the approximate quantity of raw aluminum available for mining on Earth?
- What are some of the benefits of recycling aluminum (specifically) as opposed to refining new ore?