Investigation 1: How Thick is Aluminum Foil?

Purpose:

1. To determine the thickness of one sheet of aluminum foil in centimeters.
2. To determine the thickness of aluminum foil in terms of atoms of aluminum.

Let's collect some background first and review some chemistry concepts at the same time.

Properties of Aluminum:

Symbol _____
Atomic Number _____ What does this mean?
Mass Number _____ What does this mean?
Atomic Number _____ What does this mean?

Number of electrons in a neutral atom of aluminum: _____

Draw a Bohr Diagram for aluminum:

Draw the Lewis Dot Diagram for Aluminum:

How many electrons must an atom of aluminum gain or lose in order to form a stable ion? _____ Explain why.

What would the charge on this ion be? _____ Explain why.

Is aluminum a metal or non-metal? _____

Density	_____	Colour	_____
Is it Malleable?	_____	Is it Ductile?	_____
Atomic Radius	_____	Melting Point	_____

Materials List:

Form this list once you have decided on a procedure for your lab.

Diagram of Apparatus:

A diagram is only required when special lab set-ups are needed. The diagram must be a minimum of 1/2 page. Straight lines must be drawn with a ruler. All diagrams must be fully labelled. One option is to take a picture of your lab set-up, label this and add it to your report.

Procedure:

Your procedure should be in numbered steps with sufficient detail that someone else could repeat your work.

1.

2.

3.

Observations:

It is often better to organize your observations in a well designed table.

Calculations:

When calculations are required in a lab they must be clearly shown with proper units and significant digits.

Conclusions:

Conclusions should be numbered. They are short statements answering the purpose. They do not include explanations or discussion. Save this for the final section. For this experiment you will need a minimum of 2 conclusions.

1.

2.

Discussion:

This is the section where you will include analysis questions. This is where you can demonstrate your understanding of the concepts covered in the lab and is there the most important section of the lab.

This section can be used to discuss possible sources of error and ways to improve he lab.

Necessary Math Skills:

1. Scientific Notation (Text pg. 649)

   How to deal with very large or very small numbers.

   For example the speed of light is 300,000,000. m/s.

   This large number can be simplified by using scientific notation:

   300,000,000. → 3.0×10^{8}

   The number of bricks used to make the Great Wall of China:

   3,873,000,000. → ☐

Convert the following numbers into scientific notation:

1. The number of hydrogen atoms that can fit on the head of a pin:

   5,000,000,000,000 

2. Number of people in Canada:

   34,880,500 

3. Number of people in the world:

   7,168,000,000 

4. Number of grains of sand to fill one bucket:

   184,800,000 

5. The number of molecules of water in one drop:

   1,670,000,000,000,000,000,000 

We can also write very small numbers using scientific notation:

Example: The width of a human hair is:

0.000 100 m 

Now convert the following:

1. The diameter of a red blood cell:

   0.000 007 5 m 

2. The thickness of a cell membrane:

   0.000 000 008 250 m 

3. The thickness of a cell membraine in mm:

   0.000 008 250 mm 

4. Typical length of a covalent bond:

   0.000 000 000 154 m 

5 The diameter of an atom of aluminum:

   ?????? 

Using Scientific Notation in a calculator:

Enter 7.184×10^{9} into your calculator.

Type 7.184 EE or EXP 9

The EE or EXP key on your calculator is a fast way to type in "times 10 to the exponent"

Determine the answer to the following. Give you answer in scientific notation:

$$\begin{array}{r} 6.35 \\ \times\ 3.08 \times 10^{8} \\ \hline \end{array}$$

1.9558×10^{9}

$$\begin{array}{r} 4.298 \\ \times\ 3.14 \times 10^{-5} \\ \hline \end{array}$$

1.35×10^{-4}

Uncertainty in Measurement (text pg. 649 - Nelson)
(How many decimal places should I keep?)

I've measured my desk and found it to be 0.79865431 m wide.

What is wrong with this statement?

How many decimal places do you think I should keep?

Obviously I can't claim to be able to measure this accurately. Therefore some of these decimal places are meaningless and should not be included in my final statement. The numbers that are left are called significant digits.

For example the above measurement I could probably justify an accuracy to the closest mm. This number should therefore be rewritten as 0.799 m. The remaining digits above are deemed insignificant and are eliminated.

Significant Digits:

Read this section on page 650 (Nelson) of your textbook and determine the number of significant digits in the following measurements:

Number of Significant Digits

a) 35.419 s

b) 0.00067 kg

c) 156,000 mL

d) 890.007 mm

e) 943.80 cm

f) 5.640×10^7 min

g) 1400

h) 1400.

i) 25 books

How many digits do we keep when we add, subtract, multilply or divide numbers??

Here are the rules to follow:

1. When adding or subtracting a series of numbers, the answer must have the same number of decimals as the least precise measurement.

   For example:

   12.5 + 187.69 - 82.473 = 117.717

   We can only keep one decimal place.

2. When multiplying or dividing the number of digits in the answer must have the same number of significant digits as the number with the fewest digits in the question.

   For example:

   35.06 x 1.00735 = 35.317691

   4 Sig Fig 6 Sig Fig can only have 4 Sig Fig

   The answer then is 35.32 ??? Why?

Rules for Rounding

1. When the first digit to be dropped is less than 5, the preceding digit is not changed.
   Example: Round the following number to 3 digits:

   12.6289

2. When the first digit to be dropped is greater than 5, or is 5 followed by at least one digit greater than zero, then the preceding number is increased by 1.
   Example: Round the following number to 3 significant digits:

   0.0346823 0.318514

3. When the digit to be dropped is 5 and there are no digits after the 5, or only zeros, then:

   - increase the preceding digit by 1 if it is odd.
   - leave the preceding number unchanged if it is even.

   Example: Round the following number to 3 significant digits:

   6.87500

   26.45

Practice:

1. $D = \frac{35.6\ g}{28.987\ cm^3}$

2. V = 3.585 cm x 11.20 cm x 8.4331 cm

3. P = 3.45 cm + 5.678 cm + 34.2 cm

4. $A = 3.14 \times (1.428\ cm)^2$

5. $H = \frac{58.765\ cm^3}{(5.67cm \times 8.32cm)}$

6. Find the mass of a sample of aluminum with a volume of 4.87 cm^3 if the density of aluminum is 2.6989 g/cm^3 .

Practice:

1. $D = \frac{35.6\ g}{28.987\ cm^3}$ $= 1.23\ g/cm^3$

2. $V = 3.585\ cm \times 11.20\ cm \times 8.4331\ cm$ $= 338.6\ cm^3$

3. $P = 3.45\ cm + 5.678\ cm + 34.2\ cm$ $43.3\ cm$

4. $A = 3.14 \times (1.428\ cm)^2$ $6.40\ cm^2$

5. $H = \frac{58.765\ cm^3}{(5.67cm \times 8.32cm)}$ $= 1.25\ cm$

6. Find the mass of a sample of aluminum with a volume of 4.87 cm^3 if the density of aluminum is 2.6989 g/cm^3 .

$m = D \times V = 2.6989\ g\backslash cm^3 \times 4.87\ cm^3 = 13.1\ g$

Therefore the mass of the sample is 13.1 g.