Calculating Moles

Asking Questions
In this investigation you will be collecting data that will allow you to calculate the number of atoms or molecules in a sample of matter. The chemist’s way of counting atoms and molecules is by using a unit called *the mole*. The reason that chemists have their own unique way of counting is because atoms and molecules are so small and there are a huge number of them present in even a small mass of an element or compound! Here is some information that will play an important part in calculating moles:

- Avogadro’s number is the number of atoms or molecule in one mole of a substance.
- Avogadro’s number = $6.022 \times 10^{23}$
- One mole of an element contains $6.022 \times 10^{23}$ atoms.
- The atomic mass of one mole of an element is equal to the average atomic mass.
- One mole of a compound contains $6.022 \times 10^{23}$ molecules.
- The atomic mass of one mole of a compound is equal to the average formula mass.
- The average atomic mass or formula mass is also called the molar mass.

As an example, a mole of water molecules would have a mass of 18.01 grams and only have a volume of about 1/3 cup!! That mass of water contains $6.022 \times 10^{23}$ molecules.

Another example is copper, which is an element. A mole of copper atoms has a mass of 63.55 grams. That mass of copper contains $6.022 \times 10^{23}$ atoms. A mole of copper is contained in just 22 copper (pre-1982) pennies. One mole – same number of atoms or molecules, but a different mass!

Watch *Solving the puzzle of the periodic table* to find out a little bit more about how large Avogadro’s number really is.

Preparing to Investigate
Before beginning the investigation, read through the rest of the lab instructions to learn more about what you will be doing and make a note about safety concerns. Develop procedures that you will follow to gather data that will help you answer the scientific question(s) you are trying to answer. Be sure to include a list of materials and equipment you will need to carry out this investigation. Additionally think about the observations you will make and the data you will collect and prepare appropriate data and observation tables.

Gathering Evidence
- Wear goggles and a lab apron throughout the investigation.
- Select at least five chemical samples from the table in the center of the lab.
- Use forceps or plastic gloves when handling the samples.
- Write a description of the physical properties of your samples.
- Use the same mass of each sample (∓0.2 grams)
Analyzing Evidence
1. Calculate the molar mass of each sample. Show all of your work.
2. Calculate the number of moles present in each sample. Show all of your work.
3. Calculate the number of atoms or molecules present in each sample. Show all of your work.

Interpreting Evidence
4. What did your samples have in common, and how did they differ?
5. Use your answer from question 3 to find the total number of atoms of each sample of a compound.

Making Claims
6. Make a general statement about how the number of moles is related to the mass of the sample.
7. Make a general statement about how the number of atoms or molecules is related to the mass of the sample.
8. Research and find an analogy relating the size of Avogadro’s Number to an everyday item. Cite your sources.
9. In your own words and using evidence from the investigation, answer the scientific question(s) that you posed at the beginning of the investigation.

Reflecting on the Investigation
10. Think about your experimental design for the investigation. Did you need to make any modifications so that your data produced accurate results? Explain.
11. Think of another question you could have asked about your samples and describe how you would collect data to answer it.