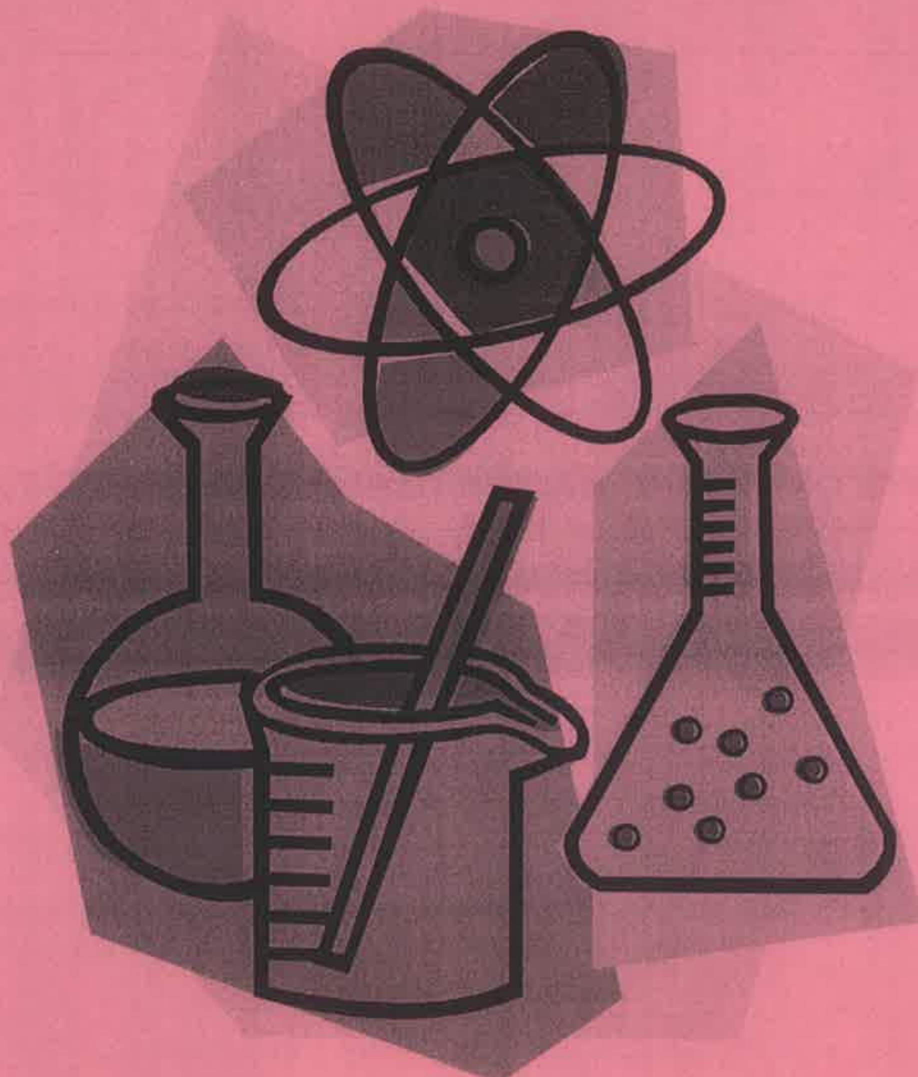
UNIT SIX:



The Math of Chemistry

Name:______________________________ Date: __________

HOW MANY MOLES?

INTRODUCTION: The term mole, seems an unlikely term as it is often confused with the dim, as in not bright, (a myth), nearly blind (sad but true) furry woodland creature. But, mole it is. Moles are actually quite versatile and are widely used in Chemistry. The term is a bit generic as is the term dozen. When we think of a dozen bananas we instantly envision 12 bananas. The term mole is used to "count" the number of particles of a substance, represent the mass of substances or even volume of gases.

One way moles are used is to count the number of particles of a substance. A mole of a substance is equal to 6.02×10^{23} representative particles of a substance. This is just as easy to remember as remembering a dozen is equal to 12

PURPOSE: To determine the number of moles in different common measurements.

SAFETY:

Make a list of all safety procedures related to this lab.

MATERIALS:

NaCl	Water	Chalk
Scale	Beaker	

)CEDURE:

PART 1: MOLES OF SODIUM CHLORIDE IN A TEASPOON OF SALT

1. Take a sample of sodium chloride and measure the mass of the sample.
2. Record the value.

PART 2: MOLES OF WATER IN ONE SIP

1. Take a sample of water and place it in a beaker. Measure the mass of the sample.
2. Take a "sip" of water out of the cup by dumping out some water.
3. Measure the mass of the sample after removing the "sip" of water.
4. Record all values.

PART 3: MOLES OF CHALK NEEDED TO WRITE YOUR NAME

1. Take a piece of chalk and measure the weight of the chalk.
2. Write your name on the chalk board.
3. Measure the weight of the chalk again.
4. Record all values.

CALCULATIONS:

1. Calculate the molecular mass of salt.
2. Convert the mass of the teaspoon of salt to moles (use significant figures).
3. Calculate the molecular mass of water.
4. Convert the mass of the sip of water to moles (use significant figures).
5. Calculate the molecular mass of chalk (calcium carbonate).
6. Convert the mass of the chalk used to moles (use significant figures).

OBSERVATIONS:

Mass of Sodium Chloride	Molecular Mass of Sodium Chloride	Moles of Sodium Chloride

Mass of Beaker	Mass of Beaker & Water	Mass of Beaker & Water after "sip"	Mass of "sip" of Water	Molecular Mass of Water	Moles of the "sip" of Water

Mass of Chalk Before Writing	Mass of Chalk After Writing	Mass of Chalk Used	Molecular Mass of Chalk	Moles of Chalk Used

QUESTIONS:

Copy and complete the following questions in your lab notebook.

1. How many moles does 80.0 grams of H_2O represent?
2. How many moles does 22.0 grams of CO_2 represent?
3. What is the mass of 5.0 moles of $Ba(CN)_2$?
4. What is the mass of 0.75 moles of $CuSO_4$?
5. Calculate the mass of:
   a. 2.00 moles of water
   b. 4.38 moles of chlorine
   c. 0.025 moles of ammonia
   d. 1.8 moles of oxygen
6. Calculate the number of moles in:
   a. 25 g of helium
   b. 12.5 g of methane
   c. 0.364 g of iodine
   d. 40.0 g of sodium

Name:_______________________ Date: _________

PERCENT COMPOSITION OF A HYDRATE

PURPOSE:

INTRODUCTION:

Hydrates are ionic compounds (salts) that have a definite amount of water as part of their structure. This water is called the water of hydration. The water is combined with the salt in a definite ration. Ratios vary in different hydrates but are specific for any given hydrate.

When hydrates are heated, the water of hydration is released as water vapor. This remaining solid is known as the anhydrous salt. The general reaction for heating a hydrate is:

$$\text{HYDRATE} + \xrightarrow{\Delta} \text{ANHYDROUS SALT} + \text{WATER}$$

* Δ This symbol over the arrow indicates the reactants were heated.

The percent of water in a hydrate is can be found experimentally by accurately determining the mass of the hydrate and the mass of the anhydrous salt. The percentage of the water in the original hydrate can be calculates as follows:

PERCENT OF WATER = (MASS OF WATER LOST / MASS OF HYDRATE) X 100

SAFETY:

MATERIALS:

Porcelain Evaporating Dish	Crucible Tongs	Microspatula	Electronic Balance	Ring Stand
Iron Ring	Clay Triangle	Bunsen Burner	Goggles	Copper Sulfate
Eye Dropper	Water	Insulating Pad		

PREPARATION OF THE EVAPORATING DISH:

PROCEDURE:

1. **Preparing the set up**
   a. Prepare the evaporating dish as seen in the diagram.
   b. Heat the dish in the hottest part of the flame for 2-3 minutes.
   c. Using crucible tongs, remove the evaporating dish and place it on the insulation pad to cool for 2-3 minutes.

2. **Measuring the mass of the hydrate and the evaporating dish**
   a. Carefully using tongs, carry your evaporating dish to a balance and find the mass of the empty evaporating dish and record it in your data table.
   b. With the evaporating dish still on the balance, measure about 2.00 grams of copper sulfate hydrate. Record the total mass.

3. **Heating the Hydrate.**
   a. Place the dish with the hydrate onto the clay triangle in your setup and heat gently for 2-3 minutes with a low flame.
   b. Increase the flame and heat strongly for another 305 minutes or until the blue color has disappeared. If the edges are too brown, remove the heat momentarily from underneath and resume heating with a lower flame.
   c. Remove the dish from the flame and place into the insulating pad to cool for only 1-2 minutes.

4. **Finding the mass of the hydrate after heating (Anhydrate!)**
   a. Carefully using tongs carry your evaporating dish to a balance and find the mass of the dish after the hydrate is heating. Record this mass.
   b. Using an eyedropper, add a few drops of water to the evaporating dish slowly. Record your observations under your recorded masses.

OBSERVATIONS:

MASS OF EVAPORATING DISH ____________________

MASS OF EVAPORATING DISH + HYDRATE ____________________

MASS OF EVAPORATING DISH + ANHYDRATE ____________________

OBSERVATIONS FOR STEP # 10: ______________________________

QUESTIONS:

1. What is the mass of the hydrate that you used?

2. Find the mass of the water that was lost.

3. Calculate the percentage of water that was originally in the hydrate using your experimental data.

4. Determine the theoretical (actual) % of water that is supposed to be in the hydrate using your periodic table. The formula is $CuSO_4 \bullet 5H_20$

5. Using the % of water from your data and the theoretical % of water from 4, find the percent error of your results.

6. Why should you allow the dish to cool after you heat the hydrate, before measuring the mass?

7. Why is it important to measure the mass of the anhydrous salt immediately after you cool it?

8. Explain what happened in step # 10.

9. It is possible that not all the water was removed from the hydrate when you heated it. How would this have affected your experimental value for the percent of water? (Explain whether it is less, more, same and why)

10. A student heats 9.00 grams of hydrate to a constant mass of 6.00 grams. Find the percent of water in this hydrate.