Name: _____

Date: _____

Gram Formula Mass

If a scientist wanted to produce water in the laboratory they would need 2 atoms of hydrogen for every 1 atom of oxygen. How can a scientist measure out exact quantities of atoms? THEY ARE UNABLE TO DO THIS because a single atom cannot be seen or measured directly. We are able to however take measurements of mass and volume. By using the quantity known as the mole, scientists are able to link the number of atoms or molecules (particles) of any substance to a macroscopic amount. **One mole is also equal to 6.02 x 10^{23} particles of a substance, 22.4 liters of a gas AND the gram-formula mass of a substance.**

Since we are able to take measurement of mass and one mole equals the gram formula mass (gfm) for a substance, we can now measure out an amount in grams and convert it to the exact number of molecules or atoms.

According to the periodic table, the atomic mass of hydrogen is 1.0 amu and oxygen is 16.0 amu but again, we are unable to directly measure atoms because of their size. Instead of using atomic mass units, we will now use a unit of grams. We now assume the mass of hydrogen is 1.0 gram and the mass of oxygen is 16.0 grams. To generate water, the following balanced reaction between hydrogen and oxygen gas occurs:

$$2\ H_2 + O_2 \rightarrow 2\ H_2O$$

4.0 g **32.0 g** **36.0 g** **(Mass is conserved)**

A scientist would need to measure out 4.0 g of hydrogen gas (the mass of 2 moles of hydrogen) and 32.0 g of oxygen gas (the mass of 1 mole of oxygen) to produce 36.0 grams of H_2O (the mass of 2 moles of water). This would give the scientist the correct ratio of hydrogen atoms to oxygen atoms to produce water. (Remember we need 2 H for every 1 O in the formula H_2O).

Look at following steps to calculate the gram formula mass of the following compound:

$$Na_2CO_3$$

1. **Count the number of each type of atom:**
   a. 2 Na
   b. 1 C
   c. 3 O
2. **Look up in the Periodic Table the atomic mass of each element. (Round to the nearest tenth)**
   a. Na= 23.0 g
   b. C= 12.0 g
   c. O = 16.0 g
3. **Multiply the number of atoms by the mass of each element and add all of the values:**
   a. Na: 2 x 23.0 = 46.0 g
   b. C: 1 x 12.0 = 12.0 g
   c. O: 3 x 16.0 = 48.0 g

   46.0 + 12.0 + 48.0 = 106.0 g/mol

This is the amount of grams of Na_2CO_3 contained in 1 mole.

1 mole, or 6.02 x 10^{23} molecules, of sodium carbonate (Na_2CO_3) weighs 106.0 grams and a scientist could indeed me 106.0 grams using a lab balance.

Calculate the gram formula mass of the following compounds. Use the steps already shown to you on the previous page. **Round the masses from the Periodic table to the nearest whole number**

	Formula	# of atoms of each element	Multiply each number of atoms by its formula mass from the periodic table.	Add up the numbers to get the gram formula mass of the compound
1	NaCl			
2	H_2SO_4			
3	CH_4			
4	$Mg(OH)_2$			
5	LiF			
6	$CaCO_3$			
7	NH_4OH			
8	$Mg_3(PO_4)_2$			
9	$C_6H_{12}O_6$			
10	F_2			

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