Name:	Date:	
Chemistry ~ Ms. Hart Class: 6.6 The Mole	Anions or Cations	SCHOOL FOR CRIMINAL JUSTICE
1Mg +O <sub>2</sub> $\rightarrow$ MgO	How many moles of Mg, O <sub>2</sub> , and MgO are there?	What is the mole ratio of Mg: MgO?
What kind of reaction is this?	Mg O <sub>2</sub> MgO	What is the mole ratio of O2:Mg?
2Sb +Cl <sub>2</sub> $\rightarrow$ SbCl <sub>3</sub>	How many moles of       Sb       Cl2       SbCl3	What is the mole ratio of Sb: Cl <sub>2</sub> ?
What kind of reaction is this?		
3 NaBr + $Cl_2 \rightarrow$ NaCl + Br <sub>2</sub>	How many moles of       NaBr       Cl2       NaCl       Br2	What is the mole ratio of NaBr: Br <sub>2</sub> ? What is the mole ratio of Br <sub>2</sub> : NaBr?
What kind of reaction is this?		
4NaClO <sub>3</sub> $\rightarrow$ NaCl +O <sub>2</sub>	How many moles of NaClO <sub>3</sub> NaCl O <sub>2</sub>	What is the mole ratio of NaCl: NaClO <sub>3</sub> ?
What kind of reaction is this?		
5 Fe + HCl $\rightarrow$ FeCl <sub>2</sub> + H <sub>2</sub>	How many moles of Fe HCl	What is the mole ratio of Fe: FeCl <sub>2</sub> ?

	FeCl <sub>2</sub>	
	H <sub>2</sub>	
What kind of reaction is this?		
	How many moles of	What is the mole ratio of
$6. \qquad \underline{\qquad N_2 + \_ O_2 \rightarrow \_ N_2O_5}$	N <sub>2</sub>	$N_2O_5: N_2?$
	0	
	N <sub>2</sub> O <sub>5</sub>	
What kind of reaction is this?		
		Million the media with the
7. $MgCO_2 \rightarrow MgO + CO_2$	How many moles of	what is the mole ratio of MgO: $CO_2$ ?
	MgCO <sub>3</sub>	
	MgO	
	CO <sub>2</sub>	What is the mole ratio of
		CO <sub>2</sub> : MgO?
Mat hind of magation is this?		
what kind of reaction is this?		
0	How many moles of	What is the male ratio of
8. $MgBr_2 + Cl_2 \rightarrow MgCl_2 +$	MgBr <sub>2</sub>	What is the mole ratio of $MgBr_2$ : $MgCl_2$
$\frac{1}{\mathrm{Br}_2} = \frac{\mathrm{Br}_2}{\mathrm{Br}_2} = \mathrm{$	Cl <sub>2</sub>	1122121112012
	MgCl <sub>2</sub>	
	Br <sub>2</sub>	
What kind of reaction is this?		
	How many moles of	What is the mole ratio of
9	7	Cu: Zn?
$\underline{\qquad} Zn + \underline{\qquad} CuSO_4 \rightarrow \underline{\qquad} Cu + \underline{\qquad} ZnSO_4$		
	CuSO <sub>4</sub>	
	Cu	
IATh at him d of monotice in this ?	ZnSO <sub>4</sub>	
what Kina of reaction is this?		
	How many moles of	What is the mole ratio of
$10. \_$ NH4NU2 7N2 +H2U	NH4NO2	п20 : Nп4NU2?
	N2	
	H2O	
What kind of reaction is this?		

#### **Stoichiometry Part I: Mole to Mole**

Example 1:

Using the chemical equation below:

 $2 \operatorname{Al} + 3 \operatorname{CuSO}_4 \xrightarrow{} \operatorname{Al}_2(\operatorname{SO}_4)_3 + 3 \operatorname{Cu}$ 

What is the number of moles of Al needed if 9 moles of Cu is produced?

**Step 1.** Write the given (include units!). Given= \_

Step 2. What are we looking for (include units!) Want to know: \_\_\_\_\_

Step 3. What is the mole-to-mole ratio between the given and the compound we are looking for?

**Step 4:** List the given first and then multiply it by the ratio we found in step 3 so that the unit for what we want to know is the only factor left over.

## Example 2:

Using the chemical equation below:

 $4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$ 

If 10 moles of Fe is used, how many moles of  $Fe_2O_3$  is produced?

Step 1. Write the given (include units!). Given=\_\_\_\_\_

Step 2. What are we looking for (include units!) Want to know: \_\_\_\_\_

Step 3. What is the mole-to-mole ratio between the given and the compound we are looking for?

**Step 4:** List the given first and then multiply it by the ratio we found in step 3 so that the unit for what we want to know is the only factor left over.

## Example 3:

Using the chemical equation below: N<sub>2</sub>O<sub>5</sub> + H<sub>2</sub>O → 2HNO<sub>3</sub> How many moles of HNO<sub>3</sub> is produced if 17 moles of H<sub>2</sub>O is reacted?

#### Example 4:

Given the reaction:  $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$ 

What is the total number of moles of Ca needed to react completely with 4.0 moles of H<sub>2</sub>O?

- (1) 1.0
- (2) 2.0
- (3) 0.50
- (4) 4.0

## Practice Part I: Mole-to-mole conversion (complete on loose leaf!)

- 1. Determine the number of moles of Ca produced when you start with 3 moles of CaCl<sub>2</sub> in the chemical reaction: CaCl<sub>2</sub>  $\rightarrow$  Ca + Cl<sub>2</sub>
- 2. Determine the number of moles of MgO produced when you start with 4 moles of Mg in the chemical reaction:  $2 \text{ Mg} + O_2 \rightarrow 2 \text{ MgO}$
- 3. Determine the number of moles of MgO produced when you start with 5 moles of  $O_2$  in the chemical reaction:  $2 \text{ Mg} + O_2 \rightarrow 2 \text{ MgO}$ .
- 4. Some dry chemicals can be used to put out forest fires. One of these chemicals is  $NaHCO_3$ . When  $NaHCO_3(s)$  is heated, one of the products is  $CO_2(g)$ , as shown in the balanced equation below.

 $2 \text{ NaHCO}_3 + \text{heat} \rightarrow \text{Na}_2\text{CO}_3(s) + \text{H}_2\text{O}(g) + \text{CO}_2(g)$ 

- a) Show the correct numerical setup for calculating the percent composition by mass of carbon in the product Na<sub>2</sub>CO<sub>3</sub>.
- b) Determine the total number of moles of  $CO_2(g)$  produced when 7.0 moles of  $NaHCO_3(s)$  is completely reacted.

## **Stoichiometry Part II: Moles – Grams!**

## Example 1:

What is the mass of 4.76 moles of  $Na_3PO_4$  (gram-formula mass = 164 grams/mole)?

**Step 1.** *List the given. (Write units!)* Given = \_\_\_\_\_

Step 2. Determine what we need to find. (Write units!) Need to find = \_\_\_\_\_

Step 3. Calculate the gram formula mass of the molecule that we are dealing with.

Well... in this case, we already have it: Gram formula mass of \_\_\_\_\_ =

**Step 4.** Set up by listing the given first and multiply it the gram-formula mass we found in step 3 so that the unit for what we want to know is the only factor left over.



What is the mass of $5.36$ moles of $H_2O$ ?	
<b>Step 1.</b> List the given. (Write units!)Given =	
<b>Step 2.</b> Determine what we need to find. (Write units!)	Need to find =

**Step 3.** Calculate the gram formula mass of the molecule that we are dealing with.

Gram formula mass of \_\_\_\_\_ =

**Step 4.** Set up by listing the given first and multiply it the gram-formula mass we found in step 3 so that the unit for what we want to know is the only factor left over.

## **Stoichiometry Part III: Gram-to-mole conversions**

• We can convert from gram-to-mole using the same method.

## Example 1:

Determine the total number of moles of  $CH_3Br$  in 19 grams of  $CH_3Br$  (gram-formula mass = 95 grams/mol).

**Step 1.** *List the given. (Write units!)* Given = \_\_\_\_\_

Step 2. Determine what we need to find. (Write units!) Need to find = \_\_\_\_\_

**Step 3.** Calculate the gram formula mass of the molecule that we are dealing with.

Well... in this case, we already have it: Gram formula mass of \_\_\_\_\_ =

**Step 4.** Set up by listing the given first and multiply it by the gram-formula mass we found in step 3 so that the unit for what we want to know is the only factor left over.

<b>Example 2:</b> What is the total number of moles in 80.0 grams of $C_2H_5Cl$ (gram-formula mass = 64.5 grams/mol).
Step 1. List the given. (Write units!) Given =
<b>Step 2.</b> <i>Determine what we need to find. (Write units!)</i> Need to find =

**Step 3.** Calculate the gram formula mass of the molecule that we are dealing with.

**Step 4.** Set up by listing the given first and multiply it by the gram-formula mass we found in step 3 so that the unit for what we want to know is the only factor left over.

# Part II: Mole-to-gram Conversions Practice!

- 5. What is the mass of 4 moles of Li?
- 6. Approximately how many grams of HCl do you have if there are 3 moles of HCl?
- 7. Approximately how many grams of  $H_2SO_4$  do you have if there are 2 moles of  $H_2SO_4$ ?

# Part III: Gram-to-mole conversion

- 8. Approximately how many moles of Na do you have if there are 69 grams of Na?
- 9. Approximately how many moles of KCl do you have if there are 150 grams of KCl?
- 10. Approximately how many moles of  $H_2SO_4$  do you have if there are 392 grams of  $H_2SO_4$ ?

# Additional Practice/Homework:

1. According to the reaction $2Al + 3H_2SO_4 \rightarrow 3H_2 + Alg$ H <sub>2</sub> SO <sub>4</sub> needed to react completely with 5 mol of Al is				Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> , the total number of moles of l is	
(1)	2.5	mol	(2) 5 mol	(3) 7.5 mol	(4) 9 mol
	2.	Given the equation $N_2$ when 10 mol of $H_2$ rea	$_2 + 3H_2 \rightarrow 2NH_3$ , what is the the total completely with N <sub>2</sub> ?	otal number of moles of N	H <sub>3</sub> produced
(1)	2 m	nol	(2) 3 mol	(3) 6.7 mol	(4) 15 mol
	3. If 4	The process of photos $6CO_2 + 6H_2O + energ$ mol of C <sub>6</sub> H <sub>12</sub> O <sub>6</sub> is prod	ynthesis can be represented h y $\rightarrow C_6 H_{12}O_6 + 6O_2$ uced by the process, how man	by the following equation, ny moles of CO2 and H2O w	ere used?
	4.	Given the equation M with 0.5 mol of magne	$g + 2HCl \rightarrow MgCl_2 + H_2$ , how esium?	many moles of HCl are need	eded to react

(1) 0.5 mol (2) 1 mol (3) 2 mol (4) 4 mol

5. Consider the	e following equation:	$2C_2H_6 + O_2 \rightarrow 4CO_2 + 6H_2O$	
When 4 mol of 0	C <sub>2</sub> H <sub>6</sub> are burned the num	ber of moles of CO <sub>2</sub> produced will be	
(1) 2 mol	(2) 6 mol	(3) 7 mol	(4) 8 mol