

# General Chemistry I – CHM1045

## (Chapter 4) Chemical Stoichiometry

### Definitions:

Chemical Stoichiometry is the numerical relationships between the amounts of reactant and products in a chemical reaction.

### Problem Solving Guide:

**Step 1:** Identify the given information.

**Step 2:** Identify what the problem wants you to find.

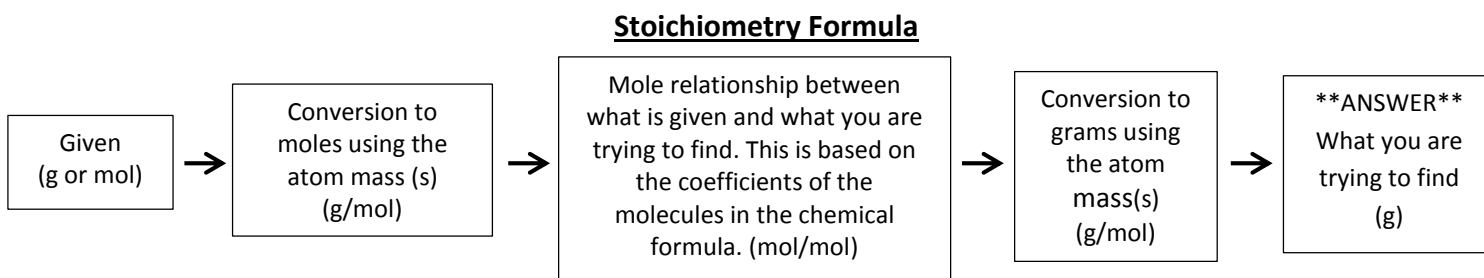
**Step 3:** Set up your stoichiometry formula.

**Step 4:** Input the given mass. If the mass is given in moles skip step 5.

**Step 5:** Convert the mass from grams (g) to moles (mol) by using the atomic mass (s).

**Step 6:** This is the bridge that uses the given information to find out the answer. This step combines the reactant coefficient and the product coefficient (mole to mole ratio).

**Step 7:** Convert the mass from moles (mol) to grams (g) by using the atomic mass (s).



\*\*\*At the end of your stoichiometry formula you should be left in the units that you are trying to find (grams or moles).\*\*\*

### Mole Relationships (Ratios)

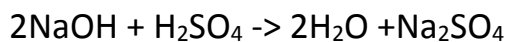
1. **What is it?** We can use these ratios to determine what amount of a molecule, in **moles**, will react with or produce a given number of **moles** of a different molecule.
2. **How do you find it?** The mole ratios can be found by looking at the coefficients associated with each molecule. Coefficients are the large numbers that are in the front of each molecule. If there is no number in front of the molecule it means that there is only one (1) mole of the molecule in the reaction.

Chemical Formula	$2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow 2\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$			
Molecule	NaOH	H <sub>2</sub> SO <sub>4</sub>	H <sub>2</sub> O	Na <sub>2</sub> SO <sub>4</sub>
Mole Ratio	2	1	2	1

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## Example:

How many grams of sodium sulfate will be formed if 89.3 grams of sodium hydroxide was used in the reaction? There will be an excess of sulfuric acid.



Molecular Mass:  
 $\text{Na}_2\text{SO}_4 = 142.1 \text{ grams/mol}$   
 $\text{NaOH} = 40 \text{ grams/mol}$

<del>89.3 g NaOH</del>	<del>1 mol NaOH</del>	<del>1 mol Na<sub>2</sub>SO<sub>4</sub></del>	<del>142.1 g Na<sub>2</sub>SO<sub>4</sub></del>	158.6 g Na <sub>2</sub> SO <sub>4</sub>	⇒	159 g Na <sub>2</sub> SO <sub>4</sub> (3 sig. fig)
	<del>40 g NaOH</del>	<del>2 mol NaOH</del>	<del>1 mol Na<sub>2</sub>SO<sub>4</sub></del>			

## Practice:

- Oxygen gas can be produced by decomposing potassium chlorate using the reaction below. If 138.6 g of  $\text{KClO}_3$  is heated and decomposes completely, what mass of oxygen gas is produced?  
 $2\text{KClO}_3 (\text{s}) \rightarrow 2\text{KCl} (\text{s}) + 3\text{O}_2$
- Calculate how many grams of HF will be made if you start with 5.33 mol  $\text{F}_2$ .  
 $5\text{F}_2 (\text{g}) + 2\text{NH}_3 (\text{g}) \rightarrow \text{N}_2\text{F}_4 (\text{g}) + 6\text{HF} (\text{g})$
- How many grams of aluminum sulfate are produced if you react 74.44 g  $\text{CuSO}_4$ ?  
 $2\text{Al} (\text{s}) + 3\text{CuSO}_4 (\text{aq}) \rightarrow \text{Al}_2(\text{SO}_4)_3 (\text{aq}) + 3\text{Cu} (\text{s})$
- How many grams of  $\text{O}_2$  will be produced by 12.00 moles of  $\text{NaClO}_3$ ?  
 $2\text{NaClO}_3 (\text{s}) \rightarrow 2\text{NaCl} (\text{s}) + 3\text{O}_2 (\text{g})$
- How many grams of NaCl are produced when 80.0 grams of  $\text{O}_2$  are produced?  
 $2\text{NaClO}_3 (\text{s}) \rightarrow 2\text{NaCl} (\text{s}) + 3\text{O}_2 (\text{g})$
- The average human requires 120.0 grams of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) per day. How many grams of  $\text{CO}_2$  (in the photosynthesis reaction) are required for this amount of glucose?  
 $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
- Molten iron and carbon monoxide are produced in a blast furnace by the reaction of iron(III) oxide and coke (pure carbon). If 25.0 kilograms of pure  $\text{Fe}_2\text{O}_3$  is used, how many kilograms of iron can be produced?  
 $\text{Fe}_2\text{O}_3 + 3\text{C} \rightarrow 2\text{Fe} + 3\text{CO}$
- How many moles of Cu are needed to react with 3.50 moles of  $\text{AgNO}_3$ ?  
 $\text{Cu} + 2\text{AgNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{Ag}$
- What mass of iron is needed to react with 16.0 grams of sulfur?  
 $8\text{Fe} + \text{S}_8 \rightarrow 8\text{FeS}$
- How many grams of  $\text{Na}_2\text{O}$  are required to produce  $1.60 \times 10^2$  grams of NaOH?  
 $\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{NaOH}$

Answers: 1) 54.286 g O<sub>2</sub> 2) 127.92 g HF 3) 53.23 g Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> 4) 576.00 g O<sub>2</sub> 5) 97.417 g NaCl 6) 175.9 g CO<sub>2</sub> 7) 17.5 kg Fe 8) 1.75 mol Cu 9) 27.9 g Fe 10) 43.9 g FeS