Name: ______________________________________ Period: ____ Date: ______

REACTIONS / MOLES / STOICHIOMETRY NOTES
HONORS CHEMISTRY

Directions: This packet will serve as your notes for this chapter. Follow along with the PowerPoint presentation and fill in the missing information. Important terms / ideas are in all capitals and bolded!

- **CHEMICAL REACTION**:

  -Changes the way ________ are __________ together

  -Atoms _______________ be created or destroyed!

- Indicators of a Reaction

  1) 3)

  2) 4)

- **CHEMICAL EQUATION**:

  -**REACTANTS**:

  -**PRODUCTS**:

  __________________ → __________________

- Symbols in Equations

  ____ separates the reactants

  ____ separates reactants from products

  ____ indicates a reversible reaction

  ____ solid

  ____ gas

  ____ liquid

  ____ aqueous or water solution

  ____ indicates heat is supplied

  CATALYST:

- Rules for Writing Equations

  1) Reactants must be on the ________

  2) Products must be on the _________

  3) Correct ____________ (and ___________) should be written

  4) An __________ should separate the products from reactants

  -Ex:

- Equation Practice

  -Examples: Write the skeleton equation for each reaction:

  - Hydrogen (g) + Bromine (g) form ________________________

  - Potassium chlorate breaks down into _____________________ and ____________

- Balancing Chemical Equations

  -Since we cannot break the ________________________________, equations MUST be balanced

  -Balanced equations have the ______________ of each type of atom on both sides of the equation

  -____________________ go in _________ of the formulas so the # of atoms of each element is the same on each side

  WHAT GOES ____ = WHAT COMES _______!

  -Coefficients vs. Subscripts:

- Equation Examples

  -Example #1:

  -Example #2:

- Errors to Avoid

  -NEVER change a ________________ to balance an equation

  - Ex: ________ is a different compound than _________

  -NEVER put a _____________________ in the middle of a formula

  - Ex:

- Best Rule for Balancing…

  MAKE A _______________________________________!!

  -Show it:

- Balancing Chemical Equations

  -Example #1:

  -Example #2:

***If a polyatomic ion is present on _______ sides of the equation, it can be placed in the table as a __________ and not be _________!**

- Balancing Practice

  -Examples: Make a Reactants / Products Table and balance.

  - ________ + ________ ➔ _____________

  - ________ + ________ ➔ _____________

  - ________ + _____________ ➔ ________ + _____________

- Types of Reactions

  -_____________ of reactions exist… but there are only several categories of reactions

  -We will examine ________ types:

- **SYNTHESIS REACTION**:

  _____ + _____ ➔ _________

  -Example: ___________… Iron plus oxygen produces __________________

  -Example: Predict the products for the reaction and balance.

- **DECOMPOSITION REACTION**:

  _________ ➔ _____ + _____

  -Example: ________ decomposes into carbon and water with the help of a ___________

  -Example: Predict the products for the reaction and balance.

- **SINGLE-REPLACEMENT REACTION**:

  _____ + _________ ➔ _____ + _________

  -Metals replace __________, nonmetals replace _______________!!

  -Sometimes it ______________!! A must be ________________ than B!!

-**ACTIVITY SERIES**

- Higher metal (_________________) can _______________ any metal lower than it, otherwise _______________ WILL OCCUR!!
- Metals from Li to Na will ____________ H from acids and water… from Mg to Pb will _____________ H from _________ only!
- Higher halogens (_____________) can ____________ any halogen lower than it!!

  Write the list:

Activity Series of Metals (Decreasing reactivity ↓)

Name	Symbol
Lithium	Li
Potassium	K
Calcium	Ca
Sodium	Na
Magnesium	Mg
Aluminum	Al
Zinc	Zn
Iron	Fe
Lead	Pb
(Hydrogen)	(H)*
Copper	Cu
Mercury	Hg
Silver	Ag

Most Reactive

Li	Lithium
K	Potassium
Ba	Barium
Sr	Strontium
Ca	Calcium
Na	Sodium
Mg	Magnesium
Al	Aluminum
Mn	Manganese
Zn	Zinc
Cr	Chromium
Fe	Iron
Cd	Cadmium
Co	Cobalt
Ni	Nickel
Sn	Tin
Pb	Lead
H	Hydrogen
Sb	Antimony
As	Arsenic
Bi	Bismuth
Cu	Copper
Hg	Mercury
Ag	Silver
Pt	Platinum
Au	Gold

Least Reactive

ONLY IF ___ IS MORE REACTIVE THAN ___!!

-Example: Many _________ (but not all) will displace ________________ with an acid

-Example: Predict the products for the reaction and balance.

-Example: Predict the products for the reaction and balance.

- **DOUBLE-REPLACEMENT REACTION**:

_________ + _________ → _________ + _________

-Metals in the compound are ALWAYS written __________!!

-Sometimes these ______________ either!

-Usually involves a ____________________!!

-Example: Precipitate is formed from the reaction of two _____________ solutions

-Example: Predict the products for the reaction and balance.

- **COMBUSTION REACTION**:

__________ + _____ → __________ + __________

-If the reaction is COMPLETE, the products are always _________ and _________!! If INCOMPLETE, the products are _________ and _________!

-Example: Burning a __________________ in the presence of ____________ (very common to us) producing __________

-Example: Predict the products for the reaction and balance.

- Determining the Reaction Type

-Examine the ________________ to determine the type: (E = element / C = compound)

  - E + E ______________________
  - C + C → C ______________________
  - C ______________________
  - E + C ______________________
  - C + C → C + C ______________________
  - $CH + O_2$ ______________________

- Reactions Practice

-Examples: Determine the type of reaction for each. Then, predict the products and balance.

  - ________ + ________ →
  - _____________ + ________ →
  - ________ + _____________ →
  - _____________ →
  - _____________ + ________ →
  - _____________ + _____________ →

- Measurement

  -We can measure by mass or volume or we can ___________ pieces

  -We measure mass in _________

  -We measure volume in __________

  -We count pieces in numbers, or ___________, or __________, or… ____________!

- Conversion

  -Mole conversions are useful but not ______________ in a lab…

  1 mole element = ____________________ (grams)

  -Get it right from the _______________________!!

  -For example, 1 mole of arsenic has ________ g

- **MOLAR MASS**:

  -How to Determine Molar Mass:

  1) Determine the # of _______ of the individual elements that make up the compound (just look at the _____________)
  2) Look up the ________ of each element
  3) Multiply the ________ of each by the # of ________ of each
  4) Add up the _____________

  -Example: Find the molar mass of glucose (_____________).

- Practice

  -Examples: Calculate the molar mass of each.

  - __________:

- __________:

- __________:

- **PERCENT COMPOSITION**:

  -Determine the mass of each _________ and divide each by the total mass of the ___________

  -Formula:

  -Example: Calculate the % composition of a compound that is _____ g of Ag and ______ g of S.

  -Example: A compound is formed when ______ g Mg combines with ______ g N. What is the % composition?

  -Example: Calculate the % composition of ___________.

  -Example: What is the % composition of ________?

- **MOLE**:

  -When measuring ________________ and ________, we use moles

  -Used to count very ___________ items

  -Helps convert from the _______________________ to the _____________________

  -BUT, WHAT AMOUNT?: _______________________ "____________________________"

  -THAT AMOUNT, BUT OF WHAT?

  - **REPRESENTATIVE PARTICLES**:

    Ex:

- Conversions

  1 mole = __________________ atoms

  1 mole = __________________ molecules

  1 mole = __________________ formula units

  These can be used in _________________________________ problems!!

- Atoms to Moles

  -Example: A sample of Mg has ________________ atoms of Mg. How many moles of Mg are contained in the sample?

- Practice

  -Example: How many atoms are there in _______ moles of Xe?

  -Example: How many moles of $MgCl_2$ are __________________ formula units of $MgCl_2$?

  -Example: How many molecules of CO_2 are there in ________ moles of CO_2?

- Mole-Mass Relationship

  -Sometimes it is convenient to have measurements in ________ instead of ________

  -We already know that __________ = __________ from the Periodic Table

  -____________ using Dimensional Analysis!

  -Example: How many grams are there in _______ moles of H_2O?

  -Example: How many moles are there in _____ grams of Cu?

- Practice

  -Example: How many moles is ________ g NaOH?

  -Example: How many grams are there in _________ moles of CO_2?

  -Example: How many atoms are there in ________ g of C?

- Mole-Volume Relationship

  -Many chemicals exist as _________ but difficult to ________

  -Moles of a gas can be related to volume (______), but temperature and pressure also play a role

  -**Standard Temp. and Pressure (STP)**:

  -At STP:

1 mole gas = _________ liters

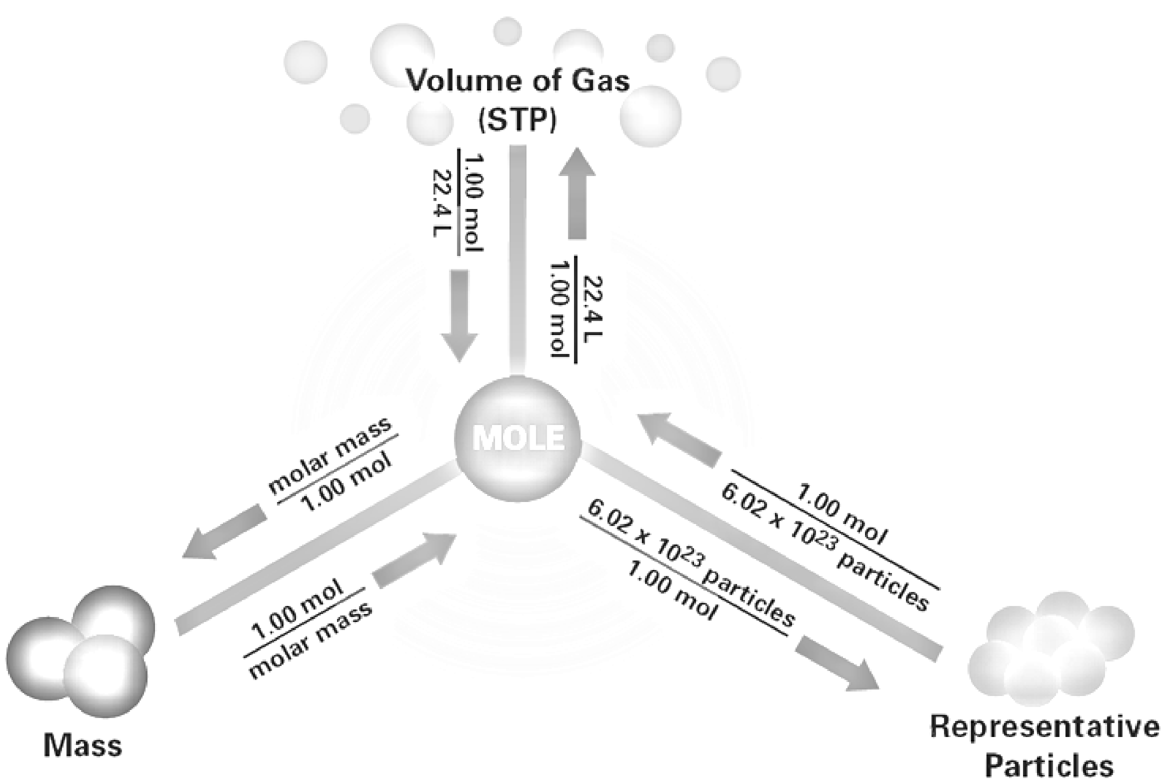
-Example: What is the volume of ______ moles of CO_2 at STP?

-Example: What is the volume of ______ grams of He at STP?

- Practice

-Example: How many moles are _______ L of O_2 at STP?

-Example: What is the volume of _____ g of CH_4 at STP?



- **EMPIRICAL FORMULA**:

  -How to Determine:

  1) Change the % to _______ (if necessary)

  2) Convert grams to ________ for each element

  3) Divide **ALL** of the mole answers by the _______________ (mole ratio)

  4) If all ___________, then move on… if not then _____________ to get whole #

  5) Use the whole # to represent the number of each ___________… write the formula

  -Example: Determine the empirical formula of the following compound: ________% C, ________% O, and ________% Cl.

- Practice

  -Example: Determine the empirical formula of a compound that is ________% K, ________% C, ________% H, and ________% O.

  -Example: Methamphetamine is made of ________% C, ________% H, and ________% N. What is its empirical formula?

- **MOLECULAR FORMULA**:

-How to Determine:

1) Calculate the _______________ formula (if needed)

2) Calculate the _________________ of the empirical formula

3) Divide the given _______________ molar mass by the ________________ molar mass

4) Multiply ________________ of empirical formula by this #

5) Write the molecular formula

-Example: Determine the molecular formula of a compound composed of _______% C and _______% H with a molar mass of 70 g/mol.

-Combustion Example: Combustion of 10.68 g of Vitamin C (containing only C, H, and O) yields _______ g of CO_2 and _______ g of H_2O. The molar mass of the compound is 176.1 g/mol. What are the empirical and molecular formulas of this compound?

-Example: A compound is known to be composed of _______% C, _______% H, and _______% Cl. Its molar mass is known to be 197.92 g. What is its molecular formula?

- **STOICHIOMETRY**:

  -Balanced equation is much like a ___________… tells you the necessary _________________, amounts, and the amount of product that will be made

  -Use this information to "_____________" the ____________ to make how much you want

  -Example: ___ eggs + ___ cups flour + ___ cup sugar + ___ cups milk ➔ ___ cookies

  I need ___ eggs for every ___ cookies

  I need ___ cups flour for every ___ sugar

  I need ___ cups milk for every ___ cookies

  There's a __________ for each ingredient and product!

  -Example: ___ H_2 + ___O_2 ➔ ___ H_2O

  I need ___ H_2 for every ___ O_2

  I need ___ H_2O for every ___ O_2

  I need ___ H_2 for every ___ H_2O

  There's a ___________ for each reactant and product… ___________________!!

- Balanced Equations

  -Coefficients in a balanced chemical equation can represent a ratio of ________, molecules, _________(gases), or _________... NOT _________!

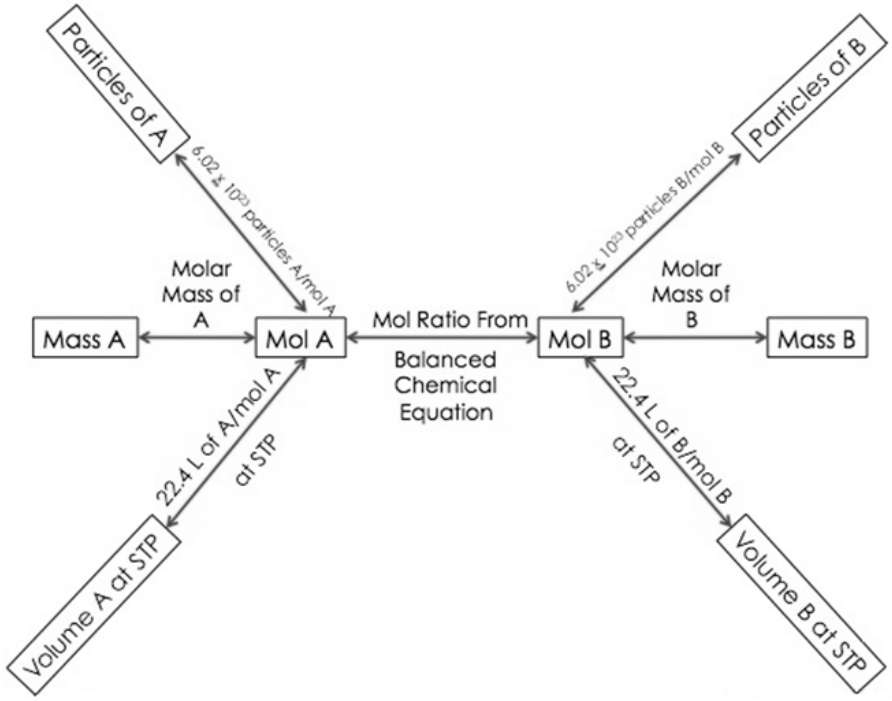
  -Convert from an amount of one ________________ to another or to amounts of ___________

  -Use ____________________

  Equations must be _____________________________ and _______________ in order to do these problems!!

- Stoichiometry Problems

  -Always follow this same basic format…



- Mole to Mole Conversions

  -Example: Sodium and chlorine gas react to produce sodium chloride. How many moles of sodium chloride can be produced from _______ moles of sodium?

  -Example: How many moles of O_2 are produced when ______ moles of aluminum oxide decompose?

- Mass to Mass Conversions

  -Example: If ______ g of Fe (3+) are added to a solution of copper (II) sulfate, how much solid copper would form?

  -Example: Silicon computer chips are made using the following reaction: $SiCl_4 + 2\ Mg \rightarrow 2\ MgCl_2 + Si$. How many grams of Mg are needed to make _____ g of Si?

- Mass to Volume Conversions

  -Example: Potassium metal reacts with water to produce potassium hydroxide and hydrogen gas. If _____ g K is reacted completely, how many liters of H_2 gas can be produced at STP?

- Practice

  -Example: In order to combust _____ moles of C_2H_2, how many moles of O_2 are required? Balance the following: $C_2H_2 + O_2 \rightarrow CO_2 + H_2O$

  -Example: Sodium and chlorine gas react to give sodium chloride. If you end up with _____ g of NaCl, how many grams of Na did you start with?

  -Example: If Mg and ______ L of HCl gas are reacted, how many grams of $MgCl_2$ are formed?

- **LIMITING REAGENT**:

  -Amount of reactants available for a reaction ________ the amount of product that can be made

  -**EXCESS REAGENT**:

  -To determine the limiting reagent, you must do _____ stoichiometry problems with the reactants

  -Reactant that makes the __________ amount of ___________ is the limiting reagent!!!

  -How to Determine:

  1) Convert to ________ for each of the givens (remember two problems!)

  2) Use the _____________ to convert to moles of the product

3) Keep going to ________ of the product (could just compare moles, but usually the question asks you this anyway)

4) Reactant that produces the __________ product is the limiting reactant

- Limiting Reagent Problems

  -Example: Copper reacts with sulfur to form copper (I) sulfide. If _____ g of Cu reacts with ______ g S, how much product will be formed?

  -Example: How much of the __________ reagent will be left over from the previous problem?

- Practice

  -Example: Identify the limiting reagent and how much ammonia gas can be produced when ____ g of nitrogen gas reacts with ____ g of hydrogen gas.

  -Example: How many _______ of excess reagent are left over from the previous problem?

  -Example: Use the equation: $Mg + 2\ HCl \rightarrow MgCl_2 + H_2$. Identify the limiting reagent when ____ g HCl reacts with _____ g Mg. How much $MgCl_2$ will form?

- **PERCENT YIELD**:

  -No one is ____________ in the laboratory... used to figure out how ______________ the methods were

  -**ACTUAL YIELD**:

  -**THEORETICAL YIELD**:

  -Equation:

  -How to Determine:

  1) __________ is given or found in lab
  2) Calculate __________________ by dimensional analysis (may need limiting reagent)
  3) Use the ______________

  ***SHOULD __________ BE GREATER THAN _________... WHY?**

  -Example: A group of students determined that they should get _____ g of product from a reaction. They actually ended up with _____ g. What is their percent yield?

- Practice

  -Example: About _____ g of aluminum are reacted with _____ g of copper (II) sulfate producing aluminum sulfate and copper. If _____ g of copper are produced, what is the percent yield?