Name:_____**Period:**_____**Date:**_____
Ms. Randall
Unit 6: Moles and Chemical Reactions Workbook

The **bold, underlined** words are **important vocabulary words** that you should be able to define and use properly in explanations. This is a study guide for what you will be tested on throughout the year. The objectives are divided into categories of "**Knowledge**" (**what you have to *know***) and "**Application**" (**what you have to be able to *do***).

I. CHEMICAL FORMULAS, REACTIONS & STOICHIOMETRY		
	Knowledge	**Application**
1.	○ **Chemical formulas** are used to represent compounds. ○ The main types of chemical formulas include: **empirical**, **molecular**, and **structural**. ○ An **empirical formula** is the simplest whole-number ratio of atoms in a compound. ○ **Molecular formulas** are chemical formulas that show the *actual* ratio of atoms in a molecule of that compound. ○ **Structural formulas** can also be used to represent covalent compounds. These use lines to show covalent bonds between atoms and also show the geometrical arrangement of atoms in the compound.	○ Determine the empirical formula from a molecular formula ○ Draw structural formulas for covalent (molecular) compounds
2.	○ One **mole** of any substance is equal to 6.02×10^{23} pieces of that substance. ○ The **formula mass** of a compound is equal to the sum of the atomic masses of its atoms (units are **atomic mass units**) ○ The **molar mass (gram-formula mass)** of a substance is equal to the formula mass in *grams* – hence "gram-formula mass". ○ The mass of one mole of any substance is equal to its molar mass (gram-formula mass).	○ Calculate the molar mass (gram-formula mass) of a substance ○ Determine the molecular formula, given the empirical formula and the molar mass ○ Determine the number of moles of a substance, given its mass and vice versa
3.	○ The **percent composition** by mass of each element in a compound can be calculated mathematically.	○ Calculate the percent composition of any element in a given compound ○ Calculate the percent composition of water in a given hydrate
4.	○ Balanced chemical equations show **conservation of matter, energy, and charge**. ○ The coefficients in a balanced equation can be used to determine **mole ratios** in the reaction.	○ Balance equations, given the formulas for reactants and products ○ Calculate simple mole-mole ratios, given balanced equations
5.	○ Types of chemical reactions include **synthesis, decomposition, single replacement, and double replacement**.	○ Identify the different types of chemical reactions, given their chemical equations

Goal setting: Based upon your learning style results and the information above list at least two techniques you plan to use to study during this unit.

1.
2.

What grade would you like to achieve on this unit based on your efforts? _____%

Lesson 1: Chapter Diary 7

Objective: To summarize the concepts related to Moles and Stoichiometry.

Directions: After reading the Chapter diary 7 answer the following questions.

1. What is a mole?

2. What is the relationship between a mole and Avogadro's number?

3. How is Avogadro's number used in chemistry calculations?

4. What is the difference between an empirical formula and molecular formula?

List 10 facts from the reading

List any questions you may have from your reading:

Lesson 2: Chemistry and the Mole Date:_____

Objective: To define and calculate molar mass. To apply the formula relating mass in grams to moles

Lesson summary:

Check your understanding:

1. **Fill in the table below. Put an "M" if the substance is molecular/covalent, an "I" if ionic, and an "H" if a hydrate.**

	Formula	Moles of each atom	Gram formula mass		Formula	Moles of each atom	Total moles of atoms
a.	Example: $HClO_3$ M	1 mol H atoms 1 mol Cl atoms 3 mol O atoms	84 g/mol	d.	$CaCl_2$		
b.	$NH_4C_2H_3O_2$			e.	$Mg_3(PO_4)_2$		
c.	$Mg(OH)_2$			f.	$CH_3CH_2CH_3$		

1. How many **moles** are in 39.0 grams of LiF?

2. What is the **mass** of 4.5 moles of KOH?

Practice:

1. Calculate the gram-formula mass for each compound below. Show your work.

NaCl

$CuSO_4 \bullet 5H_2O$

H_2O

Cu

2. Determine the mass of each of the following quantities. Show your work.

2.0 mol of NaCl

3.25 mol of $CuSO_4 \bullet 5H_2O$

. 0.50 mol of H_2O

0.75 mol of Cu

3. Determine the number of moles in each of the following quantities. Use the GFM's given in to solve.

35 g of NaCl

110. g of $CuSO_4 \bullet 5H_2O$

108 g of H_2O

250. g of Cu

Lesson 3: Types of Formulas **Date:_____**

Objective: To compare and contrast Empirical and molecular formulas. To calculate the molecular formula from the empirical formula and molecular mass.

Check your understanding:

1. Identify each of the following as an empirical or molecular formula. If a formula is molecular, write its empirical formula.

Formula	**Empirical or Molecular?**	**Simplify if Molecular**	**Formula**	**Empirical or Molecular?**	**Simplify if Molecular**
NaCl			N_2O_4		
C_2H_6			$Ra(CN)_2$		
C_6H12O_6			$Ba(NO_3)_2$		

2. What is the molecular formula of a compound that has a mass of 56g and an empirical formula of CH_2?

Practice:

1. What is the molecular formula of a compound that has a mass of 289g and an empirical formula of NH3?

2. What is the molecular formula of a compound with a mass of 760g and an empirical formula of Cr_2O_3?

3. What is the molecular formula of a compound that has an empirical formula of NO_2 and molecular mass of 92.0 g?

4. A compound has an empirical formula of HCO_2 and a molecular mass of 90 grams per mole. What is the molecular formula of this compound?

Lesson 4 Types of Chemical Reactions **Date:_____**

Objective: Identify various types of reactions: synthesis, decomposition, single replacement, & double replacement

Check your Understanding:

SHOW ALL WORK!- Name the type of Reaction

1. $4Li + O_2 \longrightarrow 2\ LI_2O$

   Type of Reaction: _____

2. $Al + CuCl_2 \longrightarrow AlCl_3 + Cu$

   Type of Reaction: _____

3. $2AuBr_3 \longrightarrow 2Au + 3Br_2$

   Type of Reaction: _____

4. $BaCl_2 + Na_2SO_4 \longrightarrow 2NaCl + BaSO_4$

   Type of Reaction: _____

<u>Practice:</u> Determine if the following reactions are synthesis (S), decomposition (D), single replacement (SR), or double replacement (DR) reactions.

1. H_2 + Cl_2 → 2HCl _____
2. NaOH + HCl → NaCl + H_2O_____
3. $2NH_3$ → N_2 + $3H_2$_____
4. Mg + H_2SO_4 → $MgSO_4$ + H_2_____
5. F_2 + 2HBr → Br_2 + 2HF_____
6. $Zn(NO_3)_2$ + $CaCO_3$ → $Ca(NO_3)_2$ + $ZnCO_3$_____
7. 4Al + $3O_2$ → $2Al_2O_3$_____
8. $CuSO_4 \bullet 5H_2O$ → CuO + H_2SO_4 + $4H_2O$_____
9. SiF_6 + 6Xe → $SiXe_6$ + $3F_2$_____
10. $2\ NaClO_3 \rightarrow 2\ NaCl + 3\ O_2$ _____
11. $2\ AgNO_3 + Ni \rightarrow Ni(NO_3)_2 + 2\ Ag$_____
12. $H_2CO_3 \rightarrow H_2O + CO_2$ _____
13. $BaCO_3 \rightarrow BaO + CO_2$_____
14. $4\ Cr + 3\ O_2 \rightarrow 2\ Cr_2O_3$_____
15. $Ca + 2\ HCl \rightarrow CaCl_2 + H_2$ _____
16. $Ca(C_2H_3O_2)_2 + Na_2CO_3 \rightarrow CaCO_3 + 2\ NaC_2H_3O_2$ _____
17. $Cu(OH)_2 + 2\ HC_2H_3O_2 \rightarrow Cu(C_2H_3O_2)_2 + 2\ H_2O$_____
18. $8\ Cu + S_8 \rightarrow 8\ CuS$ _____
19. $P_4 + 5\ O_2 \rightarrow 2\ P_2O_5$_____
20. $2\ K + 2\ H_2O \rightarrow 2\ KOH + H_2$ _____

Lesson 5: Balancing Equations **Date:_____**

Objective: Balance a chemical reaction by adjusting only the coefficients

You Must Watch this!!!!!
Balancing chemical reactions

Check your understanding:

Balance the following equations in the space provided:

1. ___ Fe + ___ $AgNO_3$ → ___ $Fe(NO_3)_2$ + ___ Ag

2. ___ AgI + ___ $Fe_2(CO_3)_3$ → ___ FeI_3 + ___ Ag_2CO_3

3. ___ NaCl → ___ Na + ___ Cl_2

4. ___ H_2O → ___ H_2 + ___ O_2

Practice : Balance the following equations in the space provided

1) ___ $NaNO_3$ + ___ PbO → ___ $Pb(NO_3)_2$ + ___ Na_2O

2) ___ AgI + ___ $Fe_2(CO_3)_3$ → ___ FeI_3 + ___ Ag_2CO_3

3) ___ $C_2H_4O_2$ + ___ O_2 → ___ CO_2 + ___ H_2O

4) ___ $ZnSO_4$ + ___ Li_2CO_3 → ___ $ZnCO_3$ + ___ Li_2SO_4

5) ___ V_2O_5 + ___ CaS → ___ CaO + ___ V_2S_5

6) ___ $Mn(NO_2)_2$ + ___ $BeCl_2$ → ___ $Be(NO_2)_2$ + ___ $MnCl_2$

7) ___ AgBr + ___ $GaPO_4$ → ___ Ag_3PO_4 + ___ $GaBr_3$

8) ___ H_2SO_4 + ___ $B(OH)_3$ → __ $B_2(SO_4)_3$ + ___ H_2O

9) ___ Fe_2O_3 + ___ H_2 → ___ Fe + ___ H_2O

10) ___ Li + ___ N_2 → ___ Li_3N

11) ___ Zn + ___ HCl → ___ $ZnCl_2$ + ___ H_2

12) ___ NaCl + ___ $AgNO_3$ → ___ $NaNO_3$ + ___ AgCl

13) ___ Ca_3P_2 → ___ Ca + ___ P

14) ___ HCl + ___ F_2 → ___ HF + ___ Cl_2

15) ___ $(NH_3)_2CO_3$ + ___ $CaSO_4$ → ___ $CaCO_3$ + ___ $(NH_3)_2SO_4$

Lesson 6 : Calculating Mole Ratios **Date:_____**

Objective: Solve mole-mole Stoichiometry problems given a balanced reaction

Check your understanding: SHOW ALL WORK!

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

1. If 12 moles of C_3H_8 react completely, how many moles of H_2O are formed in the reaction above?

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

2. If 20 moles of CO_2 are formed, how many moles of O_2 reacted in the reaction above?

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

3. If 8 moles of O_2 react completely, how many moles of H_2O are formed in the reaction above?

$N_2 + 3H_2 \rightarrow 2NH_3$

4. If 2.5 moles of N_2 react completely, how many moles of NH_3 are formed in the reaction above?

Practice:

1. Use the balanced reaction below and the relationship that "1 mole of a compound = the gram formula mass of that compound" to answer the questions below.

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

a. Calculate the gram formula masses for the three substances seen in the reaction abov

b. How many moles are present in 54 grams of H_2O? (Remember: one mole of H_2O is ALWAYS equal to 18 grams)

c. What is the ratio of H_2O to H_2 moles according to the balanced reaction above?

d. Using the reaction above (remember, it is just like a recipe!), how many moles of H_2 would be produced if 4 moles of H_2O are used?

e. How many grams of H_2 are present in 4 moles of H_2?

f. What is the ratio of H_2 to O_2 in the reaction above?

g. If you have 2.5 moles of H_2O, how many moles of O_2 will be produced?

h. What is the ratio of H_2O to O_2 in the reaction above?

i. If you produce 0.25 moles of O_2, how many moles of H_2O did you react?

j. Convert 0.35 moles of H_2O to grams.

k. Convert 0.6 grams of H_2 to moles.

Lesson 7: Percent Composition **Date:_____**

Objective: To apply a formula to calculate % composition

Check your understanding:

1. What is the percentage by mass of carbon in CO_2?

2. What is the percent by mass of nitrogen in NH_4NO_3?

3. What is the percent by mass of oxygen in magnesium oxide?

4. What is the percent by mass of water in $BaCl_2 \bullet 2H_2O$?

5. Challenge Question: A 10.40 gram sample of hydrated crystal is heated to a constant mass of 8.72 grams. This means all of the water has been driven out by the heat.

   a) Calculate the mass of water that was driven out:

   b) Calculate the %mass of water in the hydrate.

Practice: <u>SHOW ALL WORK</u>

1. Determine the percent by mass of the given element in the following compound.

   % O in
   $CuSO_4 \bullet 5H_2O$

2. A substance known as heavy water can be obtained from ordinary water and could be a significant source of energy in the future. Heavy water contains deuterium, H-2. Instead of the two hydrogen atoms in a typical water molecule, a heavy water molecule has two deuterium atoms. In 3.78 kilograms of ordinary water, the percent composition by mass of heavy water is approximately 0.0156%.

   Calculate the mass of heavy water in a 3.78-kilogram sample of ordinary water. Your response must include *both* a correct numerical setup and the calculated result.

3. A sample of boron is approximately 3.14% B-6 by mass. The mass of just B-6 in this sample is 0.376 g. Calculate the total mass of the sample.

5. Determine the percent by mass of water in the following hydrates.
   a. $Na_2CO_3 \bullet 10H_2O$

   b. Initial mass of hydrate: 9.5 g
      Final mass of anhydrous salt: 3.77 g

Unit Study Guide

Law, Theories, BIG ideas	**Equations, Calculations, Reference Tables**
Laws:	Equation: (When to use & units)
Theories:	Calculations (When to use)
BIG ideas:	Reference Table (Hints & tricks)

Helpful tips, sayings, shortcuts

Things I always forget…

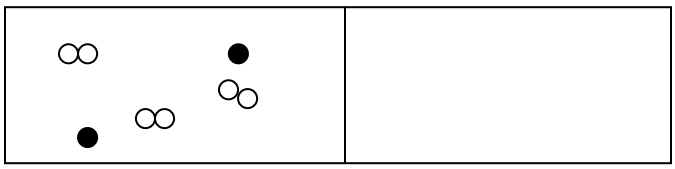
Unit Review:

Moles and Chemical Reactions

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can still do everything from Unit 1.	
_____2. I can still do everything from Unit 2.	
_____3. I can still do everything from Unit 3.	
_____4. I can still do everything from Unit 4.	
_____5. I can still do everything from Unit 5.	
_____6. I can calculate the gram formula mass of a compound or substance	**a. O_2** **b. Na_3PO_4**
_____7. I can calculate the number of moles of a substance when given the mass	**a. 64g O_2** **b. 567 g Na_3PO_4**
_____8. I can calculate the of the mass a substance when given number of moles	**a. 7 moles O_2** **b. 0.6 moles Na_3PO_4**

_____9. I can define empirical formula, molecular formula, and hydrate.	**Definitions:** empirical formula molecular formula hydrate
_____10. Given the empirical formula and the molar mass, I can determine the molecular formula of a compound.	What is the molecular formula of a compound that has the empirical formula of CH and a molar mass of 78 g/mol.
_____11. I can use particle diagrams to show conservation of mass in a chemical equation.	Using the symbols shown below, complete the equation below to illustrate conservation of mass. ● = Al ○ = 2Al + $3Br_2$ -----> $2AlBr_3$ 
_____12. I can balance a chemical equation showing conservation of mass using the lowest whole number coefficients.	Balance the following chemical equation using the lowest whole number coefficients. _____$Al_2(SO_4)_3$ + _____$Ca(OH)_2$ -----> _____$Al(OH)_3$ + _____$CaSO_4$
_____13. Given a partially balanced equation, I can predict the missing reactant or product.	Use the law of conservation of mass to predict the missing product. $2NH_4Cl$ + CaO -----> $2NH_3$ + _____ + $CaCl_2$

_____14. Given a list of chemical reactions, I can classify them as being a synthesis reaction, decomposition reaction, single replacement reaction, or double replacement reaction.	Classify the following reactions as synthesis, decomposition, single replacement, or double replacement. A) $Mg + 2AgNO_3 \rightarrow Mg(NO_3)_2 + 2Ag$ _____ B) $2Mg + O_2 \rightarrow 2MgO$ _____ C) $MgCO_3 \rightarrow MgO + CO_2$ _____ D) $MgCl_2 + 2AgNO_3 \rightarrow 2AgCl + Mg(NO_3)_2$ _____
_____15. Given a balanced equation, I can state the mole ratios between any of the reactants and/or products.	Given the following balanced equation, state the mole ratios between the requested substances. $C_3H_8(g) + 5O_2(g) \text{ -----> } 3CO_2(g) + 4H_2O(l)$ The mole ratio between C_3H_8 and O_2 is _____C_3H_8:_____O_2. The mole ratio between C_3H_8 and CO_2 is _____C_3H_8:_____CO_2. The mole ratio between C_3H_8 and H_2O is _____C_3H_8:_____H_2O. The mole ratio between CO_2 and O_2 is _____CO_2:_____O_2. The mole ratio between H_2O and CO_2 is _____H_2O:_____CO_2.
_____16. I can define stoichiometry.	**Definition:** stoichiometry
_____17. Given the number of moles of one of the reactants or products, I can determine the number of moles of another reactant or product that is needed to completely use up the given reactant/product.	Using the equation from question #20, determine how many moles of O_2 are needed to completely react with 7.0 moles of C_3H_8. Using the equation from question #20, determine how many moles of CO_2 are produced when 7.0 moles of C_3H_8 completely react.