Name _Answer Key_____

#6 Chemical Reactions

Quantitative Chemistry

Student Learning Map

Unit EQ: How are reactants and products portrayed in a chemical reaction?

Key Learning: The Law of Conservation of Mass dictates the need to write and balance chemical equations.

UNIT CONCEPT:

1. Balancing Chemical Equations	2. Word Problems	3. Classification of Chemical Reactions
LESSON ESSENTIAL QUESTIONS:		
a. Why do I need to balance chemical equations? b. How do I balance chemical equations?	How do I combine nomenclature with chemical reactions?	a. How do we classify chemical reactions? b. How do I use classification to predict products of simple reactions?
LESSON ESSENTIAL VOCABULARY:		
Reactants Products Coefficient Law of Conservation of Mass Aqueous	Diatomic Molecule	Combustion Synthesis Decomposition Single Displacement Double Displacement Neutralization

Date:

1a. Introduction to Chemical Equations

EQ: Why do I need to balance chemical equations?

Indicators of a Chemical Reaction:

1. Formation of a _____.
2. Production of _____.
3. Production (or absorption) of _____.

Parts of a Chemical Equation:

$$2Na_{(s)} + Cl_{2(g)} \rightarrow 2NaCl_{(s)}$$

(s) =

(l) =

(g) =

(aq) =

Arrows:

Why do we need to balance chemical equations?

Date:

1b. Balancing Chemical Equations

EQ: How do I balance chemical equations?

Review: Determine the number of atoms in each of the following compounds:

NaCl	___1___ Na	___1___ Cl	
K_3N	___3___ K	___1___ N	
Al_2O_3	___2___ Al	___3___ O	
Li_2SO_4	___2___ Li	___1___ S	___4___ O
$Fe(NO_3)_3$	___1___ Fe	___3___ N	___9___ O

Coefficients: Examine the coefficients in front of each compound. How many atoms are represented NOW?

3NaCl	___3___ Na	___3___ Cl	
$4Al_2O_3$	___8___ Al	___12__ O	
$2Fe(NO_3)_3$	___2___ Fe	___6___ N	___18__ O

Rules for Balancing: ***You can only add coefficients, NOT subscripts!***

1. Start with the most _____ element or compound.
2. Balance _____ last.
3. Balance _____ second to last.
4. If stuck on oxygen, _____ everything except O_2, then balance.
5. Double-check.

Date:

1b. Balancing Chemical Equations (cont.)

Balance the equations below. Be sure to double-check your work!

1. $2\ K + S \rightarrow K_2S$

2. $2\ Al + 3\ Cl_2 \rightarrow 2\ AlCl_3$

3. $2\ AgNO_3 + Cu \rightarrow Cu(NO_3)_2 + 2\ Ag$

4. $2\ Na + Cl_2 \rightarrow 2\ NaCl$

5. $2\ Mg + O_2 \rightarrow 2\ MgO$

6. $2\ LiF \rightarrow 2\ Li + F_2$

7. $Cl_2 + 2\ KI \rightarrow I_2 + 2\ KCl$

8. $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$

9. $P_4 + 6\ Cl_2 \rightarrow 4\ PCl_3$

10. $2\ Ag + H_2S \rightarrow Ag_2S + H_2$

Date:

1b. Balancing Chemical Equations (cont.)

Balance the equations below. Be sure to double-check your work!

1. $P_4 + 6\ H_2 \rightarrow 4\ PH_3$

2. $2\ AsI_3 \rightarrow 2\ As + 3\ I_2$

3. $3\ Ca(C_2H_3O_2)_2 + 2\ K_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6\ KC_2H_3O_2$

4. $2\ C_2H_6 + 7\ O_2 \rightarrow 4\ CO_2 + 6\ H_2O$

5. $2\ OF_2 \rightarrow O_2 + 2\ F_2$

6. $3\ BaO + 2\ Al \rightarrow Al_2O_3 + 3\ Ba$

7. $2\ NO + O_2 \rightarrow 2\ NO_2$

8. $2\ Na_2O_2 + 2\ H_2O + 4\ CO_2 \rightarrow 4\ NaHCO_3 + O_2$

9. $16\ Cr + 3\ S_8 \rightarrow 8\ Cr_2S_3$

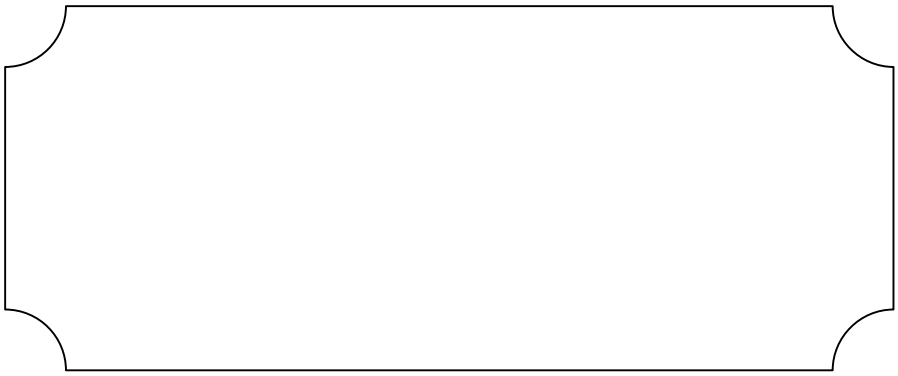
10. $4\ NH_3 + 3\ Cl_2 \rightarrow 3\ NH_4Cl + NCl_3$

Date:

2. Word Equations

EQ: How do I combine nomenclature with chemical reactions?

DIATOMIC MOLECUES



Problems:

1. Chromium + Oxygen → Chromium(III) Oxide

   $4\ Cr + 3\ O_2 \rightarrow 2\ Cr_2O_3$

2. Aluminum Hydrogen Carbonate → Aluminum Carbonate + Carbon Dioxide + Water

   $2\ Al(HCO_3)_3 \rightarrow Al_2(CO_3)_3 + 3\ CO_2 + 3\ H_2O$

3. Chlorine + Potassium Iodide → Potassium Chloride + Iodine

   $Cl_2 + 2\ KI \rightarrow 2\ KCl + I_2$

4. Silicon Dioxide + Hydrofluoric Acid → Silicon Tetrafluoride + Water

   $SiO_2 + 4\ HF \rightarrow SiF_4 + 2\ H_2O$

5. Hydrogen + Nitrogen → Nitrogen Trihydride

   $3\ H_2 + N_2 \rightarrow 2\ NH_3$

6. Copper + Sulfuric Acid → Copper(II) Sulfate + Sulfur Dioxide + Water

   $Cu + 2\ H_2SO_4 \rightarrow CuSO_4 + SO_2 + 2\ H_2O$

Date:

2. Word Equations (cont.)

Balance the equations below. For the word equations, be sure to write the correct formulas before balancing.

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

2. $2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O$

3. $2\ C_6H_{14} + 19\ O_2 \rightarrow 12\ CO_2 + 14\ H_2O$

4. $2\ CrI_3 \rightarrow 3\ I_2 + 2\ Cr$

5. $2\ CsClO_3 \rightarrow 2\ CsCl + 3\ O_2$

6. $C_2H_5OH + 3\ O_2 \rightarrow 2\ CO_2 + 3\ H_2O$

7. $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$

8. Lithum + Chlorine → Lithium Chloride

   $2\ Li + Cl_2 \rightarrow 2\ LiCl$

9. Iron(II) Oxide + Carbon → Iron + Carbon Dioxide

   $2\ FeO + C \rightarrow 2\ Fe + CO_2$

10. Silver Nitrate + Copper(II) Chloride → Silver Chloride + Copper(II) Nitrate

    $2\ AgNO_3 + CuCl_2 \rightarrow 2\ AgCl + 1\ Cu(NO_3)_2$

Date:

2. Word Equations (cont.)

11. Silicon Tetrachloride + Magnesium → Silicon + Magnesium Chloride

$SiCl_4 + 2\ Mg \rightarrow Si + 2\ MgCl_2$

12. Diarsenic Trioxide + Potassium Iodide + Hydrochloric Acid → Arsenic Triiodide + Potassium Chloride + Water

$As_2O_3 + 6\ KI + 6\ HCl \rightarrow 2\ AsI_3 + 6\ KCl + 3\ H_2O$

Problems:

1. Sodium chloride is produced from the reaction between sodium metal and chlorine gas.

   $2\ Na + Cl_2 \rightarrow 2\ NaCl$

2. Solid iron(III) sulfide reacts with gaseous hydrogen chloride to form solid iron(III) chloride and hydrogen sulfide gas.

   $Fe_2S_3 + 6\ HCl \rightarrow 2\ FeCl_3 + 3\ H_2S$

3. Calcium acetate reacts with potassium phosphate to produce a white precipitate of calcium phosphate and potassium acetate.

   $3\ Ca(C_2H_3O_2)_2 + 2\ K_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6\ KC_2H_3O_2$

4. Magnesium burns in oxygen to create magnesium oxide.

   $2\ Mg + O_2 \rightarrow 2\ MgO$

5. Hydrochloric acid is used to digest food in the stomach. It is also the cause of acid indigestion. To treat this, many antacids contain calcium hydroxide. This compound neutralizes hydrochloric acid, producing calcium chloride and water.

   $2\ HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2\ H_2O$

6. Xenon difluoride and water are the products of the reaction between hydrofluoric acid, xenon, and oxygen gas.

   $4\ HF + 2\ Xe + O_2 \rightarrow 2\ XeF_2 + 2\ H_2O$

Date:

2. Word Equations (cont.)

7. The human body uses glucose ($C_6H_{12}O_6$) and oxygen to produce energy. These two compounds react with each other to produce carbon dioxide and water.

   $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$

8. Sodium sulfate and zinc carbonate are the products of the reaction between zinc sulfate and sodium carbonate.

   $ZnSO_4 + Na_2CO_3 \rightarrow Na_2SO_4 + ZnCO_3$

9. Ammonia (NH_3) has an extremely pungent odor, and it is used in commercial cleaning products. When it reacts with oxygen, it produces water and nitrogen gas.

   $4\ NH_3 + 3\ O_2 \rightarrow 6\ H_2O + 2\ N_2$

10. Hydrogen sulfide is a very flammable and poisonous gas. It is responsible for the odor of rotten eggs. When it burns, it combines with oxygen in the air to form sulfur dioxide gas and water vapor.

    $2\ H_2S + 3\ O_2 \rightarrow 2\ SO_2 + 2\ H_2O$

11. Baking soda (also known as sodium hydrogen carbonate) breaks down in the presence of heat to form sodium carbonate. The byproducts are carbon dioxide and water vapor.

    $2\ NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$

12. Silicon tetrafluoride and water are the products of the reaction between silicon dioxide and hydrofluoric acid.

    $SiO_2 + 4\ HF \rightarrow SiF_4 + 2\ H_2O$

13. Many metals react with acids to form hydrogen gas. For example, when magnesium is added to hydrochloric acid, it produces hydrogen gas along with magnesium chloride.

    $Mg + 2\ HCl \rightarrow H_2 + MgCl_2$

14. Water vapor is produced when hydrogen gas burns in oxygen.

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

Date:

3a. Classifying Reactions

EQ: How do we classify chemical reactions?

Type	Definition	Characteristics	Examples

Date:

3a. Classifying Reactions (cont.)

Balance and classify the following reactions:

	Reaction	Classification
1	$K_2SO_4 + CaCl_2 \rightarrow 2\ KCl + CaSO_4$	double displacement
2	$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$	combustion
3	$4\ PBr_3 \rightarrow P_4 + 6\ Br_2$	decomposition
4	$2\ AgNO_3 + Cu \rightarrow Cu(NO_3)_2 + 2\ Ag$	single displacement
5	$NH_4OH + HBr \rightarrow H_2O + NH_4Br$	neutralization
6	$Pb + O_2 \rightarrow PbO_2$	synthesis
7	$2\ SnO + C \rightarrow 2\ Sn + CO_2$	single displacement
8	$KOH + HCl \rightarrow H_2O + KCl$	neutralization

For 9-11, write the balanced equation AND determine the classification.

9. Barium reacts with nitrogen gas to form barium nitride.

   $3\ Ba + N_2 \rightarrow Ba_3N_2$; synthesis

10. Pentane (C_5H_{12}) combusts to form carbon dioxide and water.

    $C_5H_{12} + 8\ O_2 \rightarrow 5\ CO_2 + 6\ H_2O$; combustion

11. Lead(II) bromide and sodium nitrate are the products of the reaction between lead(II) nitrate and sodium bromide.

    $Pb(NO_3)_2 + 2\ NaBr \rightarrow PbBr_2 + 2\ NaNO_3$; double displacement

Date:

3b. Predicting Products

EQ: How do I use classification to predict products of simple reactions?

	Products	Examples
Combustion		$CH_4 + O_2 \rightarrow CO_2 + H_2O$ $C_2H_6 + O_2 \rightarrow CO_2 + H_2O$
Synthesis		$Na + Cl_2 \rightarrow NaCl$ $Al + O_2 \rightarrow Al_2O_3$
Decomposition		$LiF \rightarrow Li + F_2$ $Fe_2O_3 \rightarrow Fe + O_2$
Single Displacement		$Mg + CuCl_2 \rightarrow Cu + MgCl_2$ $Cl_2 + KI \rightarrow I_2 + KCl$
Double Displacement		$BaCl_2 + Na_2SO_4 \rightarrow NaCl + BaSO_4$ $AgNO_3 + NaCl \rightarrow NaNO_3 + AgCl$
Neutralization		$HCl + KOH \rightarrow KCl + H_2O$ $HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + H_2O$