Unit 6: Chemical Reactions (Chapter 11)

\[
\begin{align*}
\text{F} & + 2\text{W} + \text{H} + 2\text{P} \rightarrow \text{FW}_2\text{HP}_2
\end{align*}
\]

(1) Reactants
1 carbon atom, 2 oxygen atoms

(2) Product
1 carbon atom, 2 oxygen atoms


**Part 1: Pre-Quiz**

DIRECTIONS: Before watching the video, circle the word that correctly completes the sentence. How much do you already know about chemical reactions?

1. Chemical reactions that give off heat are called *(exothermic/endothermic)* reactions.

2. *(Cellular Respiration/Photosynthesis)* occurs in plants and is responsible for all life on earth.

3. The substances that react in a chemical reaction are called *(reactants/products)*.

4. The substances produced in a chemical reaction are called *(reactants/products)*.

5. The symbol, \( ightarrow \), in a chemical reaction is read as *(“yields”/“makes”)*.

6. In chemical equations, the *(subscripts/coefficients)* indicate the relative proportions of reactants and products.

7. A *(oxidizing agent/catalyst)* is a substance that speeds up a chemical reaction without being permanently altered.

8. During chemical reactions, matter *(is/is not)* created or destroyed.

9. To balance a chemical equation, *(subscripts/coefficients)* are added to the equation.

10. *(Decomposition/composition)* occurs when a compound breaks down into two or more simpler substances.

**Part 2: Video Questions**

DIRECTIONS: While watching the video, fill in the blanks with the correct word(s).

1. **True or False.** The combustion of fuel is an example of a chemical reaction. __________

2. A complex series of chemical reactions called ______________________________ occurs in plants and is responsible for all life on earth.

3. Cellular _______________________________ occurs in animals and converts the light energy of the chemical energy stored in plants and other animals into the energy necessary to fuel growth, locomotion, reproduction, and other critical function.

4. Chemical reactions called _______________________________ reactions give off heat.

5. Other reactions called _______________________________ reactions absorb heat and cool the immediate environment.

6. **True or False.** During all chemical reactions, a chemical change takes place that produces new substances with properties different than those of the original substances. __________

7. The original substances in a chemical reaction are called _______________________________.


8. The new substances produced by a chemical reaction are called ________________.

9. What 1700’s French chemist realized that the mass of the reactants is equal to the mass of the products? ____________________________

10. While the mass of the reactants and products is always equal, the __________ levels are not.

11. In a chemical equation, the arrow that is found between the reactants and products is read as “__________________”

12. The small numbers found to the lower right of the element symbols are called ____________.

13. ________________ indicate the relative proportions of reactants and products.

14. **True or False.** Subscripts are always changed to balance a chemical equation. ______________

15. Chemical reactions can largely be broken down into three major types of reactions:
   ___________________________  ___________________________  ___________________________

16. ________________ occurs when two or more compounds or elements are combined together to form a new compound.

17. List two products that synthetic polymers are used in:
   ___________________________  and  ___________________________

18. ________________ occurs when a compound breaks down and releases two or more elements or compounds.

19. A ________________ is a substance that speeds up a chemical reaction without being permanently altered.

20. In a ________________ replacement reaction, two compounds that separate into positive and negative ions in a solution switch partners and form two new compounds.

21. List two factors that affect the speed and strength of a chemical reaction.
   ___________________________  and  ___________________________

22. It is possible to speed up a reaction by increasing the ________________ of one or both reactants.

23. **True or False.** Many chemical reactions occur in nature. ______________
**Across:**

1. Natural Gas, CH₄

7. Type of respiration process that is made up of a number of reactions rather than a single reaction.

9. Type of reaction in which one substance breaks down into two or more simpler substances.

10. Dissolved in water.

11. While the mass of reactants and products is always equal, the _______ levels are not.

12. Combustion of fuels in automobiles and jet engines are examples of chemical ________.

15. NH₃

16. Substance that speeds up a reaction but is not consumed in the reaction.

17. Product formed from the reaction between a metallic oxide and water; a metallic hydroxide.

18. Substance found on the left side of an equation.

20. A horizontal arrow in a chemical equation can be read as ________.

22. Anything that occupies space and has mass; in cannot be created or destroyed.

24. Type of chemical reaction that gives off heat.

25. Charged particles.

26. Type of replacement reaction in which two soluble ionic compounds “switch partners” to form a precipitate or molecular compound.

27. Solid formed in a double replacement reaction.

28. Type of replacement reaction in which an element replaces a less reactive element in an ionic compound.

**Down:**

2. Type of reaction that absorbs heat and cools off the immediate surroundings.

3. Form of energy produced by a combustion reaction.

4. Biological catalysts that speeds up reactions in the body.

5. The heart of chemistry.

6. Small numbers that indicate the number of atoms present in a compound.

8. Large molecules made by covalently bonding together simpler molecules; many plastics are composed of these.

10. Product formed from the reaction between a nonmetallic oxide and water.

13. Numbers used to balance chemical equations.

14. Another word for a composition reaction in which a new substance is synthesized by a combination of two or more reactants.

19. Product formed in both complete and incomplete combustion reactions.

21. Type of product represented by a down arrow on the right side of an equation.

23. Substances formed in a chemical reaction.

29. Type of product represented by an up arrow on the right side of the equation.
Balancing Chemical Reactions

Consider this reaction: \(2 \text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}\)

**Reactant:** A starting substance in a chemical reaction.
- List the reactant(s): ____________________________

**Product:** A substance resulting from a chemical reaction.
- List the product(s): ____________________________

Consider this reaction: \(\text{H}_2 + \text{Cl}_2 \rightarrow \text{HCl}\)

<table>
<thead>
<tr>
<th>Reactant Side</th>
<th>Product Side</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>How many H atoms?</strong></td>
<td><strong>How many H atoms?</strong></td>
</tr>
<tr>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td><strong>How many Cl atoms?</strong></td>
<td><strong>How many Cl atoms?</strong></td>
</tr>
<tr>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td>Total atoms</td>
<td>Total atoms</td>
</tr>
<tr>
<td>_______</td>
<td>_______</td>
</tr>
</tbody>
</table>

Does it follow the conservation of mass? Are the total atoms of each element equal on both sides of the equation? ____________

We will use **coefficients** to balance this equation. Note that coefficients are not the same as subscripts. When balancing reactions, we **CANNOT** change subscripts.

_____\(\text{H}_2\) + _____\(\text{Cl}_2\) → _____\(\text{HCl}\)

- How many atoms of each element are present in the compound, \(\text{Fe}_2(\text{SO}_4)_3\)?
  Fe _________ S _________ O _________
- How many atoms of each element are present in the compound, \(3\text{Fe}_2(\text{SO}_4)_3\)?
  Fe _________ S _________ O _________
Do you remember the 7 diatomic molecules? You can only write these elements as diatomic molecules when they are by themselves:

- 
- Example: if they are in the compound HCl, you cannot write H₂Cl₂!!!!

Balancing Chemical Equations is trial and error, but there are a few guidelines to follow:

1. First, balance the atoms of elements and those that appear only once on each side of the equation by using coefficients. NEVER change the subscript of a formula!
2. Balance H atoms and O atoms after atoms of all other elements have been balanced.

DIRECTIONS: Balance the following chemical reactions:

a.) _____ Zn + _____HCl → _____ZnCl₂ + _____H₂

b.) _____CH₄ + _____O₂ → _____CO₂ + _____H₂O

c.) _____KC₂H₃O₂+ _____Na₂S → _____K₂S + _____NaC₂H₃O₂
DIRECTIONS: Write a balanced chemical equation for the following reactions.

d.) Bromine combines with nitrogen to produce nitrogen tribromide.

e.) Solid sodium reacts with powdered sulfur to produce sodium sulfide.

f.) Aqueous solutions of sulfuric acid and sodium hydroxide react to form aqueous sodium sulfate and water.

g.) Benzene (C₆H₆) burns in air to produce carbon dioxide and water.
Balancing Chemical Equations

DIRECTIONS: balance the equations below by writing the correct coefficient on the space provided, even if it is a “1”. For problems 1 – 9, write the word equation on the space provided.

1. _____ N₂ + _____ H₂ → _____ NH₃

2. _____ KClO₃ → _____ KCl + _____ O₂

3. _____ NaCl + _____ F₂ → _____ NaF + _____ Cl₂

4. _____ H₂ + _____ O₂ → _____ H₂O

5. _____ AgNO₃ + _____ MgCl₂ → _____ AgCl + _____ Mg(NO₃)₂

6. _____ AlBr₃ + _____ K₂SO₄ → _____ KBr + _____ Al₂(SO₄)₃

7. _____ FeCl₃ + _____ NaOH → _____ Fe(OH)₃ + _____ NaCl

8. _____ P + _____ O₂ → _____ P₂O₅

9. _____ HCl + _____ CaCO₃ → _____ CaCl₂ + _____ H₂O + _____ CO₂
10. ______ CH₄ + ______ O₂ → ______ CO₂ + ______ H₂O

11. ______ Na + ______ H₂O → ______ NaOH + ______ H₂

12. ______ Ag₂O → ______ Ag + ______ O₂

13. ______ S₈ + ______ O₂ → ______ SO₃

14. ______ CO₂ + ______ H₂O → ______ C₆H₁₂O₆ + ______ O₂

15. ______ K + ______ MgBr₂ → ______ KBr + ______ Mg

16. ______ C₃H₈ + ______ O₂ → ______ CO₂ + ______ H₂O

17. ______ Al + ______ N₂ → ______ AlN

18. ______ NaCl + ______ H₂SO₄ → ______ Na₂SO₄ + ______ HCl

19. ______ Al + ______ CuSO₄ → ______ Al₂[SO₄]₃ + ______ Cu

20. ______ C₈H₁₈ + ______ O₂ → ______ CO₂ + ______ H₂O

21. ______ Fe(OH)₃ → ______ Fe₂O₃ + ______ H₂O

22. ______ C + ______ O₂ → ______ CO

23. ______ H₂ + ______ S → ______ H₂S

24. ______ Al + ______ O₂ → ______ Al₂O₃

25. ______ H₂ + ______ O₂ → ______ H₂O
DIRECTIONS: 1) Balance each equation. If the coefficient is a “1”, write a “1” in the space provided.
   2) Name the substances printed in **BOLD**
   3) Write a fact about each reaction.

1. _____ Fe + _____ S → _____ FeS

   Names: __________________________________________________________

   Fact: __________________________________________________________________________

2. _____ H₂ + _____ Cl₂ → _____ HCl

   Names: __________________________________________________________

   Fact: __________________________________________________________________________

3. _____ Mg + _____ O₂ → _____ MgO

   Names: __________________________________________________________

   Fact: __________________________________________________________________________

4. _____ O₂ + _____ H₂ → _____ H₂O

   Fact: __________________________________________________________________________

5. _____ HgO → _____ Hg + _____ O₂

   Names: __________________________________________________________

   Fact: __________________________________________________________________________

6. _____ Ca + _____ H₂O → _____ Ca(OH)₂ + _____ H₂

   Names: __________________________________________________________

   Fact: __________________________________________________________________________

7. _____ CH₄ + _____ O₂ → _____ CO₂ + _____ H₂O

   Names: __________________________________________________________

   Fact: __________________________________________________________________________
8. \( \text{Na}_2\text{O}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}_2 \)

Names: 

Fact: 

9. \( \text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3 \)

Names: 

Fact: 

10. \( \text{Al} + \text{O}_2 \rightarrow \text{Al}_2\text{O}_3 \)

Names: 

Fact: 

11. \( \text{KMnO}_4 \rightarrow \text{K}_2\text{O} + \text{MnO} + \text{O}_2 \)

Names: 

Fact: 

---

**Brain Boggle Chembalancer**


1. \( \text{F}_2 + \text{Al}_2\text{O}_3 \rightarrow \text{AlF}_3 + \text{O}_2 \)

Fact: 

2. \( \text{C}_2\text{H}_6 + \text{O}_2 \rightarrow \text{CO} + \text{H}_2\text{O} \)

Fact: 

3. \( \text{NH}_3 + \text{O}_2 \rightarrow \text{NO} + \text{H}_2\text{O} \)

Fact: 

4. \( \text{C}_5\text{H}_12 + \text{O}_2 \rightarrow \text{CO} + \text{H}_2\text{O} \)

Fact: 

5. \( \text{C}_8\text{H}_18 + \text{O}_2 \rightarrow \text{CO} + \text{H}_2\text{O} \)

Fact: 

---
Name ___________________________________________ Period ______

Balancing Chemical Equations: A Number Search

Balance each chemical reaction below. Find the string of coefficients for each reaction within the number search and circle it. Remember, no coefficient actually means “1”. See the example.

Example: \( 2\text{H}_2 + \text{1}_2 \rightarrow \text{2H}_2\text{O} \) coefficient string: 212

Clues

1. _____ Na + _____ Cl\(_2 \) → _____ NaCl

2. _____ Fe + _____ O\(_2 \) → _____ Fe\(_2\)O\(_3 \)

3. _____ KClO\(_3 \) → _____ KCl + _____ O\(_2 \)

4. _____ NH\(_3 \) + _____ O\(_2 \) → _____ NO + _____ H\(_2\)O

5. _____ Na + _____ H\(_2\)O → _____ NaOH + _____ H\(_2 \)

6. _____ Fe + _____ H\(_2\)O → _____ Fe\(_3\)O\(_4 \) + _____ H\(_2 \)

7. _____ Br\(_2 \) + _____ CaI\(_2 \) → _____ CaBr\(_2 \) + _____ I\(_2 \)

8. _____ Ca(OH)\(_2 \) + _____ H\(_3\)PO\(_4 \) → _____ Ca\(_3\)(PO\(_4 \))\(_2 \) + _____ H\(_2\)O

9. _____ Co(OH)\(_3 \) + _____ HNO\(_3 \) → _____ Co(NO\(_3 \))\(_3 \) + _____ H\(_2\)O

10. _____ Al\(_2\)(SO\(_4 \))\(_3 \) + _____ Ca\(_3\)(PO\(_4 \))\(_2 \) → _____ AlPO\(_4 \) + _____ CaSO\(_4 \)
Balancing Equations Practice Quiz

DIRECTIONS: Write a number, even if it is a “1”, in the spaces to balance the equation. Do not leave any blank.

1. _____ Ca + _____ AlCl₃ → _____ CaCl₂ + _____ Al

2. _____ Fe + _____ O₂ → _____ Fe₂O₃

3. _____ ClF + _____ NH₃ → _____ NH₄Cl + _____ NF₃

DIRECTIONS: Write the correct formulas under the word equation. Be sure to balance the equation.

4. lead + sulfuric acid → plumbic sulfate + hydrogen gas

5. ferric chloride + ammonium hydroxide → ferric hydroxide + ammonium chloride
Balancing Equations Race

1) \[ \_\_\_\_\_C_3\text{H}_8 + \_\_\_\_\_O_2 \rightarrow \_\_\_\_\_\text{CO}_2 + \_\_\_\_\_\text{H}_2\text{O} \]

2) \[ \_\_\_\_\text{Al} + \_\_\_\_\_\text{Fe}_3\text{N}_2 \rightarrow \_\_\_\_\_\text{AlN} + \_\_\_\_\_\text{Fe} \]

3) \[ \_\_\_\_\_\text{Na} + \_\_\_\_\_\text{Cl}_2 \rightarrow \_\_\_\_\_\text{NaCl} \]

4) \[ \_\_\_\_\_\text{H}_2\text{O}_2 \rightarrow \_\_\_\_\_\text{H}_2\text{O} + \_\_\_\_\_\text{O}_2 \]

5) \[ \_\_\_\_\_\text{C}_6\text{H}_12\text{O}_6 + \_\_\_\_\_\text{O}_2 \rightarrow \_\_\_\_\_\text{H}_2\text{O} + \_\_\_\_\_\text{CO}_2 \]

6) \[ \_\_\_\_\_\text{H}_2\text{O} + \_\_\_\_\_\text{CO}_2 \rightarrow \_\_\_\_\_\text{C}_7\text{H}_8 + \_\_\_\_\_\text{O}_2 \]

7) \[ \_\_\_\_\_\text{NaClO}_3 \rightarrow \_\_\_\_\_\text{NaCl} + \_\_\_\_\_\text{O}_2 \]

8) \[ \_\_\_\_\_\text{(NH}_4\text{)}_3\text{PO}_4 + \_\_\_\_\_\text{Pb(NO}_3\text{)}_4 \rightarrow \_\_\_\_\_\text{Pb}_3\text{(PO}_4\text{)}_4 + \_\_\_\_\_\text{NH}_4\text{NO}_3 \]

9) \[ \_\_\_\_\_\text{BF}_3 + \_\_\_\_\_\text{Li}_2\text{SO}_3 \rightarrow \_\_\_\_\_\text{B}_2\text{(SO}_3\text{)}_3 + \_\_\_\_\_\text{LiF} \]

10) \[ \_\_\_\_\_\text{C}_7\text{H}_17 + \_\_\_\_\_\text{O}_2 \rightarrow \_\_\_\_\_\text{CO}_2 + \_\_\_\_\_\text{H}_2\text{O} \]

11) \[ \_\_\_\_\_\text{CaCO}_3 + \_\_\_\_\_\text{H}_3\text{PO}_4 \rightarrow \_\_\_\_\_\text{Ca}_3\text{(PO}_4\text{)}_2 + \_\_\_\_\_\text{H}_2\text{CO}_3 \]

12) \[ \_\_\_\_\_\text{Ag}_2\text{S} \rightarrow \_\_\_\_\_\text{Ag} + \_\_\_\_\_\text{S}_8 \]

13) \[ \_\_\_\_\_\text{KBr} + \_\_\_\_\_\text{Fe(OH)}_3 \rightarrow \_\_\_\_\_\text{KOH} + \_\_\_\_\_\text{FeBr}_3 \]

14) \[ \_\_\_\_\_\text{KNO}_3 + \_\_\_\_\_\text{H}_2\text{CO}_3 \rightarrow \_\_\_\_\_\text{K}_2\text{CO}_3 + \_\_\_\_\_\text{HNO}_3 \]

15) \[ \_\_\_\_\_\text{Pb(OH)}_4 + \_\_\_\_\_\text{Cu}_2\text{O} \rightarrow \_\_\_\_\_\text{PbO}_2 + \_\_\_\_\_\text{CuOH} \]

16) \[ \_\_\_\_\_\text{Cr(NO}_2\text{)}_2 + \_\_\_\_\_\text{(NH}_4\text{)}_2\text{SO}_4 \rightarrow \_\_\_\_\_\text{CrSO}_4 + \_\_\_\_\_\text{NH}_4\text{NO}_2 \]

17) \[ \_\_\_\_\_\text{KOH} + \_\_\_\_\_\text{Co}_3\text{(PO}_4\text{)}_2 \rightarrow \_\_\_\_\_\text{K}_3\text{PO}_4 + \_\_\_\_\_\text{Co(OH)}_2 \]

18) \[ \_\_\_\_\_\text{Sn(NO}_2\text{)}_4 + \_\_\_\_\_\text{Pt}_3\text{N}_4 \rightarrow \_\_\_\_\_\text{Sn}_3\text{N}_4 + \_\_\_\_\_\text{Pt(NO}_2\text{)}_4 \]

19) \[ \_\_\_\_\_\text{B}_2\text{Br}_6 + \_\_\_\_\_\text{HNO}_3 \rightarrow \_\_\_\_\_\text{B(NO}_3\text{)}_3 + \_\_\_\_\_\text{HBr} \]

20) \[ \_\_\_\_\_\text{ZnS} + \_\_\_\_\_\text{AlP} \rightarrow \_\_\_\_\_\text{Zn}_3\text{P}_2 + \_\_\_\_\_\text{Al}_2\text{S}_3 \]
TYPES OF CHEMICAL REACTIONS

A. Composition \(A + B \rightarrow AB\)
   1. two elements \(\rightarrow\) a binary compound
      - a metal and a nonmetal
         - write the metal first followed by the nonmetal
         - crisscross the charges derived from the periodic table to determine the formula
         - add coefficients to balance the equation
      - two nonmetals
         - write the \textit{least} electronegative element (the one farther away from fluorine) first followed by the other nonmetal
         - the least electronegative element has the represent the positive part of the molecule, so assign it a positive charge from the periodic table \(\rightarrow\) i.e. the column it is in
         - assign a negative charge to the second nonmetal (just like you always do) and crisscross the charges
         - add coefficients to balance the equation
   2. metallic oxide + water \(\rightarrow\) a base (metallic hydroxide)
   3. nonmetallic oxide + water \(\rightarrow\) an acid
      - since it is an acid, \(H^+\) is the positive part of the compound
      - for the negative part of the compound, write the “-ate” ion that exists between the nonmetal and oxygen (make sure to balance the formula)
      - Balance the equation. \textbf{IF} the oxygens do not balance, adjust the number of oxygens in the acid to balance the equation \(\rightarrow\) i.e. change the polyatomic ion to the \textit{ite, per,} or \textit{hypo} formula

B. Decomposition \(AB \rightarrow A + B\)
   1. binary compound \(\rightarrow\) two elements
   2. base \(\rightarrow\) metallic oxide + water
   3. acid \(\rightarrow\) nonmetallic oxide + water
      - make sure you have the correct formula for the acid
      - write water as one of the products
      - balance only the hydrogens by adding coefficients
      - add subscripts to the nonmetal oxide formula to balance the equation \textbf{(NOTE: this is a gimmick that works; it is the only time you will add subscripts to balance an equation)}
   4. metallic carbonate \(\rightarrow\) metallic oxide + carbon dioxide
   5. metallic chlorate \(\rightarrow\) metallic chloride + oxygen gas
   6. hydrated salt \(\rightarrow\) salt + water

C. Single Replacement \(A + BX \rightarrow B + AX; X + AY \rightarrow Y + AX\)
   1. active metal (or \(H_2\)) + ionic compound \(\rightarrow\) new metal (or \(H_2\)) + ionic compound
      - when an active metal reacts with water, the metal replaces only one of the hydrogens in water, forming a base and hydrogen gas as the products. It is easy to see how this occurs if water is written HOH.
   2. active halogen + ionic halide \(\rightarrow\) halogen + ionic compound

D. Double Replacement \(AX + BY \rightarrow AY + BX\)
   1. two soluble ionic compounds \(\rightarrow\) two new compounds, one of which must be an insoluble ionic compound or a molecular compound
### Solubility Chart

<table>
<thead>
<tr>
<th>Positive Ion</th>
<th>Negative Ion</th>
<th>Solubility</th>
</tr>
</thead>
<tbody>
<tr>
<td>sodium, potassium, ammonium</td>
<td>nitrate, acetate, chlorate</td>
<td>soluble</td>
</tr>
<tr>
<td>silver, mercury, lead</td>
<td>carbonate, phosphate, sulfide, hydroxide</td>
<td>insoluble</td>
</tr>
<tr>
<td>barium, calcium, strontium</td>
<td>chloride, bromide, iodide</td>
<td>soluble</td>
</tr>
<tr>
<td></td>
<td>sulfate</td>
<td>soluble</td>
</tr>
</tbody>
</table>

### Activity Series of Metals

- lithium
- rubidium
- potassium
- barium
- strontium
- calcium
- sodium
- magnesium
- aluminum
- manganese
- zinc
- chromium
- iron
- cadmium
- cobalt
- nickel
- tin
- lead
- hydrogen
- copper
- mercury
- silver
- gold

### Activity Series of Halogens

- fluorine
- chlorine
- bromine
- iodine
## Chemical Reactions

**symbols used in chemical equations**

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>→</td>
<td>used in place of a single arrow to indicate a reversible reaction</td>
</tr>
<tr>
<td>↓</td>
<td>a reactant or product in the solid state; also used to indicate a precipitate</td>
</tr>
<tr>
<td>(l)</td>
<td>a reactant or product in the aqueous state ~ dissolved in water</td>
</tr>
<tr>
<td></td>
<td>a reactant or product in the gaseous state</td>
</tr>
<tr>
<td>Δ or heat</td>
<td>alternative to (g), but used only to indicate a gaseous product</td>
</tr>
<tr>
<td>KI</td>
<td></td>
</tr>
</tbody>
</table>
TYPES OF CHEMICAL REACTIONS

A. COMPOSITION: A + B → AB

TYPES OF COMPOSITION REACTIONS:

1. 2 ELEMENTS → A BINARY COMPOUND

   A. METAL + NONMETAL → BINARY IONIC COMPOUND

   Mg + N₂ → __________
   - Write the metal first, then the nonmetal.
   - Assign charges derived from the PT.
   - Use the crisscross method to determine the formula for the binary ionic compound.
   - Add coefficients to balance the equation.

   Ca + O₂ → __________

   B. NONMETAL + NONMETAL → BINARY COVALENT COMPOUND

   H₂ + Br₂ → __________
   - Write the least electronegative nonmetal first, then the second nonmetal.
   - Assign the first nonmetal a positive charge equal to the number of the column that it’s in.
   - Assign a negative charge to the second nonmetal just like you have always done.
   - Use the crisscross method to determine the formula for the binary molecular compound.
   - Add coefficients to balance the equation.

   S + O₂ → __________
**2. METALLIC OXIDE + WATER ➞ A BASE (METALLIC HYDROXIDE)**

What is a metallic oxide? ______________________________

Examples ______________________________

What are some examples of a base? ______________________________

CaO + H₂O ➞ __________

- Write the metal first, then OH⁻.
- Assign a positive charge to the metal.
- Use the crisscross method to determine the formula for the metallic hydroxide.
- Add coefficients to balance the equation.

Na₂O + H₂O ➞ __________

**3. NONMETALLIC OXIDE + WATER ➞ AN ACID**

What is a nonmetallic oxide? ______________________________

Examples: ______________________________

What is an acid? ______________________________

Examples: ______________________________

P₂O₅ + H₂O ➞ __________

- Write H⁺ followed by the “ate” polyatomic ion that exists between the nonmetal and oxygen.
- Use the crisscross method to balance the formula of the acid.
- Balance all atoms except oxygen. If the oxygen atoms are not balanced, adjust the number of oxygens in the acid formula to balance the equation (i.e. change the polyatomic ion to the īte form).

SO₂ + H₂O ➞ __________
Composition Reactions

NAME ___________________________ PERIOD __________

Directions: Predict the products of the following reactions and then balance the equations.

1. _____ Li + _____ I₂ → _______________________

2. _____ Mg + _____ N₂ → _______________________

3. _____ H₂ + _____ N₂ → _______________________

4. _____ SO₃ + _____ H₂O → _____________________

5. _____ Mn + _____ Cl₂ → _____________________
   [manganese II]

6. _____ Cl₂O₃ + _____ H₂O → _____________________

7. _____ Sr + _____ S → _______________________

8. _____ Pb + _____ Cl₂ → _____________________
   [lead II]

9. _____ S + _____ O₂ → _______________________

10. _____ K + _____ Br₂ → _____________________

11. _____ I₂ + _____ Cl₂ → _____________________

12. _____ P₂O₅ + _____ H₂O → _____________________

13. _____ Fe + _____ O₂ → _____________________
   [iron III]

14. _____ Cr₂O₃ + _____ H₂O → _____________________

15. _____ Ag + _____ O₂ → _____________________
B. DECOMPOSITION: AB → A + B

WHAT IS A DECOMPOSITION REACTION? __________________________

___________________________________________________________

TYPES OF DECOMPOSITION REACTIONS:

1. BINARY COMPOUND → 2 ELEMENTS

MgO → _______ + _______

KCl → _______ + _______

- Separate the two elements that make up the compound. (Remember the diatomic elements!)
- Balance the equation.

2. BASE → METALLIC OXIDE + WATER

Ca(OH)₂ → _______ + _______

NaOH → _______ + _______

- Write the formula for water (always 1 of the products).
- Write the metal ion from the base with a charge derived from the PT.
- Write the oxide ion (O²⁻).
- Balance the formula.
- Balance the equation.

3. ACID → NONMETALLIC OXIDE + WATER

HClO₄ → _______ + _______

H₂SO₃ → _______ + _______

- Write the formula for water (always 1 of the products).
- Balance the hydrogens by adding coefficients.
- Add subscripts to the nonmetal oxide formula to balance the equation. (NOTE: this is a gimmick that works; it is the ONLY time you will add subscripts to balance an equation)
4. **METALLIC CARBONATE** → **METALLIC OXIDE + CARBON DIOXIDE**

**WHAT IS A METALLIC CARBONATE?**

**EXAMPLES:**

- \( \text{CaCO}_3 \) → _______ + _______
  - Write the formula for carbon dioxide (always 1 of the products).
  - Write the metal ion from the metallic carbonate with a charge derived from the PT.
  - Write the oxide ion (O\(^{2-}\)); balance the formula
  - Balance the equation.

- \( \text{Na}_2\text{CO}_3 \) → _______ + _______

5. **METALLIC CHLORATE** → **METALLIC CHLORIDE + OXYGEN GAS**

**WHAT IS A METALLIC CHLORATE?**

**EXAMPLES:**

**WHAT IS A METALLIC CHLORIDE?**

**EXAMPLES:**

- \( \text{KClO}_3 \) → _______ + _______
  - Write the formula for oxygen gas (always 1 of the products).
  - Write the metal ion from the metallic chlorate with a charge derived from the PT.
  - Write the chloride ion (Cl\(^{-1}\)); balance the formula
  - Balance the equation.

- \( \text{Mg(ClO}_3\text{)}_2 \) → _______ + _______

6. **HYDRATED SALT** → **SALT + WATER**

**WHAT IS A HYDRATED SALT?**

**EXAMPLES:**

- \( \text{BaCl}_2 \cdot 2\text{H}_2\text{O} \) → _______ + _______
  - Separate the hydrated salt into salt and water.

- \( \text{CuSO}_4 \cdot 5\text{H}_2\text{O} \) → _______ + _______
  - Keep the coefficients the same.
Decomposition Reactions

NAME ___________________________ PERIOD __________

Directions: Predict the products of the following reactions and then balance the equations.

1. _____ ZnCO₃ → _______________ + _______________

2. _____ Ba(ClO₃)₂ → _______________ + _______________

3. _____ CaCO₃ → _______________ + _______________

4. _____ KClO₃ → _______________ + _______________

5. _____ H₂CO₃ → _______________ + _______________

6. _____ Ba(OH)₂ → _______________ + _______________

7. _____ HgO → _______________ + _______________

8. _____ NaCl → _______________ + _______________

9. _____ H₂SO₄ → _______________ + _______________

10._____ Ag₂O → _______________ + _______________

11._____ Fe(OH)₃ → _______________ + _______________

12._____ PBr₅ → _______________ + _______________

13._____ CuSO₄•5H₂O → _______________ + _______________

14._____ H₃PO₄ → _______________ + _______________

15._____ NiCO₃ → _______________ + _______________
Composition & Decomposition Reactions

Directions: For the following composition and decomposition reactions:
1. Write the balanced formula equation in the blank space.
2. Finish the word equation for the reaction on the line provided.

**Composition**

1. Diphosphorus trioxide is placed in water ________________________________

2. A scoop of barium oxide is put into water ________________________________

3. Lithium metal is heated in the presence of oxygen gas ______________________

**Decomposition**

1. Potassium hydroxide is heated in a test tube ______________________________

2. Nitrogen triiodide decomposes ________________________________

3. Sodium carbonate is placed in a crucible and heated ______________________
TYPES OF CHEMICAL REACTIONS

E. Composition \[ A + B \rightarrow AB \]

1. two elements \(\rightarrow\) a binary compound
   - a metal and a nonmetal
     - write the metal first followed by the nonmetal
     - crisscross the charges derived from the periodic table to determine the formula
     - add coefficients to balance the equation
   - two nonmetals
     - write the least electronegative element (the one farther away from fluorine) first followed by the other nonmetal
     - the least electronegative element has the represent the positive part of the molecule, so assign it a positive charge from the periodic table \(\rightarrow\) i.e. the column it is in
     - assign a negative charge to the second nonmetal (just like you always do) and crisscross the charges
     - add coefficients to balance the equation

2. metallic oxide + water \(\rightarrow\) a base (metallic hydroxide)
3. nonmetallic oxide + water \(\rightarrow\) an acid
   - since it is an acid, \(H^+\) is the positive part of the compound
   - for the negative part of the compound, write the "-ate" ion that exists between the nonmetal and oxygen [make sure to balance the formula]
   - balance the equation. IF the oxygens do not balance, adjust the number of oxygens in the acid to balance the equation \(\rightarrow\) i.e. change the polyatomic ion to the ite, per, or hypo formula

F. Decomposition \[ AB \rightarrow A + B \]

1. binary compound \(\rightarrow\) two elements
2. base \(\rightarrow\) metallic oxide + water
3. acid \(\rightarrow\) nonmetallic oxide + water
   - make sure you have the correct formula for the acid
   - write water as one of the products
   - balance only the hydrogens by adding coefficients
   - add subscripts to the nonmetal oxide formula to balance the equation (NOTE: this is a gimmick that works; it is the only time you will add subscripts to balance an equation)
4. metallic carbonate \(\rightarrow\) metallic oxide + carbon dioxide
5. metallic chlorate \(\rightarrow\) metallic chloride + oxygen gas
6. hydrated salt \(\rightarrow\) salt + water

G. Single Replacement \[ A + BX \rightarrow B + AX \; ; \; X + AY \rightarrow Y + AX \]

1. active metal (or \(H_2\)) + ionic compound \(\rightarrow\) new metal (or \(H_2\)) + ionic compound
   - when an active metal reacts with water, the metal replaces only one of the hydrogens in water, forming a base and hydrogen gas as the products. It is easy to see how this occurs if water is written HOH.
2. active halogen + ionic halide \(\rightarrow\) halogen + ionic compound

H. Double Replacement \[ AX + BY \rightarrow AY + BX \]

1. two soluble ionic compounds \(\rightarrow\) two new compounds, one of which must be an insoluble ionic compound or a molecular compound
Solubility Chart

<table>
<thead>
<tr>
<th>positive ion</th>
<th>negative ion</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>sodium, potassium, ammonium</td>
<td>nitrate, acetate, chlorate</td>
<td>soluble</td>
</tr>
<tr>
<td>silver, mercury, lead</td>
<td>carbonate, phosphate, sulfide, hydroxide</td>
<td>insoluble</td>
</tr>
<tr>
<td>barium, calcium, strontium</td>
<td>chloride, bromide, iodide</td>
<td>soluble</td>
</tr>
<tr>
<td></td>
<td>sulfate</td>
<td>soluble</td>
</tr>
</tbody>
</table>

Activity Series of Metals

- lithium
- rubidium
- potassium
- barium
- strontium
- calcium
- strontium
- sodium
- magnesium
- aluminum
- manganese
- zinc
- chromium
- iron
- cadmium
- cobalt
- nickel
- tin
- lead
- hydrogen
- copper
- mercury
- silver
- gold

Activity Series of Halogens

- fluorine
- chlorine
- bromine
- iodine
C. SINGLE REPLACEMENT: A + BX → B + AX

1. METAL (OR H₂) + IONIC COMPOUND → NEW METAL (OR H₂) + IONIC COMPOUND
   - Al + Pb(NO₃)₂(aq) → __________ + __________
   - HCl(aq) + Hg → __________ + __________
   - Write the ion form of each of the reactants.
   - The cations switch places!
   - Check the activity series of metals to see if the reaction can occur.
   - If yes, write the symbol of the metal that is replaced.
   - Write the formula for the ionic compound.
   - Balance the equation.

2. HALOGEN + IONIC HALIDE → HALOGEN + IONIC COMPOUND
   - KBr + Cl₂ → __________ + __________
   - I₂ + NaBr → __________ + __________
   - Identify the halogens.
   - The halogens switch places!
   - Check the activity series of halogens to see if the reaction can occur.
   - If yes, write the symbol of the halogen that is replaced. (Remember diatomics!)
   - Write the formula for the ionic compound.
   - Balance the equation.

3. ACTIVE METAL + H₂O → HYDROGEN GAS + BASE
   - Na(s) + H₂O(l) → __________ + __________
   - Write the formula for hydrogen gas. (always 1 of the products)
   - Write the formula for the base: the metal ion followed by the hydroxide ion (OH⁻).
   - Balance the formula.
   - Balance the equation.
Single Replacement Reactions

NAME _____________________________ PERIOD __________

Directions: Predict the products of the following reactions and then balance the equations.

1. _____ CaCl$_2$ + _____ Sr ⟷
2. _____ NaF + _____ Cl$_2$ ⟷
3. _____ Al + _____ Fe$_2$O$_3$ ⟷
4. _____ SnCl$_4$ + _____ Na ⟷
5. _____ HCl + _____ Cd ⟷
6. _____ Mn + _____ HgCl$_2$ ⟷
7. _____ H$_2$O + _____ Ca ⟷
8. _____ Mg + _____ CuBr$_2$ ⟷
9. _____ CuO + _____ H$_2$ ⟷
10. _____ Cu + _____ AgNO$_3$ ⟷
11. _____ HBr + _____ Ba ⟷
12. _____ Cl$_2$ + _____ NaBr ⟷
13. _____ HCl + _____ Ag ⟷
14. _____ PbSO$_4$ + _____ Ba ⟷
15. _____ CdI$_2$ + _____ Br$_2$ ⟷
16. _____ Fe + _____ H$_2$SO$_4$ ⟷
17. _____ Cd + _____ CuSO$_4$ ⟷
18. _____ K + _____ H$_2$O ⟷
19. _____ Al + _____ AgNO$_3$ ⟷
D. DOUBLE REPLACEMENT: \( AX + BY \rightarrow AY + BX \)

“Hey...Let’s switch partners!”

2 SOLUBLE IONIC COMPOUNDS \( \rightarrow \) 2 NEW COMPOUNDS

one of the new compounds must be either an

INSOLUBLE IONIC COMPOUND—A PRECIPITATE!!

MOLECULAR CMPD (All nonmetals)

★ If neither of these is formed, then there is NO RXN!

*Reading the Solubility Chart: The highest rule always wins!*

**SOLUBLE** - can dissolve in water - (aq)

**INSOLUBLE** - cannot dissolve in water - a precipitate! (↓)

- Write the ion form of each reactant.
- The cations switch partners!
- Use the crisscross method to balance the new formulas.
- If a molecular compound (all nonmetals) is a product, balance the equation.
- If both products begin with a metal (ionic compounds), check the solubility chart for a precipitate.
- If a ppt. is present, label it and balance the equation.
- If there is no molecular comp. or ppt. formed, then no reaction takes place.

\[
\begin{align*}
\text{KI (aq)} + \text{Pb(NO}_3\text{)}_2\text{(aq)} & \rightarrow \text{_________} + \text{_________} \\
\text{HCl (aq)} + \text{NH}_4\text{OH(aq)} & \rightarrow \text{_________} + \text{_________} \\
\text{(NH}_4\text{)}_2\text{S (aq)} + \text{Zn(Cl)}_2\text{(aq)} & \rightarrow \text{_________} + \text{_________} \\
\text{CaBr}_2\text{(aq)} + \text{NaCl (aq)} & \rightarrow \text{_________} + \text{_________}
\end{align*}
\]
**SPECIAL DECOMPOSITION REACTION**

**If NH₄OH (ammonium hydroxide) or H₂CO₃ (carbonic acid) are produced, they will break down further into the following substances:**

____________________________________________________________________

____________________________________________________________________

---

**E. COMBUSTION:**

1. **complete**  
   
   \[ C_xH_y + O_2 \rightarrow CO_2 + H_2O \]

2. **incomplete**  
   
   \[ C_xH_y + O_2 \rightarrow CO + H_2O \]

---

A propane (C₃H₈) grill is lit on the outside deck.

- When the reaction description includes the terms combusts, burns, oxidizes, or reacts with air, add oxygen as a reactant.
- Determine whether the reaction is complete or incomplete combustion; then write the products.
- Balance the carbons.
- Balance the hydrogens.
- Balance the oxygens.

A propane (C₃H₈) grill is lit in a closed garage.

A butane lighter (C₄H₁₀) burns completely.
Double Replacement Reactions

NAME _____________________________________________ PERIOD ____________

Directions: Predict the products of the following reactions and then balance the equations.

1. _____ FeSO₄ [aq] + _____ H₃PO₄ [aq] →
2. _____ Cs₂CO₃ [aq] + _____ ZnBr₂ [aq] →
3. _____ Pb(NO₃)₂ [aq] + _____ Na₂CO₃ [aq] →
4. _____ MgSO₄ [aq] + _____ Ca(C₂H₃O₂)₂ [aq] →
5. _____ NH₄Cl [aq] + _____ Ba(OH)₂ [aq] →
6. _____ NaBr [aq] + _____ Pb(NO₃)₂ [aq] →
7. _____ Ca(C₂H₃O₂)₂ [aq] + _____ KNO₃ [aq] →
8. _____ Ba(OH)₂ [aq] + _____ NH₄C₂H₃O₂ [aq] →
9. _____ NH₄OH [aq] + _____ Al(NO₃)₃ [aq] →
10. _____ MgCl₂ [aq] + _____ CdSO₄ [aq] →
11. _____ NH₄Br [aq] + _____ Ag C₂H₃O₂ [aq] →
12. _____ H₂SO₄ [aq] + _____ NaOH [aq] →
13. _____ K₂S [aq] + _____ CuSO₄ [aq] →
14. _____ HCl [aq] + _____ BaCO₃ [aq] →
15. _____ AgNO₃ [aq] + _____ HNO₃ [aq] →
16. _____ SrCO₃ [aq] + _____ H₂SO₄ [aq] →
17. _____ Ba(OH)₂ [aq] + _____ Na₂SO₄ [aq] →
18. _____ Al(OH)₃ [aq] + _____ Fe₂(SO₄)₃ [aq] →
19. _____ Pb(C₂H₃O₂)₂ [aq] + _____ K₂SO₄ [aq] →
**Single Replacement, Double Replacement, and Combustion Reactions**

I. Predict whether each of the following single replacement reactions will occur. For the reactions that will occur, write the products and balance the equation. For those that do not occur, write no reaction.

a. \( \text{Ag} (s) + \text{H}_2\text{O} (l) \rightarrow \)

b. \( \text{Br}_2 (l) + \text{KI} (\text{aq}) \rightarrow \)

c. \( \text{Cu} (s) + \text{HCl} (\text{aq}) \rightarrow \)

d. \( \text{Cd} (s) + \text{HCl} (\text{aq}) \rightarrow \)

e. \( \text{Mg} (s) + \text{Co(NO}_3\text{)}_2 (\text{aq}) \rightarrow \)

f. \( \text{Ni} (s) + \text{CuCl}_2 (\text{aq}) \rightarrow \)
\( \text{(nickel II)} \)

II. Based on the activity series of metals and halogens, which element within each pair is more likely to replace the other in a compound? Circle your answer.

a. K and Na

b. Al and Ni

c. Ba and Cr

d. Cl and F

e. Au and Ag

f. Cl and I

g. Fe and Sr

h. I and F
III. Predict whether each of the following double replacement reactions will occur. For the reactions that will occur, label the precipitate or circle the molecular compound, and then balance the equation. For those that do not occur, write no reaction.

a. \( \text{K}_2\text{S} \text{(aq)} + \text{HNO}_3 \text{(aq)} \rightarrow \)

b. \( \text{AgNO}_3 \text{(aq)} + \text{CuS} \text{(aq)} \rightarrow \)

c. \( \text{AgNO}_3 \text{(aq)} + \text{NaCl} \text{(aq)} \rightarrow \)

d. \( \text{Zn(OH)}_2 \text{(aq)} + \text{H}_3\text{PO}_4 \text{(aq)} \rightarrow \)

e. \( \text{KOH} \text{(aq)} + \text{CuSO}_4 \text{(aq)} \rightarrow \)

f. \( \text{Mg(NO}_3)_2 \text{(aq)} + \text{BaCl}_2 \text{(aq)} \rightarrow \)

g. \( \text{Ca(ClO}_3)_2 \text{(aq)} + \text{Na}_2\text{SO}_4 \rightarrow \)

IV. Write the balanced chemical equation for the following combustion reactions.

a. complete combustion of butane, \( \text{C}_4\text{H}_{10} \)

b. incomplete combustion of methane, \( \text{CH}_4 \)

c. complete combustion of methanol, \( \text{CH}_3\text{OH} \)
Classifying Types of Reactions

DIRECTIONS: Identify the type of reaction in the space to the right. Use the following abbreviations:


1. 4Al(s) + 3O₂(g) → 2Al₂O₃(s)
2. 2HCl (aq) + Ca(OH)₂(aq) → 2H₂O (l) + CaCl₂(aq)
3. CH₄(g) + 2O₂(g) → CO₂(g) + 2H₂O (l)
4. Zn(s) + Pb(C₃H₂O₂₂)₂(aq) → Pb(s) + Zn(C₂H₃O₂₂)₂(aq)
5. SO₃(g) + H₂O (l) → H₂SO₄(aq)
6. 2HgO (s) → 2Hg (l) + O₂(g)
7. CaCO₃(s) → CaO (s) + CO₂(g)
8. 2NaI(aq) + Pb(NO₃)₂(aq) → PbI₂(↓) + 2NaNO₃(aq)
9. Cl₂(g) + 2NaI(aq) → I₂(s) + 2NaCl(aq)
10. NiCl₂(aq) + Na₂CO₃(aq) → 2NaCl(aq) + NiCO₃(↓)

DIRECTIONS: Match the reactant(s) given with ONE of the products that would form in the reaction. The answers can only be used once.

_________11. potassium + bromine →
   a. acid
_________12. magnesium sulfate (aq) + calcium acetate (aq) →
   b. base
_________13. strontium chlorate →
   c. oxygen gas
_________14. phosphoric acid →
   d. salt
_________15. sulfur trioxide + water →
   e. carbon dioxide
_________16. barium hydroxide →
   f. precipitate
_________17. aluminum + silver nitrate →
   g. metallic oxide
_________18. BaCl₂·2H₂O →
   h. new metal
_________19. calcium oxide + water →
   i. binary compound
_________20. lithium carbonate → metallic chloride + _________
   j. nonmetallic oxide
DIRECTIONS: Complete the following steps:

a. Identify the type of reaction in the space to the right using the same abbreviations from Part 1.
b. Write the balanced chemical equation in the space provided. For a double replacement reaction that occurs, be sure to label the precipitate or circle the molecular compound.

21. \( \text{NH}_3 \rightarrow \)  

22. \( \text{Br}_2 + \text{NaCl} \rightarrow \)  

23. \( \text{HC}_2\text{H}_3\text{O}_2(\text{aq}) + \text{Ba(OH)}_2(\text{aq}) \rightarrow \)  

24. \( \text{Fe(NO}_3)_3(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \)  

25. \( \text{MgO} + \text{H}_2\text{O} \rightarrow \)  

26. \( \text{Pb} + \text{ZnSO}_4 \rightarrow \)  

27. complete combustion of octane \( (\text{C}_8\text{H}_{18}) \)  

28. barium nitrate (aq) + sodium sulfate (aq)  

29. potassium chlorate  

DIRECTIONS: Balance the following equations by writing the appropriate coefficient in the blank. Be sure to include coefficients of 1. Add up all of the coefficients and write the correct answer on the line.

30. \( \_ \_ \_ \text{AgNO}_3 + \_ \_ \_ \text{MgCl}_2 \rightarrow \_ \_ \_ \text{Mg(NO}_3)_2 + \_ \_ \_ \text{AgCl} \)  

31. \( \_ \_ \_ \text{BaCl}_2 + \_ \_ \_ \text{Na}_2\text{SO}_4 \rightarrow \_ \_ \_ \text{BaSO}_4 + \_ \_ \_ \text{NaCl} \)  

32. \( \_ \_ \_ \text{Xe} + \_ \_ \_ \text{F}_2 \rightarrow \_ \_ \_ \text{XeF}_6 \)  

33. \( \_ \_ \_ \text{Al} + \_ \_ \_ \text{H}_2\text{SO}_4 \rightarrow \_ \_ \_ \text{Al}_2(\text{SO}_4)_3 + \_ \_ \_ \text{H}_2 \)  

34. \( \_ \_ \_ \text{KClO}_3 \rightarrow \_ \_ \_ \text{KCl} + \_ \_ \_ \text{O}_2 \)
DIRECTIONS: Match the correct definition with the appropriate letter. Each letter may be used more than once, or not at all.

___________1. a reaction in which an element or compound reacts with oxygen, often producing energy in the form of heat or light
   a. single replacement reaction
   b. double replacement reaction

___________2. a reaction in which two or more substances react to form a single substance
   c. base (metallic hydroxide)
   d. decomposition reaction

___________3. The solubility chart is used when predicting the products of this type of reaction
   e. activity series of the metals

___________4. a substance that speeds up a reaction without being consumed
   f. carbon monoxide
   g. combustion reaction

___________5. a reaction in which a single compound breaks down into two or more simpler substances
   h. catalyst
   i. fluorine

___________6. a reaction in which atoms of an element replace the atoms of a second element in a compound
   j. subscript

___________7. a list of metals in order of decreasing reactivity
   k. (l)

___________8. a reaction that involves the exchange of cations between two soluble compounds
   l. bromine
   m. (aq)

___________9. a solid substance formed in a double replacement reaction
   n. coefficient
   o. carbon dioxide
   p. precipitate

___________10. the symbol, ↑, is used to indicate this type of product
   q. gas
   r. composition reaction

___________11. the most reactive halogen
   s. an acid
   t. liquid

___________12. a number that appears in front of a formula in a chemical equation

___________13. the symbol that indicates a soluble substance

___________14. the symbol, (l), indicates that the substance is in this state

___________15. The products of an incomplete combustion are water and this molecular compound
   u. carbon dioxide
   v. carbon monoxide

___________16. Metallic oxides react with water to produce this type of product.
More Chemical Reactions

Name __________________________________________________________      Period _____________

Directions: Complete the flowing steps **ON THE BACK OF THIS PAPER**. Be sure to letter each step.
  a) Determine the type of reaction.
  b) Write out the balanced formula equation. If a reaction does not occur, write NR as the product.
  c) Name the products.

1. hydrogen gas + chlorine gas →
2. barium oxide + water →
3. iron III + aluminum chloride →
4. decomposition of barium chloride dihydrate →
5. chlorine gas + sodium iodide →
6. barium chloride + sodium sulfate →
7. silver sulfate + aluminum chloride →
8. phosphorus acid →
9. complete combustion of butane \( \text{C}_4\text{H}_{10} \) →
10. carbonic acid →
11. \( \text{N}_2\text{O}_5 \) + \( \text{H}_2\text{O} \) →
12. \( \text{H}_3\text{PO}_4 \) + KOH →
13. \( \text{Sr(OH)}_2 \) + AlCl₃ →
14. incomplete combustion of ethyl alcohol \( \text{C}_2\text{H}_5\text{OH} \) →
15. KCl →
16. Fe (II) + CuSO₄ →
17. Zn + HCl →
18. Cu + Pb(NO₃)₄ →
19. Ca(OH)₂ + HNO₃ →
20. Mg(OH)₂ →
CARTOON CHEMISTRY

Name: ________________________________________________________   Period _________

Describe the chemical reaction illustrated below each diagram:

____________________________________________________________________________________

____________________________________________________________________________________

TYPE OF REACTION: _____________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

TYPE OF REACTION: _____________________________________________
TYPE OF REACTION: __________________________

TYPE OF REACTION: __________________________
Get the Message? Classifying Chemical Reactions

DIRECTIONS: Classify each chemical reaction as a synthesis, decomposition, single replacement, double replacement, or combustion reaction. Code the reactions according to the following key. When complete, read the code letters vertically to “get the message.”

<table>
<thead>
<tr>
<th>Type of Reaction</th>
<th>Code Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
<td>E</td>
</tr>
<tr>
<td>Decomposition</td>
<td>A</td>
</tr>
<tr>
<td>Single Replacement</td>
<td>Y</td>
</tr>
<tr>
<td>Double Replacement</td>
<td>B</td>
</tr>
<tr>
<td>Combustion</td>
<td>M</td>
</tr>
</tbody>
</table>

KEY

<table>
<thead>
<tr>
<th>Code</th>
<th>Chemical Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>_______ ______C₃H₈ + ______O₂ → ______CO₂ + ______H₂O</td>
</tr>
<tr>
<td>2.</td>
<td>_______ ______HgO → ______Hg + ______O₂</td>
</tr>
<tr>
<td>3.</td>
<td>_______ ______Cl₂ + ______KI → ______KCl + ______I₂</td>
</tr>
<tr>
<td>4.</td>
<td>_______ ______KI + ______Pb(NO₃)₂ → ______PbI₂ + ______KNO₃</td>
</tr>
<tr>
<td>5.</td>
<td>_______ ______K + ______I₂ → ______KI</td>
</tr>
<tr>
<td>6.</td>
<td>_______ ______AgNO₃ + ______NaCl → ______AgCl + ______NaNO₃</td>
</tr>
<tr>
<td>7.</td>
<td>_______ ______KClO₃ → ______KCl + ______O₂</td>
</tr>
<tr>
<td>8.</td>
<td>_______ ______FeS + ______HCl → ______FeCl₂ + ______H₂S</td>
</tr>
<tr>
<td>9.</td>
<td>_______ ______Mg + ______HCl → ______H₂ + ______MgCl₂</td>
</tr>
<tr>
<td>10.</td>
<td>_______ ______Al + ______Pb(NO₃)₂ → ______Pb + ______Al(NO₃)₃</td>
</tr>
<tr>
<td>11.</td>
<td>_______ ______Na + ______Cl₂ → ______NaCl</td>
</tr>
<tr>
<td>12.</td>
<td>_______ ______H₂CO₃ → ______CO₂ + ______H₂O</td>
</tr>
</tbody>
</table>
**KEY**

<table>
<thead>
<tr>
<th>Type of Reaction</th>
<th>Code Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
<td>E</td>
</tr>
<tr>
<td>Decomposition</td>
<td>A</td>
</tr>
<tr>
<td>Single Replacement</td>
<td>Y</td>
</tr>
<tr>
<td>Double Replacement</td>
<td>B</td>
</tr>
<tr>
<td>Combustion</td>
<td>M</td>
</tr>
</tbody>
</table>

**Code**

13. _______ CH₄ + _______ O₂ → _______ CO₂ + _______ H₂O
14. _______ H₂SO₄ → _______ SO₃ + _______ H₂O
15. _______ F₂ + _______ NaCl → _______ NaF + _______ Cl₂
16. _______ Ca(CH₃COO)₂ + _______ (NH₄)₂CO₃ → _______ CaCO₃ + _______ NH₄CH₃COO
17. _______ N₂O₅ + _______ H₂O → _______ HNO₃

18. _______ CuSO₄ + _______ Na₂S → _______ CuS + _______ Na₂SO₄
19. _______ Ca(OH)₂ → _______ CaO + _______ H₂O
20. _______ BaCl₂ + _______ Na₂SO₄ → _______ NaCl + _______ BaSO₄
21. _______ Cd + _______ Pb(NO₃)₂ → _______ Cd(NO₃)₂ + _______ Pb

22. _______ AlCl₃ + _______ H₂SO₄ → _______ Al₂(SO₄)₃ + _______ HCl
23. _______ CuSO₄ + _______ Fe → _______ FeSO₄ + _______ Cu
24. _______ Na₂O + _______ SO₂ → _______ Na₂SO₃

25. _______ AgCH₃COO + _______ K₂CrO₄ → _______ Ag₂CrO₄ + _______ KCH₃COO
26. _______ Ni + _______ CuCl₂ → _______ NiCl₂ + _______ Cu
27. _______ CaO + _______ P₂O₅ → _______ Ca₃(PO₄)₂

**MESSAGE:**

_______________________________________________________________
_______________________________________________________________________________________

_______________________________________________________________
Evidence of Chemical Reactions

INTRODUCTION:
The study of chemical reactions begins in the laboratory. Chemists mix substances together and look for evidence (gas formation, formation of a precipitate, color change, or energy change) to indicate that a reaction has occurred. Additional experiments are conducted to identify the products. It is through extensive experimentation that enough information is accumulated to enable us to predict the products of some reactions. Students must learn to not only make good observations, but to also speculate about their meaning.

MATERIALS:
watch glass 2 large test tubes
test tube rack test tube holder
wooden splint matches
3 M hydrochloric acid 3 M sodium hydroxide
silver nitrate magnesium ribbon
sodium bicarbonate copper sheet
steel wool candle

PROCEDURE: In each of the following procedures, you are going to observe EVIDENCE that a chemical reaction has occurred. In your observations table, record all pertinent information that indicates that a chemical reaction has occurred.

A. ACID-BASE NEUTRALIZATION
1. Combine 5 ml of 3 M hydrochloric acid with 5 ml of 3 M sodium hydroxide in a large test tube.
2. After observing the reaction, pour the contents of the test tube down the sink.

B. REACTION OF METALS WITH OXYGEN
1. Take a small piece of magnesium ribbon. (about 3 cm long)
2. Get a watch glass from the lab bench, and light your Bunsen burner.
3. Caution: Do not look directly at burning magnesium ribbon. You will damage your eyesight. Holding the magnesium ribbon at one end with tongs, place the other end in the flame. Once ignited, hold the burning ribbon over the watch glass.
4. After observing the reaction, throw away the remainder of the magnesium ribbon and clean the watch glass.

C. REACTION OF METALS WITH ACIDS
1. Obtain a 3-cm piece of magnesium ribbon; cut it into 6 small pieces.
2. Place the 6 small pieces of magnesium in a large DRY test tube.
3. Pour 10 mL of 3 M hydrochloric acid in a second large test tube.
4. While the acid test tube sits in your test tube rack, pick up the test tube containing the magnesium with your test tube holder. Then invert the magnesium test tube over the acid test tube, dumping the magnesium into the acid while holding the empty test tube over the top of the acid test tube.
5. While the reaction occurs, light a splint. When the reaction slows down (in about 10 seconds), remove the top test tube to uncover the acid test tube and insert the flaming splint.
6. Let the reaction sit until all the Mg is gone. After observing the reaction, pour the contents down the sink.

D. PRECIPITATION REACTIONS
1. Place about 5 ml of 3 M hydrochloric acid in a test tube.
2. Squeeze a few drops of silver nitrate solution into the test tube.
3. After observing the reaction, pour the contents into the sink.

E. ACIDS WITH CARBONATES
1. Place a scoop of baking soda (sodium bicarbonate) into a test tube.
2. Pour 5 mL of hydrochloric acid into the test tube.
3. Insert a flaming splint into the test tube.
4. After observing the reaction, pour the contents of the test tube into the sink.

F. REACTION OF METALS WITH IONIC SOLUTIONS
1. Obtain a piece of copper sheet.
2. Using steel wool, “sandpaper” a small portion of the copper to its shiny color.
3. Place a drop of silver nitrate solution on the shiny copper.
4. After observing the reaction, discard the copper into the trash.
G. COMBUSTION REACTIONS
1. Get a candle from the lab bench; light it.
2. Hold a test tube upside down approximately 2-3 cm above the flame. Be careful: DO NOT obstruct the flow of oxygen to the flame. Collect the products of the reaction for two minutes and record your observations in the data table.
3. Remove the test tube from above the flame. While holding the test tube upside down, insert a flaming splint. Observe the reaction and record in the data table.
4. Blow out the flame.
5. Wax is somewhat of a mixture but the formula can be approximated as C_{20}H_{44}.

<table>
<thead>
<tr>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>G</td>
</tr>
</tbody>
</table>
I Spy Conclusion

CONCLUSION:

1. Using COMPLETE sentences, cite your evidence.
2. Using COMPLETE sentences, write a word equation for the reaction.
3. Write the balanced equation for the reaction, including the symbols (s), (l), (g), and (aq).
4. Using COMPLETE sentences, answer the questions concerning the specific reaction.

EXAMPLE:
ACID-BASE NEUTRALIZATION
1. The test tube got very cold.
2. When solutions of hydrobromic acid and the base calcium hydroxide are mixed, water and an aqueous solution of calcium bromide are produced.
3. \( 2\text{HBr (aq)} + \text{Ca(OH)}_2 (aq) \rightarrow 2\text{H}_2\text{O} + \text{CaBr}_2 (aq) \)

<table>
<thead>
<tr>
<th>A. ACID-BASE NEUTRALIZATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Evidence</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Word Equation</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Balance Equation</strong></td>
</tr>
</tbody>
</table>

1. Is the reaction exothermic or endothermic? Explain

2. What polyatomic ion is present in the formula of all bases?

3. If sulfuric acid is spilled on the countertop, what can be used to neutralize the spill?
### B. REACTION OF METALS WITH OXYGEN

<table>
<thead>
<tr>
<th>Evidence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Word Equation</td>
<td></td>
</tr>
<tr>
<td>Balance Equation</td>
<td></td>
</tr>
</tbody>
</table>

1. Some metals can form several metallic oxides. Why? Provide an example.

   ____________________

   ____________________

### C. REACTION OF METALS WITH ACID

<table>
<thead>
<tr>
<th>Evidence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Word Equation</td>
<td></td>
</tr>
<tr>
<td>Balance Equation</td>
<td></td>
</tr>
</tbody>
</table>

1. Describe the result of the flaming splint test.

   ____________________

2. How would the result of the splint test differ if oxygen was produced in the reaction?

   ____________________
D. PRECIPITATION REACTIONS

<table>
<thead>
<tr>
<th>Evidence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Word Equation</td>
<td></td>
</tr>
<tr>
<td>Balance Equation</td>
<td></td>
</tr>
</tbody>
</table>

1. Describe a method to separate the two products.

2. Define “precipitate.”

E. ACIDS WITH CARBONATES

<table>
<thead>
<tr>
<th>Evidence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Word Equation</td>
<td></td>
</tr>
<tr>
<td>Balance Equation</td>
<td></td>
</tr>
</tbody>
</table>

1. Based on the result of the flaming splint test, describe a practical use for carbon dioxide.
F. REACTION OF METALS WITH IONIC SOLUTIONS

<table>
<thead>
<tr>
<th>Evidence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Word Equation</td>
<td></td>
</tr>
<tr>
<td>Balance Equation</td>
<td></td>
</tr>
</tbody>
</table>

1. If silver nitrate solution is placed on a piece of gold, no reaction occurs. However, if gold nitrate is placed on silver, a reaction does occur. Explain why this is true.

G. COMBUSTION REACTIONS

<table>
<thead>
<tr>
<th>Evidence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Word Equation</td>
<td></td>
</tr>
<tr>
<td>Balance Equation</td>
<td></td>
</tr>
</tbody>
</table>

1. Write a balanced equation for the reaction that occurs when a Bunsen burner is lit.

2. Lighting a match is a chemical reaction. Cite two pieces of evidence that allow you to conclude that this statement is true.
A Study of Precipitation Reactions

INTRODUCTION:

Taken from Addison-Wesley Lab Manual

The majority of ionic solids are soluble in water. Those that are not account for the observation that solid products, called precipitates, are sometimes formed when aqueous ionic solutions are mixed.

Ionic compounds are made up of positive and negative ions held together by the attractive, electrostatic forces between the oppositely charged particles. When soluble ionic compounds are placed in water, they break apart to give separate ions. The solid dissolves. When two ionic solutions are combined, the resulting mixture contains positive and negative ions from each solution. The mixing permits new combinations of ions and if one or more of these new ion combinations happens to be insoluble in water, it “falls out” of solution as a solid product, called a precipitate.

As an example, consider the mixture of silver nitrate and sodium chloride solutions. The equation is as follows:

\[ \text{NaCl (aq)} + \text{AgNO}_3 (aq) \longrightarrow \text{NaNO}_3 (aq) + \text{AgCl(s)} \]

Sodium nitrate is soluble in water but silver chloride is not, so it “falls out” of the solution as a white solid.

Since both reacting salts are soluble in water, a complete ionic equation can be written for the reaction:

\[ \text{Na}^+ (aq) + \text{Cl}^-(aq) + \text{Ag}^+ (aq) + \text{NO}_3^- (aq) \longrightarrow \]

\[ \text{Na}^+ (aq) + \text{NO}_3^- (aq) + \text{AgCl (s)} \]

It shows all the ions that are present, even those that are not involved in the precipitation reaction. These nonparticipating ions, Na\(^+\) and NO\(_3^-\), are called spectator ions.

An equation that omits the spectator ions is called a net ionic equation. The net ionic equation for the above reaction is as follows:

\[ \text{Ag}^+ (aq) + \text{Cl}^- (aq) \longrightarrow \text{AgCl (s)} \]

The symbol (s) after AgCl indicates that this compound is a solid. Sometimes the (s) is replaced by an arrow pointing down, \(\downarrow\), to show that the compound is a solid that precipitates out of the solution. The symbol (aq) indicates that the associated ion is present in aqueous solution — it is dissolved in water.

In this experiment, you will mix nine different ionic solutions in all possible combinations of two to determine which combinations result in precipitate formation. Based on your results, you will write balanced equations for each reaction that takes place.

OBJECTIVES:

- To determine which combinations of ionic solutions form precipitates.
- To identify the precipitate in each reaction.
- To write balanced equations for a reaction.

MATERIALS:

- sodium carbonate
- chronic nitrate
- sodium phosphate
- cupric sulfate
- barium hydroxide
- potassium chromate
- nickel II chloride
- cobalt II nitrate
- lead II acetate
- toothpicks
- laminated worksheet

PROCEDURE:

As you perform each experiment, record your results in the Observation Table. Put an “N.R.” in the box if no reaction occurs. If a precipitate forms, write the color of the precipitate in the correct box.

1. Obtain a laminated sheet to be used as your reaction vessel.
2. Mix each pair of solutions on the appropriate spot on the laminated sheet. Use only 2-3 drops of each solution. Be careful not to contaminate the dropper from one specimen to the next, as this could lead to erroneous results.
3. After mixing all of the solutions, observe each mixture carefully for signs of a precipitate. Note the color of any precipitate formed; record your results in the Observations Table. If it is difficult to determine whether a precipitate is present or not, use a toothpick to stir the solution.
4. Clean up your lab station. Pour the contents of the reactions down the drain. Rinse the sheet with water and thoroughly dry with a paper towel.

CONCLUSION:

Write the following equations on the back of the Observations Table; if needed, use additional lined paper.

1. For each combination of solutions that your teacher assigns to you, write a balanced formula equation. Make sure to indicate with an (s) or a down arrow (\(\downarrow\)) which of the products is the precipitate. If no reaction occurred, signify this by writing NO RXN to the right of the balanced equation.
### Observations Table

<table>
<thead>
<tr>
<th></th>
<th>nickel II chloride</th>
<th>lead II acetate</th>
<th>potassium chromate</th>
<th>chromium III nitrate</th>
<th>cupric sulfate</th>
<th>cobalt II nitrate</th>
<th>sodium carbonate</th>
<th>barium hydroxide</th>
<th>sodium phosphate</th>
</tr>
</thead>
<tbody>
<tr>
<td>nickel II chloride</td>
<td>$\times$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lead II acetate</td>
<td>$\times$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>potassium chromate</td>
<td>$\times$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>chromium III nitrate</td>
<td>$\times$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cupric sulfate</td>
<td>$\times$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cobalt II nitrate</td>
<td>$\times$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sodium carbonate</td>
<td>$\times$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>barium hydroxide</td>
<td>$\times$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sodium phosphate</td>
<td>$\times$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A Study of the different Types of Reactions

INTRODUCTION:
The study of chemical reactions begins in the laboratory. Chemists mix substances together and look for evidence (gas formation, formation of a precipitate, color change, or energy change) to indicate that a reaction has occurred. Additional experiments are conducted to identify the products. It is through extensive experimentation that enough information is accumulated to enable us to predict the products of some reactions. Students must learn to not only make good observations, but to also speculate about their meaning.

At first you may be bewildered by the wide variety of reactions that happen in the lab and the real world. You can gain some sense of control by developing and applying schemes for classifying reactions. In this course, four schemes of inorganic reactions are used — composition, decomposition, single replacement, and double replacement. As you learn more of the content of chemistry, your classification schemes will become more sophisticated, including acid-base and oxidation-reduction reactions.

In this experiment, you will carry out several reactions described in the procedure below. By making good observations you will be able to determine the products of each reaction.

OBJECTIVES:
- To observe the four types of chemical reactions.
- To predict the products of a reaction.
- To write a balanced equation for a reaction.

PROCEDURE:

EXERCISE A
1. Place one spoonful of ammonium carbonate into a test tube.
2. Holding the test tube with a test tube holder, heat the solid gently for one minute. While heating, examine the top of the test tube for one of the products.
3. Remove from the flame and waft the air toward your nose to detect an odor of the second product.
4. Using a flaming splint test the contents of the test tube for the third product, a common gas formed in the reaction.
5. Record your observations in the data table.
6. Allow the test tube to cool and then dump any remaining solid in the trash can.

EXERCISE B
1. Obtain a piece of copper foil.
2. Use forceps to hold one end of the foil in the Bunsen burner for about 30 seconds.
3. Let the foil cool and re-examine it; record in data table.
4. Once the piece of copper has cooled, discard it in the trash can.

EXERCISE C
1. Place 5 mL of hydrochloric acid into a test tube.
2. Drop a piece of mossy zinc into the acid.
3. After one minute, bring a flaming splint to the mouth of the test tube. Describe the result in your data table.
4. Let the reaction continue until all of the solid is gone.
5. Dispose of the products by filling the test tube with water and dumping down the drain.

EXERCISE D
1. Place 10 drops of potassium iodide solution in a small test tube.
2. Add 10 drops of lead II nitrate solution to the test tube. Record your observations in the data table.
3. Clean the test tube before leaving the station.

EXERCISE E
1. Place 5 mL of cupric sulfate solution in a large test tube.
2. Add a strip of magnesium. Make observations immediately and after five minutes; record in data table.
3. Pour the liquid from the test tube down the drain. Discard any remaining solid in the trash can.

EXERCISE F
1. Place a half scoop of calcium oxide in a test tube.
2. Add 10 mL of tap water to the test tube.
3. Shake the tube for two minutes; then test the liquid with neutral litmus paper. (Litmus paper turns red in the presence of an acid and blue in the presence of a base). Record your observations.
4. Pour the contents of the test tube down the drain and throw away the used litmus paper.

EXERCISE G
1. Place 10 mL of hydrogen peroxide in a test tube.
2. Add a very small amount (about a tip of a spatula) of manganese IV oxide to the test tube. (This acts as a catalyst; therefore, it is not part of the balanced equation).
3. Test the gas produced with a glowing splint.
4. When the reaction stops, observe the contents remaining in the test tube. This is the second product of the reaction.
5. Record your observations in the data table.

EXERCISE H
1. Place 1/2 scoop of copper II sulfate pentahydrate in a test tube.
2. Hold the test tube with a test tube holder and heat gently for about a minute.
3. Observe any changes that occur and record in the data table.
4. Allow the test tube to cool and then dump any remaining solid in the trash can.
### Observations

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td></td>
</tr>
</tbody>
</table>

**CONCLUSION:**

*For each of the observed reactions, fill in the chart on the next page:*

1. Name the type of reaction that took place, using these abbreviations.
   - C - composition
   - D - decomposition
   - SR - single replacement
   - DR - double replacement

2. Write a balanced equation for each reaction, including all necessary symbols — (s), (l), (g), (aq), etc.

3. Underneath the balanced equation, write a word equation. You do not need to include the symbols.

4. In the last row of the chart, write a balanced equation for the reaction used to produce heat from the Bunsen burner.
<table>
<thead>
<tr>
<th>Rxn.</th>
<th>Type</th>
<th>Balanced/Word Equations</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
WHAT DO I NEED TO KNOW??

Unit 6: Chemical Reactions

MULTIPLE CHOICE

o questions

- Vocabulary (i.e. coefficient, subscripts, soluble, insoluble, acid, base, precipitate, metallic hydroxide, metallic oxide, etc.)
- Symbols found in a chemical equation
  - (s), (l), (aq), (g), (↑), (↓), etc.
- Classifying Reactions
  - Composition vs. decomposition
  - Single replacement vs. double replacement
  - Combustion (complete & incomplete)
- Balancing reactions
- Solubility chart
  - When do you need it?
  - How do you read it?
- Predicting products
BALANCING EQUATIONS
   o Balance the equation
   o Name the bolded elements

CLASSIFYING REACTIONS
   o Identify reactions as one of the following:
     - Composition
     - Decomposition
     - Single replacement
     - Double replacement
     - Combustion

MATCHING
   o Classifying types of reactions
     - Ex: calcium + chlorine $\rightarrow$ __________
       - Answer = binary compound

PREDICTING PRODUCTS & BALANCING
   o Predict the products and then balance the equation