

## Unit 4 Review – Chemical Reactions

Key

We will start with the easiest topic and work our way to the most complex.

**Evidence of a Chemical Reaction** – There are 6 pieces of evidence that can occur to let you know a reaction has occurred.

- Gas bubbles form
- A solid precipitate forms
- A change in energy to the system, it's endothermic or exothermic
- A permanent color change
- A permanent odor change
- Formation of water

**Types of Reactions** – You will need to be able to identify the 5 different types of chemical reactions on sight. It's fairly easy if you know what to look for within each type of reaction.

- Synthesis: You know that a reaction is synthesis when there is only **one product!** There cannot be 2 different substances on the product side of the reaction.
  - o Ex.  $4 \text{ Fe (s)} + 3 \text{ O}_2 \text{ (g)} \rightarrow 2 \text{ Fe}_2\text{O}_3 \text{ (s)}$
- Decomposition: You know that a reaction is decomposition when there is only **one reactant!** There cannot be 2 different substances on the reactant side of the reaction.
  - o Ex.  $\text{H}_2\text{CO}_3 \text{ (aq)} \rightarrow \text{CO}_2 \text{ (g)} + \text{H}_2\text{O (l)}$
- Single – Replacement: You know that a reaction is single – replacement when you see that **one element replaces another** in a reaction.
  - o Ex.  $\text{Li (s)} + \text{Ca(NO}_2)_2 \text{ (aq)} \rightarrow \text{Ca (s)} + 2 \text{ LiNO}_2 \text{ (aq)}$
- Double – Replacement: You know that a reaction is double- replacement when two ionic compounds switch ions with each other. The outer two ions go together and the inner two ions go together.
  - o Ex.  $\text{BeCl}_2 \text{ (aq)} + \text{Ag}_2\text{SO}_4 \text{ (aq)} \rightarrow \text{BeSO}_4 \text{ (aq)} + 2 \text{ AgCl (s)}$
- Combustion: This is a very specific reaction. You know it's a combustion reactions if you have a hydrocarbon and oxygen gas as reactants and carbon dioxide gas and water vapor as products.
  - o Ex.  $\text{C}_4\text{H}_9\text{OH (l)} + 6 \text{ O}_2 \text{ (g)} \rightarrow 4 \text{ CO}_2 \text{ (g)} + 5 \text{ H}_2\text{O (g)}$

Try to identify these reactions. They are not balanced.

1.  $\text{AlCl}_3 + \text{Na}_2\text{SO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + \text{NaCl}$  - double - replacement
2.  $\text{Zn} + \text{S}_8 \rightarrow \text{ZnS}$  - synthesis
3.  $\text{H}_2\text{SO}_4 + \text{Fe} \rightarrow \text{H}_2 + \text{FeSO}_4$  - single - replacement
4.  $\text{C}_5\text{H}_{12} + \text{O}_2 \rightarrow \text{H}_2\text{O} + \text{CO}_2$  - combustion
5.  $\text{Al}_2\text{S}_3 \rightarrow \text{Al} + \text{S}_8$  - decomposition
6.  $\text{Li}_2\text{CO}_3 + \text{MgCl}_2 \rightarrow \text{LiCl} + \text{MgCO}_3$  - double - replacement
7.  $\text{Fe} + \text{O}_2 \rightarrow \text{FeO}$  - synthesis
8.  $\text{Zn} + \text{HBr} \rightarrow \text{H}_2 + \text{ZnBr}_2$  - single - replacement
9.  $\text{C}_5\text{H}_{10}\text{O}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$  - combustion
10.  $\text{MgO} \rightarrow \text{Mg} + \text{O}_2$  - decomposition

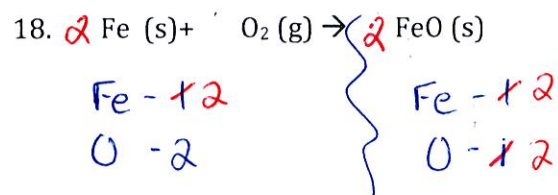
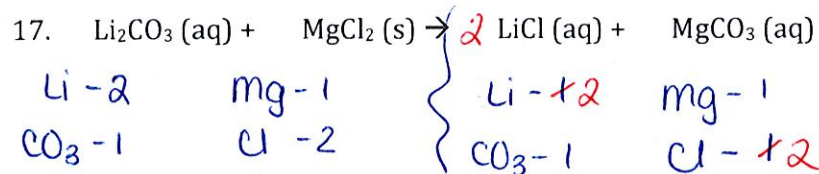
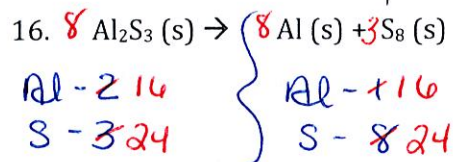
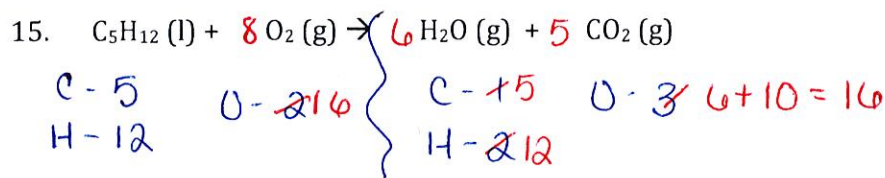
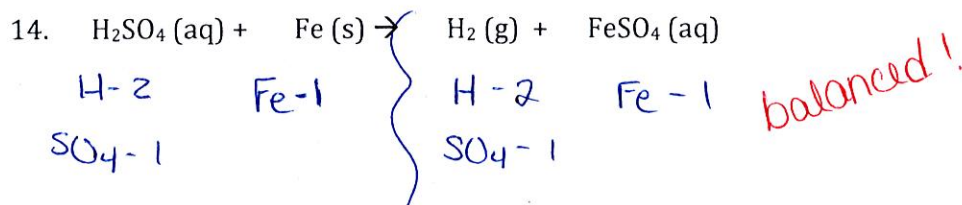
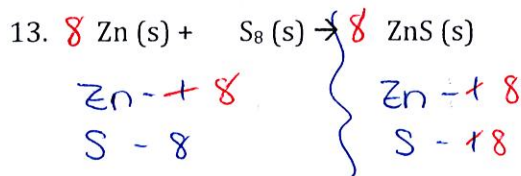
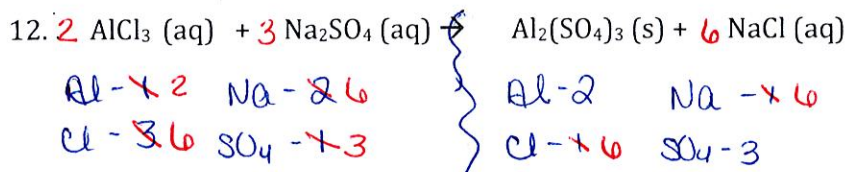
**Law of Conservation of Mass -**

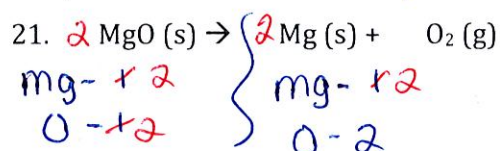
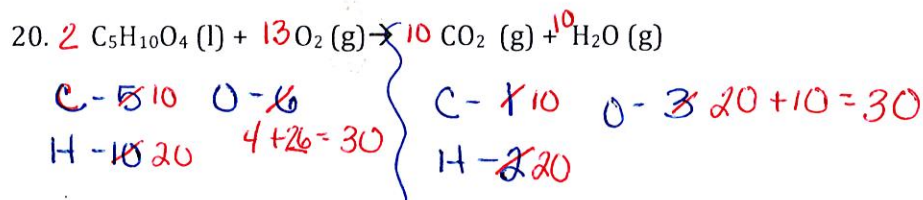
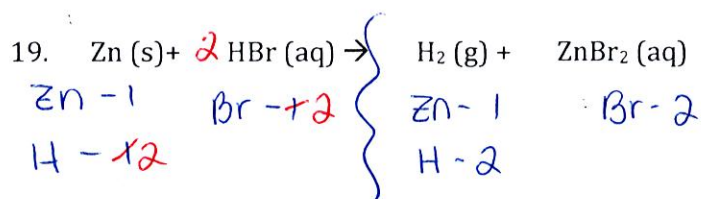
$$\text{Mass}_{\text{reactants}} = \text{Mass}_{\text{products}}$$

11. What is the definition? *mass cannot be created or destroyed during chemical reactions.*

**Balancing Chemical Equations** – the goal of balancing is to satisfy the Law of Conservation of Mass. You MUST have the same number of atoms of each element on both sides of the arrow or yield sign. The ONLY way to do this is through multiplying by COEFFICIENTS. Remember that coefficients multiply through to every element in the compound!

Balance these equations below:





**Writing Skeleton Equations** – For many, this is the hardest part of this unit. Why? Simply, because you have to know how to write formulas, know which substances are reactants, know which ones are products, and all their states of matter. Then placing them in the correct order in the equation.

If you don't know how to write formulas, for you need a refresher, I STRONGLY suggest you go back to your unit 3 notes and check things out. Use the formula writing flowchart provided to you on the blog, [www.myscitech.com](http://www.myscitech.com). USE your brain, you can do this!

**Example:** Solid sodium hydroxide reacts with a solution of calcium sulfate to produce a sodium sulfate solution and a precipitate of calcium hydroxide

Reactants: sodium hydroxide (s) & calcium sulfate (aq)  
 Products: sodium sulfate (aq) & calcium hydroxide (s)

### Word Equation

Sodium hydroxide (s) + calcium sulfate (aq) → sodium sulfate (aq) + calcium hydroxide (s)

All 4 of these substances are ionic compounds, which means we have to criss – cross ions when we write the formulas.

### Writing the formulas:

Sodium hydroxide  $\text{Na}^{1+} \quad \text{OH}^{1-}$  becomes  $\text{NaOH}$

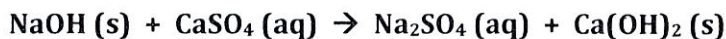
Calcium sulfate  $\text{Ca}^{2+} \quad \text{SO}_4^{2-}$  becomes  $\text{CaSO}_4$

Sodium sulfate  $\text{Na}^{1+} \quad \text{SO}_4^{2-}$  becomes  $\text{Na}_2\text{SO}_4$

Calcium hydroxide  $\text{Ca}^{2+} \quad \text{OH}^{1-}$  becomes  $\text{Ca(OH)}_2$



### Skeleton Equation



**Example:** A common middle school science fair experiment is to put eggs in vinegar. The reaction is: Solid calcium carbonate reacts with a solution of acetic acid to produce a solution of calcium acetate, carbon dioxide gas, and water.

Reactants: calcium carbonate (s) and acetic acid (aq)

Products: calcium acetate (aq), carbon dioxide (g), and water (l)

### Word Equation

Calcium carbonate (s) + acetic acid (aq)  $\rightarrow$  calcium acetate (aq) + carbon dioxide (g) + water (l)  
**ionic                      oxyacid                      ionic                      type III                      type III**

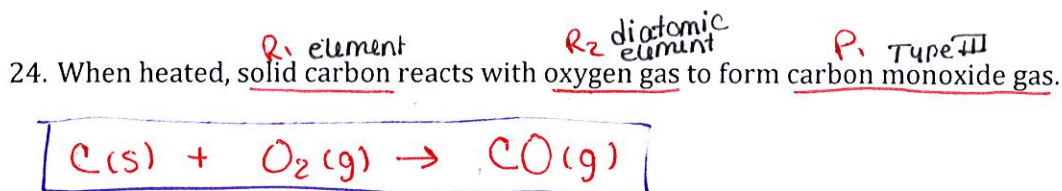
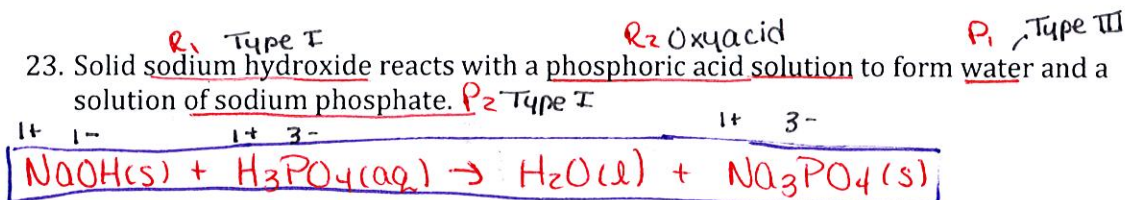
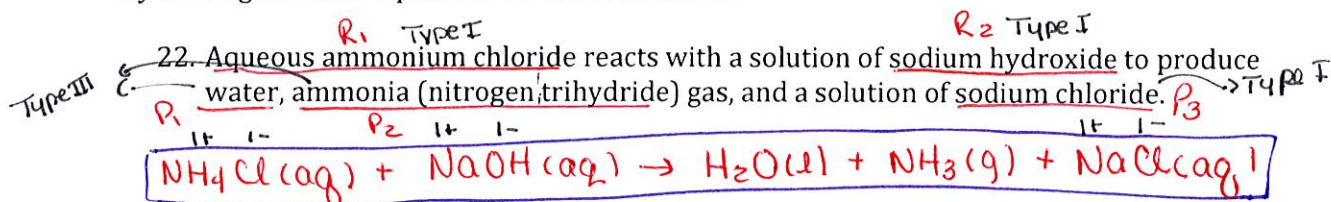
### Writing the Formulas

Calcium carbonate	Ca <sup>2+</sup>	CO <sub>3</sub> <sup>2-</sup>	becomes	CaCO <sub>3</sub>
Acetic acid	H <sup>1+</sup>	C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> <sup>1-</sup>	becomes	HC <sub>2</sub> H <sub>3</sub> O <sub>2</sub>
Calcium acetate	Ca <sup>2+</sup>	C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> <sup>1-</sup>	becomes	Ca(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub>
Carbon dioxide	CO <sub>2</sub>			
Water	H <sub>2</sub> O			

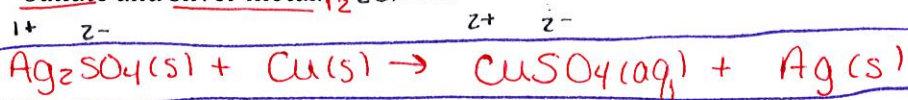
### Skeleton Equation



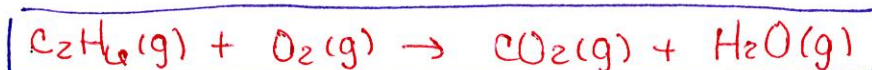
Try writing skeleton equations for these reactions.



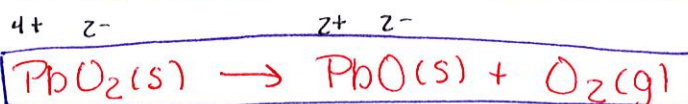
25. Solid silver (I) sulfate reacts with copper metal to produce a solution of copper (II) sulfate and silver metal.  $P_1$  Type II  $P_2$  element



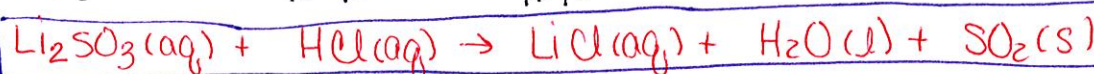
26. Ethane gas is burned in the presence of oxygen gas to produce carbon dioxide gas and water vapor.  $P_1$  Type III  $P_2$  diatomic element



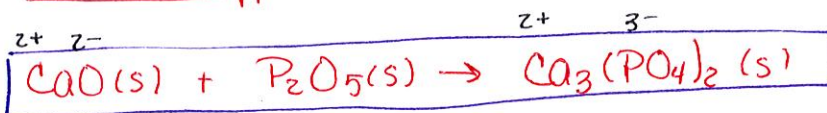
27. Solid lead (IV) oxide decomposes into solid lead (II) oxide and oxygen gas.  $P_1$  Type II  $P_2$  diatomic element



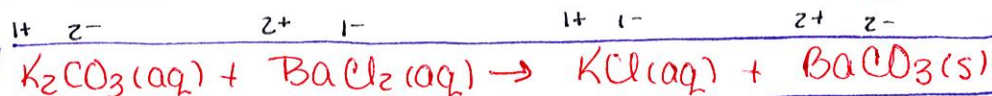
28. A solution of lithium sulfite reacts with a solution of hydrochloric acid to produce a solution of lithium chloride, water, and sulfur dioxide precipitate.  $P_1$  Type I  $P_2$  Binary acid  $P_3$  Type III



29. Solid calcium oxide and solid diphosphorous pentoxide react to form calcium phosphate solid.  $P_1$  Type I  $P_2$  Type III



30. Aqueous solutions of potassium carbonate and barium chloride react to produce potassium chloride solution and a precipitate of barium carbonate.  $P_1$  Type I  $P_2$  Type I  $P_3$  Type I



31. Ammonia (nitrogen trihydride) gas reacts with oxygen to produce gaseous nitrogen monoxide and steam.  $P_1$  Type III  $P_2$  diatomic element  $P_3$  Type III



32. Solid copper in the Statue of Liberty reacted with oxygen gas in the air to create a green copper (II) oxide coating.  $P_1$  element  $P_2$  diatomic element

