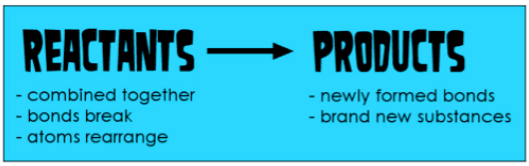
Chp15:Lect1:Chemical Reactions & Writing Chemical Formulas: ec 1 pt printing

Chemical Change: Ice melting & water freezing are both examples of physical changes. During a physical change, a substance changes form, but remains the same substance. A chemical change turns 1 or more substances into different substances that usually have different properties (they now look different, smell different, act differently, etc.) Chemical change is really important & we use it everyday to make necessary substances like rubber, plastic, medicine, etc.

A chemical reaction is material changing from a beginning mass to a resulting substance. The conclusion of a chemical reaction is that new material or materials are made, along with the disappearance of the mass that changed to make the new. This _____ that new elements have been made. In order to make new elements, the nuclear contents must change, and that requires major amounts of energy.

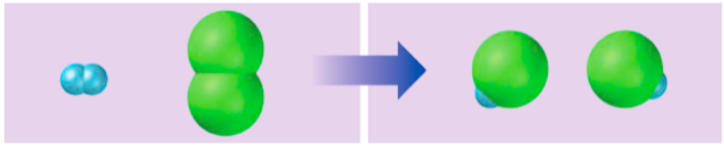
What is a chemical reaction?

A system of chemical changes that involve the breaking & reforming of bonds to create new substances. The result: a brand new substance



Signs of a Chemical Reaction

1. _____- gas formation
2. _____ solid formation
3. _____
4. _____ change – energy change



Example #2: Baking soda & Vinegar

What is the actual reaction between baking soda & vinegar?

Reactants:

ADD IT UP: How many total atoms are there?

_____ Hydrogen _____ Sodium

_____ Oxygen _____ Carbon

Parts of a Chemical Reaction

In cooking, ingredients are combined to make food. In chemical reactions, reactants are combined to make products. The _____ are substances that are combined & changed in the reaction. The _____ are the new substances that result from the reaction.

Example #1: Hydrochloric Acid

* Reactants: hydrogen (H_2 - gas) & chlorine (Cl_2 - gas)
*The bonds break, the elements rearrange, and& form new bonds with each other.
* Products: 2 HCl

Now, break the bonds, rearrange the atoms, and what do you get???

Products:

ADD IT UP: How many total atoms are there?

_____ Hydrogen _____ Sodium

_____ Oxygen _____ Carbon

A chemical reaction rearranges the atoms of the reactants to form new compounds of the products. No new atoms are created!

The Law of _____**.The mass of the reactants** _____ **the mass or the products OR:**

Mass is NEVER _____ 0r you can't get somethin' outta nothing.

Chemical Formulas/Equations:

A molecule or compound consists of at least **two atoms that are**_____.The chemical formula of a molecule or compound states **how many atoms of each**_____ are in one of its molecules. This formula is similar to an algebraic formula in its use of symbols. The description of a compound with numbers and symbols is called a chemical formula. Some formula can be quite complex.

A _____ **is a way to describe what goes on in a chemical reaction**, the actual change in a material. Chemical equations are written with the _____ of materials to include elements, ionic or covalent compounds, aqueous solutions, ions, or particles. There is an _____ pointing to the right that indicates the action of the reaction. The materials to the left of the arrow are the _____or materials that are going to react. The materials to the right of the arrow are the _____ or materials that have been produced by the reaction.

Chemical formulas

Chemical formulas are designations of **molecules and compounds in** _____ _____similar to that used in Algebra. This is a way to show the exact number of atoms & compounds in a chemical reaction. We write the chemical equation for baking soda & vinegar as follows:

$NaHCO_3 + HC_2H_3O_2$ ------> $NaC_2H_3O_2 + CO_2 + H_2O$

EXAMPLES OF CHEMICAL CHANGES shown in chemical formulas:

Chemical reactions, also called chemical changes, are not limited to happening in a chemistry lab. Here are some examples of chemical reactions with the corresponding chemical equations:

1. **A silver spoon tarnishes.** The silver reacts with sulfur in the air to make silver sulfide, the black material we call tarnish. 2 Ag + S --> _____
2. **An iron bar rusts.** The iron reacts with oxygen in the air to make rust. 4 Fe + 3 O2 --> _____
3. **Methane burns.** Methane combines with oxygen in the air to make carbon dioxide and water vapor. CH_4 + 2 O2 -->_____
4. An antacid (calcium hydroxide) neutralizes stomach acid (hydrochloric acid). $Ca(OH)_2$ + 2 HCl --> _____

Complex formulas

Just as in Algebra, you can use parentheses to separate parts in a complex formula. One example is the formula for nitroglycerin, a highly explosive substance. **$C_3H_5(NO_3)_3$** This formula shows that nitroglycerin consists of 3 atoms of C, 5 atoms of H and then 3 NO_3 nitrate ions. If the parentheses were not used, you might have a formula like: **$C_3H_5N_3O_9$** The number of atoms for each element would be correct, but it wouldn't help to describe the true structure of the nitroglycerin molecule. Remember that molecules are 3-dimensional collections of atoms.

In more complex molecules--especially in organic substances--the configuration becomes important. **Carbon dioxide is CO_2,** which means there is one atom of carbon and two atoms of oxygen in the molecule. To show the **number of molecules,** a full sized number is located in front of the molecule. This is called a_____ For example 4 molecules of carbon dioxide is designated as: **$4CO_2$** This means there are a total of 4 C atoms and 8 O atoms in the combination. A way to remember this--taken from Algebra--is to think of it as 4 x (CO_2).

BALANCING EQUATIONS

Now comes the fun part, balancing the reaction. The **Law of Conservation of Mass** states that **in a chemical reaction there** _____ Each type of element will have the same amount before the reaction and after the reaction, or as reactant and product. But you cant change the materials that participate in the reaction, so you must write an integer coefficient in front of (to the left of) each material in the reaction to make sure every type of atom has the same number on each side of the reaction.

THE 4 RULES OF CHEMICAL REACTIONS

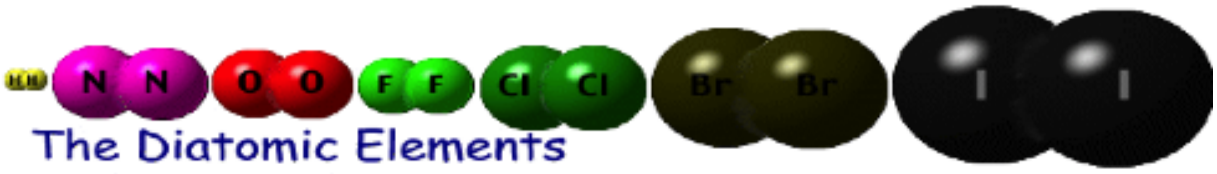
1. Chemical reactions are processes in which **atoms are** _____ into different combinations of molecules.
2. Reactants interact, change bonds, and **form products with** _____ **chemical properties**.
3. In a reaction, **the number of atoms stays the** _____, no matter how they are arranged, so their total mass stays the same.
4. Chemical reactions **usually liberate/**_____ **or absorb heat**.

In Conclusion:

The number of atoms of each element in a chemical formula is designated by the small number behind each element symbol. If there is no number, it is assumed there is only one of that element. A large number in front of a compound designates how many units there are of that compound. Parentheses can be used to designate a special structure, where other molecules are attached to the larger, complex molecule.

Chp15: Part 2 To react or not to react? THAT is the question!

H_2 N_2 O_2 F_2 Cl_2 Br_2 and I_2



IMPORTANT: Diatomic elements are nonmetal elements that form a covalent bond between two atoms. The diatomic elements are: hydrogen, nitrogen, oxygen, fluorine, chlorine, bromine and iodine. As elements they always travel in pairs of atoms and therefore you must write then as:

H_2 N_2 O_2 F_2 Cl_2 Br_2 and I_2

Chemical changes are a result of chemical reactions. All chemical reactions involve a change in substances and a change in energy. Neither matter or energy is created or destroyed in a chemical reaction---only changed. There are so many chemical reactions that it is helpful to classify them into 5 general types:

_____: **A + B -> AB**
_____: **AB -> A + B**
_____: **A + BC -> AC + B**
_____: **AB + CD -> AD + CB**
_____

1. _____ (Composition)

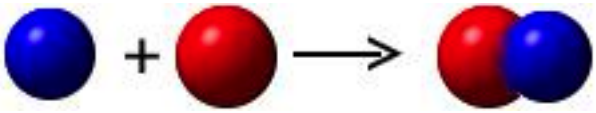
In a synthesis reaction (also known as a composition reaction), two or more simple substances combine to form a more complex substance. Two or more reactants yielding one product is another way to identify a synthesis reaction. In the simplest type of synthesis reaction, _____**combine to form a**_____

The chemical equation for this synthesis reaction looks like:

reactant + reactant ---> product

Here are four synthesis reactions:

Hydrogen + oxygen yields water: **$2H_2 + O_2 \rightarrow 2H_2O$**
Magnesium + nitrogen yields magnesium nitride **$3Mg + N_2 \rightarrow Mg_3N_2$**
Iron + sulfur yields iron(II) sulfide **$Fe + S \rightarrow FeS$**
Barium + phosphorus yields barium phosphide **$3Na + P \rightarrow Na_3P$**

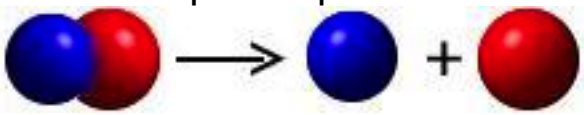


2. _____(Decomposition)

In a decomposition reaction, **a larger substance breaks apart and forms two or more**_____

The chemical equation for this decomposition reaction looks like:

reactant -------> product + product



The first thing you may notice about a decomposition reaction is that it is the complete opposite of a synthesis reaction. In fact many synthesis reactions can be reversed into a decomposition reaction. When you burn hydrogen gas, the hydrogen combines with oxygen to produce water.

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

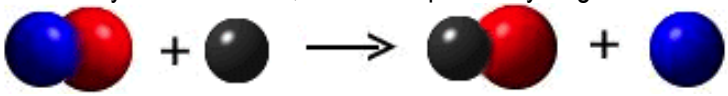
With an electrical current, water can be decomposed into hydrogen and oxygen gas. $2H_2O \rightarrow 2H_2 + O_2$: _____

3. _____

In a single replacement reaction a single uncombined element replaces another in a compound.

Two reactants yield_____

For example when zinc combines with hydrochloric acid, the zinc replaces hydrogen.



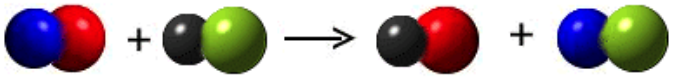
The chemical equation for this single replacement reaction looks like: **reactant + reactant------> product + product**

In a single replacement reaction, a more active element replaces a less active element in a compound.

Generally, as you go across the periodic table (from I-A to IIIV-A) metals become **less chemically active.** A metal such as magnesium is more chemically active that transition metals such as copper, tin or zinc. An easier way to identify the activity of element is to use an activity series which shows the chemical activity of both metals and nonmetals.

4. _____

In a double replacement reaction, two metal ions (in aqueous compounds) switch places.



In a double replacement reaction parts of two compounds switch places to form two new compounds. Two reactants yield two products. For example when silver nitrate combines with sodium chloride, two new compounds--silver chloride and sodium nitrate are formed because the sodium and silver switched places.

The chemical equation for this double replacement reaction looks like: **reactant + reactant ---------> product + product**

One of the products is insoluble and forms a solid. This solid, called a precipitate, is more dense than the surrounding solution and falls to the bottom of the test tube. An arrow down is used to identify a precipitate (because the precipitate sinks). In a reaction between sodium chloride solution ($NaCl_{(aq)}$) and silver nitrate solution ($AgNO_{3(aq)}$) the products are sodium nitrate $NaNO_{3(aq)}$ solution + silver chloride solid $AgCl_{(aq)}$ Since silver chloride is insoluble (won't dissolve in water) it forms a white solid and sinks to the bottom of the test tube. A solid that forms in a double replacement reaction is called a precipitate. Here is a photo of this reaction:

5. _____

Combustion or burning is the sequence of exothermic chemical reactions between a fuel and an oxidant accompanied by the production of heat and conversion of chemical species. The release of heat can result in the production of light in the form of either glowing or a flame. Fuels of interest often include organic compounds (especially hydrocarbons) in the gas, liquid or solid phase.

Chemical Reaction Summaries

Synthesis

Definition	Two or more substances combine to form a new substance
Equation	
Looks like	
Examples	$4Fe + 3O_2 \rightarrow 2Fe_2O_3$
Extra Info	Also called composition & addition reactions

Decomposition

Definition	A single compound is broken down into two or more smaller compounds
Equation	
Looks like	
Examples	$H_2CO_3 \rightarrow H_2O + CO_2$
Extra Info	Large compounds can also decompose into several other compounds.

Single-Replacement

Definition	One element replaces a similar element in a compound.
Equation	
Looks like	
Examples	$2HCl + Zn \rightarrow ZnCl_2 + H_2$
Extra Info	Here, more-reactive elements replace less-reactive ones - so sometimes it is impossible to reverse this reaction.

Double-Replacement

Definition	Ions in two compounds switch places.
Equation	
Looks like	
Examples	$NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl$
Extra Info	Often, a solid combines with a liquid & forms a precipitate in this reaction.

		Definition	A complex series of exothermic reactions between fuel & oxygen which produces energy.
Equation	Fuel + Oxygen --(heat)--> Energy	**Examples**	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + energy
Looks like		**Extra Info**	Cars are powered by a combustion reaction which uses petroleum.