Chemical Reactions Unit Review

Main Ideas:

- Compounds are formed when molecules share or transfer valence electrons through chemical bonds.
- The same set of elements can combine in many different ways to form different substances.
- The atomic theory states that all matter is composed of atoms, atoms of an element are all identical, and atoms of different elements combine in simple ratios to form chemical compounds.
- Matter can change in two ways: a chemical change or a physical change.
- When a chemical reaction occurs, a chemical change is taking place.
- We can tell a chemical reaction has occurred if a precipitate forms, if gas is formed, if the color changes, or if there's an energy change.
- During an ordinary chemical reaction, matter can't be created or destroyed—we always come out with the same amount of matter.
- In a chemical reaction, the total mass of the reactants equals the total mass of the products.

In this Issue

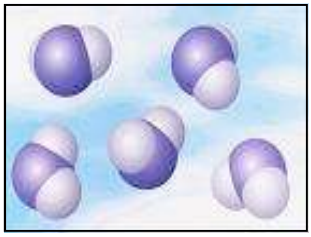
Physical and Chemical Changes

Elements combine to form substances called **compounds**. When we write out the recipes for these compounds, we write their **chemical formulas**. Each piece of that compound is called a **molecule**.

Ex:

Water's Chemical formula: H_2O

5 H_2O = 5 molecules of water



If elements do not chemically combine, they can form **mixtures**, combinations of matter where each part keeps its own properties. We have two main types of mixtures:

Heterogenous: Can see the different parts of the mixture

Homogenous: Can not see different parts of the mixture

Matter changes in two ways: chemical changes and physical changes. **Chemical changes** involve the formation of a new substance, while **physical change** is only a change in appearance or physical characteristics.

Ex: Physical-Ice Melting

Chemical-Water split into Hydrogen and Oxygen gas

In order to tell if a chemical change has occurred, it can be helpful to see one or more of the following indicators have occurred:

-Formation of a gas

-Formation of a precipitate

-Energy change

-Color change

All elements/atoms combine according to the **atomic theory**. It basically says there are three rules for atoms combining: 1) all matter is composed of atoms; 2) atoms of an element are all identical; 3) atoms of different elements combine in simple ratios to form chemical compounds.

Chemical Formulas & Bonding

Chemical formulas serve as the recipes for any substance in the universe. When we look at a chemical formula, we need to know the parts to tell how many of each element there are.

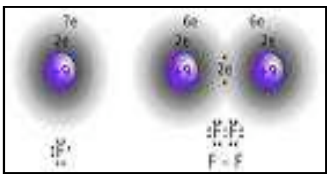
5 H_2O

Coefficient **subscript**

In one molecule of water, we have 2 hydrogens and 1 oxygen. So in 5 molecules of water, we have 10 hydrogens (5x2) and 5 oxygens (5x1).

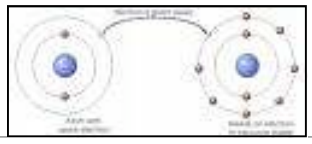
In order for us to have compounds and chemical formulas, we must know how elements bond, or stick together. There are three main types: **Covalent, ionic,** and **metallic**.

Covalent bonds share electrons. All covalent bonds are between two nonmetals.



Ex: F:F

Ionic bonds transfer electrons. All ionic bonds are between a metal and a nonmetal. Table salt is a great example: NaCl.



Ionic bonds can be predicted by valence electrons. Elements in Group 1 are most likely to bond with elements in Group 17 because of the Octet Rule. **The Octet Rule** tells us that all atoms want to get 8 electrons in their outer shell.

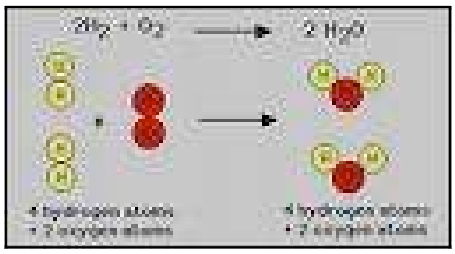
Metallic bonds also share electrons, but between two metals. An example would be ZnHg, zinc mercury.

Parts of a Chemical Equation

Whenever a chemical reaction occurs, scientists describe what happened using a **chemical equation**. We use each substance's chemical formula to describe its role in the process.

Ex: When Hydrogen gas and Oxygen gas combine to form water, we can describe it like this:

$2\ H_2 + O_2 \text{ —> } 2\ H_2O$

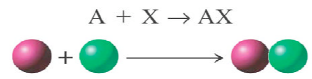


There is a 2 in front of the H and H_2O because there must be two hydrogen molecules and two water molecules in order for it to be **balanced**.

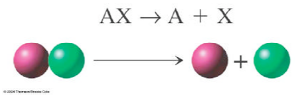
There are two main parts of a reaction, divided by an arrow. That arrow points towards the end substances, or **products**. The compounds that we begin with are called **reactants**. In the example to the left, the Hydrogens and Oxygens are the reactants, while the 2 water molecules are the products.

There are four main types of reactions: **synthesis**, **decomposition**, **single replacement**, and **double replacement**.

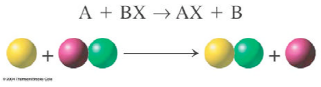
Synthesis: Reactions where two parts come together; Think two people coming together to start dating.



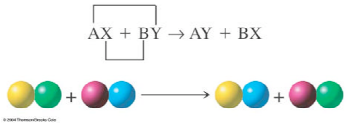
Decomposition: One part is decomposing (breaking down into smaller parts); Think divorce or relationships ending.



Single Replacement: A single element replaces another; think one boy stealing another boy's girlfriend.



Double Replacement: When two elements replace each other in a compound; think two boys switching their girlfriends.



Law of Conservation of Matter

Any scientific law is a rule that is never broken in science. The **Law of Conservation of Matter** tells us that matter is never created or destroyed.

We use this Law to figure out the mass of products or reactants in an equation. Also, because matter is never created or destroyed, we know we have to balance chemical reactions. We will review that in the section below.

Ex: When wood burns, it may seem that some disappears. However, nothing was created or destroyed because some matter escapes to the air as smoke.

In a chemical reaction, the mass of the reactants always equals the mass of the products. We can solve for any mass by writing an algebra equation.

Mass of reactants = mass of products

Ex: If 300 grams of NaN_3 decomposes to form an unknown amount of Na and 123 grams of N_2. How much Na is produced?

We know that decomposes means something breaks down, so the question tells us that:

300 g of NaN_3 —> x of Na + 123 g of N_2

Re-write this as: 300 = x + 123

Finally, x = 177, so there were 177 grams of Na produced.

Balancing Chemical Equations

Chemical reactions must be balanced because of the Law of Conservation of Matter. For a chemical reaction to be balanced, there must be the same number of each element on both sides.

Ex: $NaO + H_2O$ —> ?

There must be 2 Oxygen atoms in the products because there are 2 Os in the reactants.

There are four steps to balancing chemical reactions:

1) Get an unbalanced equation. (given)
2) Draw boxes around EACH chemical formula, then never change inside the boxes.
3) Make an element inventory, a list of the number of atoms on both sides.
4) Write numbers in front of each box until you have the same number of atoms on the product side as reactants side.

Ex:

Step 1: $Mg + O_2$ —> MgO

Step 2: <u>Mg</u> + <u>O_2</u> —> <u>MgO</u>

Step 3: <u>Mg</u> + <u>O_2</u> —> <u>MgO</u>

Step 4: $2Mg + O_2$ —> 2MgO

# R	E	#P
1	Mg	1
2	O	1