

Ch. 7 Chemical Reactions
Chemistry
Student Notes

Name: _____ Date: _____

7.1 Evidence for a Chemical Reaction

Key Ideas	Notes and Examples
A chemical reaction produces a signal that it has occurred.	Evidence for a Chemical Reaction  color change TABLE 7.1 Some Clues That a Chemical Reaction Has Occurred 1. The color changes. 2. A solid forms. 3. Bubbles form. 4. Heat and/or a flame is produced, or heat is absorbed.  solid forms  bubbles form  heat or flame occurs
These signals include:	Reactions are not always visible. Sometimes the only signal that a reaction is occurring is a change in temperature as heat is produced or absorbed.
<i>Change in composition/appearance</i>	A change in the texture or characteristic of the material, for example, rusted, corroded, molded, etc...
<i>Permanent odor or color change</i>	A permanent change in color or odor, not a change produced by adding a substance like dye or an odor that is a natural odor of a substance
<i>Solid formation or liquid formation</i>	A solid formation is called a precipitate which is an insoluble solid produced from the reaction of two aqueous solutions. These are usually formed in double displacement reactions.

Ch. 7 Chemical Reactions
Chemistry
Student Notes

Name: _____ Date: _____

	A liquid formation is forming a pure liquid not one that is dissolved in water. This is produced during neutralization reactions and the pure liquid formed is water.
<i>Gas formation</i>	The production of a gas can be observed as fizzing, bubbles, smoke, etc...
<i>Production of Heat/Flame/Light</i>	In a combustion reaction one of the reactants is oxygen gas which is needed for a flame to continue to burn. Some reactions produce light, heat, or a flame as a product of the reaction.
<i>Change in energy</i>	Some reactions can have a change in energy, for example placing a salt in water could make the temp of the water increase or decrease depending on the type of salt being dissolved.

Ch. 7 Chemical Reactions
Chemistry
Student Notes

Name: _____ Date: _____

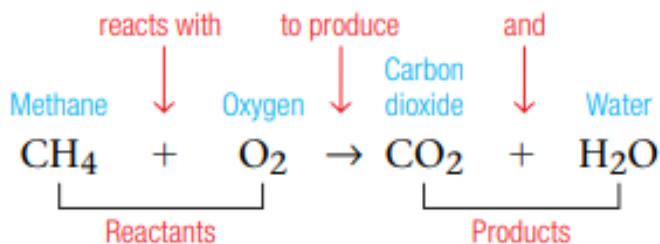
7.2 Chemical Equations

Key Ideas

A chemical equation represents a chemical reaction.

- Reactants are shown to the left of an arrow.
- Products are shown to the right of the arrow

Notes and Examples

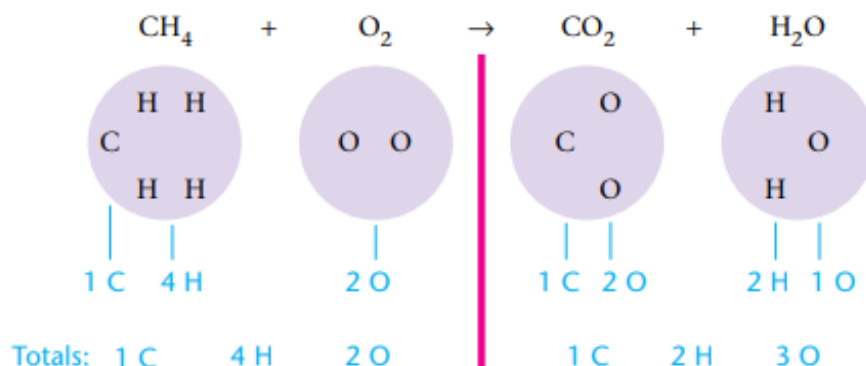


Note from this equation that the products contain the same atoms as the reactants but that the atoms are associated in different ways.

That is, a chemical reaction involves changing the ways the atoms are grouped.

In a chemical reaction atoms are neither created nor destroyed.

A balanced chemical equation must have the same number of each type of atom on the reactant and product sides.



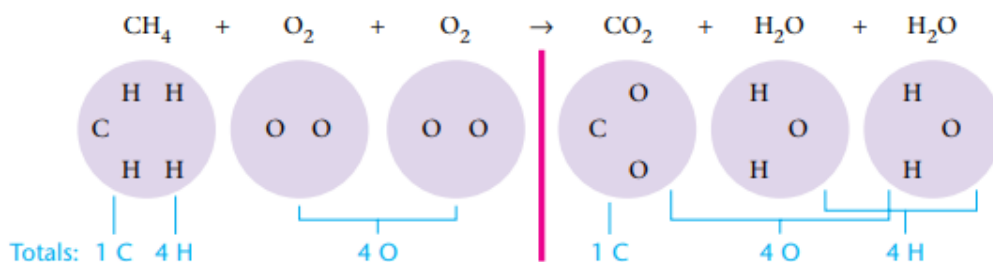
The reaction cannot happen this way because, as it stands, this equation states that one oxygen atom is created and that two hydrogen atoms are destroyed.

A reaction is only a rearrangement of the way the atoms are grouped; atoms are not created or destroyed. The total number of each type of atom must be the same on both sides of the arrow.

Ch. 7 Chemical Reactions
Chemistry
Student Notes

Name: _____ Date: _____

A balanced chemical equation uses numbers (coefficients) in front of the reactant and product formulas to show the relative numbers of each.



This balanced chemical equation shows the actual numbers of molecules involved in this reaction (see Figure 7.2).

When we write the balanced equation for a reaction, we group like molecules together:

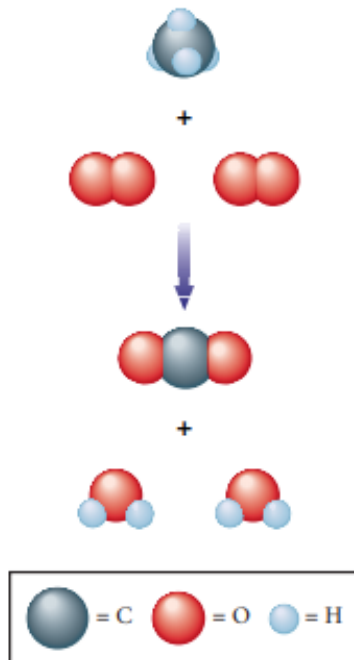
The physical states of reactants and products in a reaction are indicated by the following symbols.

Physical States	
Symbol	State
(s)	solid
(l)	liquid
(g)	gas
(aq)	dissolved in water (in aqueous solution)

Ch. 7 Chemical Reactions
Chemistry
Student Notes

Name: _____ Date: _____

Chemical reactions involve a rearrangement of the ways atoms are grouped together.



The reaction between methane and oxygen yields water and carbon dioxide.

Note that there are four oxygen atoms in the products and in the reactants; none has been gained or lost in the reaction.

Similarly, there are four hydrogen atoms and one carbon atom in the reactants and in the products.

The reaction simply changes the way the atoms are grouped.

Ch. 7 Chemical Reactions
Chemistry
Student Notes

Name: _____ Date: _____

7.3 Balancing Chemical Equations

Atoms are conserved in a chemical reaction	Atoms are neither created nor destroyed. They are just grouped differently. The same number of each type of atom is found among the reactants and among the products.
The identities (formulas) of the compounds must never be changed in balancing a chemical equation.	In other words, the subscripts in a formula cannot be changed, nor can atoms be added to or subtracted from a formula.
Most chemical equations can be balanced by trial and error—that is, by inspection. Keep trying until you find the numbers of reactants and products that give the same number of each type of atom on both sides of the arrow.	Trial and error is often useful for solving problems. It's okay to make a few wrong turns before you get to the right answer
A chemical reaction is balanced by using a systematic approach. Atoms are conserved in a chemical reaction. The identities (formulas) of the compounds must never be changed in balancing a chemical equation	Solid potassium Water Hydrogen gas Potassium hydroxide dissolved in water $\text{K(s)} + \text{H}_2\text{O(l)} \rightarrow \text{H}_2\text{(g)} + \text{KOH(aq)}$

Ch. 7 Chemical Reactions
Chemistry
Student Notes

Name: _____ Date: _____

Write the formulas of the reactants and products to give the unbalanced chemical equation.

Balance by trial and error, starting with the most complicated molecule(s).

Check to be sure the equation is balanced (same numbers of all types of atoms on the reactant and product sides).

How to Write and Balance Equations

Step 1 Read the description of the chemical reaction.

- What are the reactants, the products, and their states?
- Write the appropriate formulas.

Step 2 Write the *unbalanced* equation that summarizes the information from step 1.

Step 3 Balance the equation by inspection, starting with the most complicated molecule.

- Proceed element by element to determine what coefficients are necessary so that the same number of each type of atom appears on both the reactant side and the product side.
- Do not change the identities (formulas) of any of the reactants or products.

Step 4 Check to see that the coefficients used give the same number of each type of atom on both sides of the arrow.

- Note that an "atom" may be present in an element, a compound, or an ion.
- Check to see that the coefficients used are the smallest whole numbers that give the balanced equation. This can be done by determining whether all coefficients can be divided by the same whole numbers to give a set of smaller *whole number* coefficients.

Ch. 7 Chemical Reactions
Chemistry
Student Notes

Name: _____ Date: _____

7.4 Classifying and Predicting Chemical Equations

Reactions can be classified in various ways.

A synthesis (combination) reaction is one in which a compound forms from simpler substances, such as elements.

1 Combination Reaction

General Equation: $R + S \longrightarrow RS$

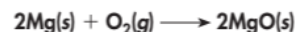
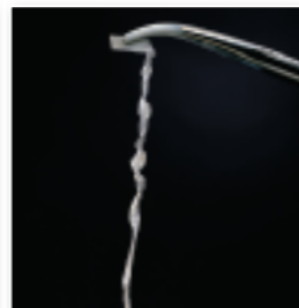
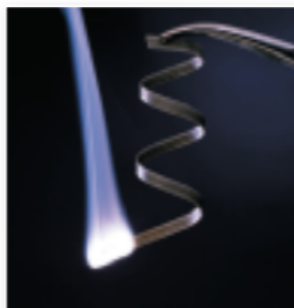
Reactants: Generally two elements, or two compounds (where at least one compound is a molecular compound)

Probable Products: A single compound

Example: Burning magnesium in air



See reactions
animated online.



A decomposition reaction occurs when a compound is broken down into simpler substances.

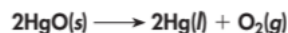
2 Decomposition Reaction

General Equation: $RS \longrightarrow R + S$

Reactants: Generally a single binary compound or a compound with a polyatomic ion

Probable Products: Two elements (for a binary compound), or two or more elements and/or compounds (for a compound with a polyatomic ion)

Example: Heating mercury(II) oxide



Ch. 7 Chemical Reactions
Chemistry
Student Notes

Name: _____

Date: _____

A single replacement reaction takes place when a single element replaces an element in a compound.

3 Single-Replacement Reaction

General Equation: $T + RS \longrightarrow TS + R$

Reactants: An element and a compound
In a single-replacement reaction, an element replaces another element from a compound in aqueous solution. For a single-replacement reaction to occur, the element that is displaced must be less active than the element that is doing the displacing.

Probable Products: A different element and a new compound

Example: Potassium in water



Activity Series of Metals

	Name	Symbol
Decreasing reactivity ↓	Lithium	Li
	Potassium	K
	Calcium	Ca
	Sodium	Na
	Magnesium	Mg
	Aluminum	Al
	Zinc	Zn
	Iron	Fe
	Lead	Pb
	(Hydrogen)	(H)*
	Copper	Cu
	Mercury	Hg
	Silver	Ag

*Metals from Li to Na will replace H from acids and water; from Mg to Pb they will replace H from acids only.

A precipitation reaction and a neutralization reaction can be classified as a double displacement reaction.

A precipitation reaction occurs when two

Ch. 7 Chemical Reactions
Chemistry
Student Notes

Name: _____ Date: _____

aqueous solutions react to form an insoluble solid (precipitate) and soluble ions.

A neutralization reaction is the reaction between an acid and a base to produce a salt (ionic compound) and water (liquid).

A combustion reaction is an oxidation–reduction reaction that involves O_2 .

4 Double-Replacement Reaction

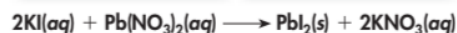


Reactants: Two ionic compounds

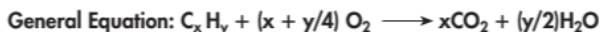
In a double-replacement reaction, two ionic compounds react by exchanging cations to form two different compounds.

Probable Products: Two new compounds
Double-replacement reactions are driven by the formation of a precipitate, a gaseous product, or water.

Example: Reaction of aqueous solutions of potassium iodide and lead(II) nitrate.



5 Combustion Reaction



Reactants: Oxygen and a compound of C, H, (O)
When oxygen reacts with an element or compound, combustion may occur.

Probable Products: CO_2 and H_2O
With incomplete combustion, C and CO may also be products.

Example: The combustion of methane gas in air

