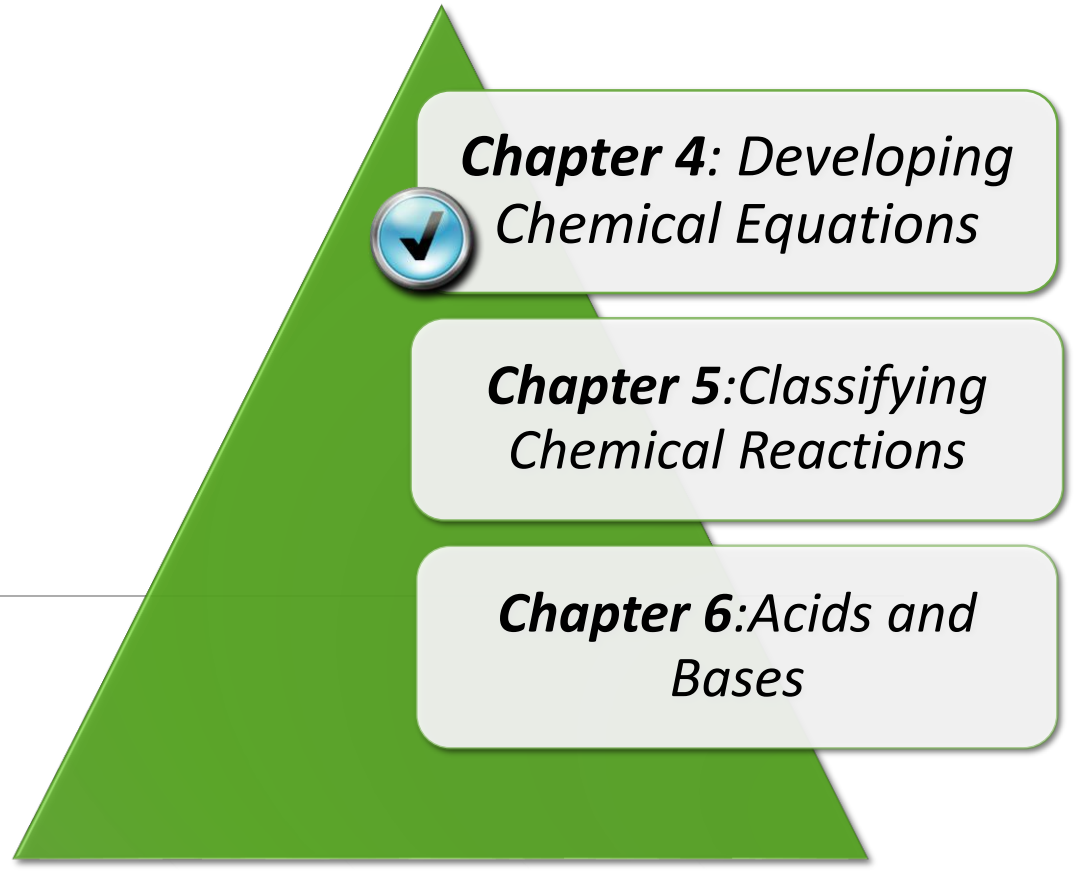
Unit 1: Chemistry (4.3)

SNC2D



Chemical Reactions

A ***chemical reaction*** is a process in which new substances with new properties are formed.

*In a **chemical reaction**, **reactants** (the starting materials) undergo a _____, changing into the _____ of the reaction.*

Chemical Reactions

Reactant:

Product:

The explosive reaction between ***water (H_2O)*** *and* ***sodium (Na)*** *produces* ***light***, ***heat***, *and* ***hydrogen (H_2) gas***.

Chemical Reactions

Law of Conservation of Mass:

Total mass of reactants = Total mass of products

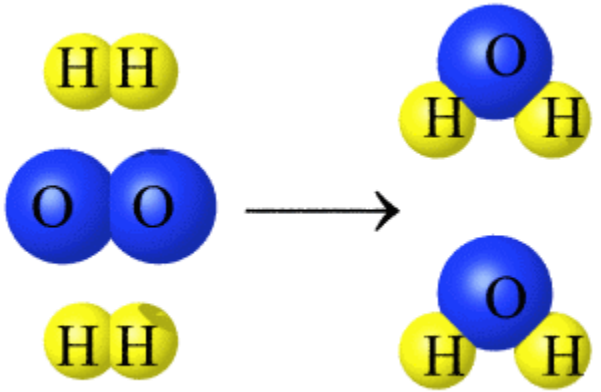
Law of Conservation of Mass

Atoms present at the ***beginning*** of the reaction must still be present ***after the reaction*** has taken place

ATOMS CANNOT BE CREATED OR DESTROYED

How does this happen?

Atoms rearrange themselves, bonding to new atoms to make a different product

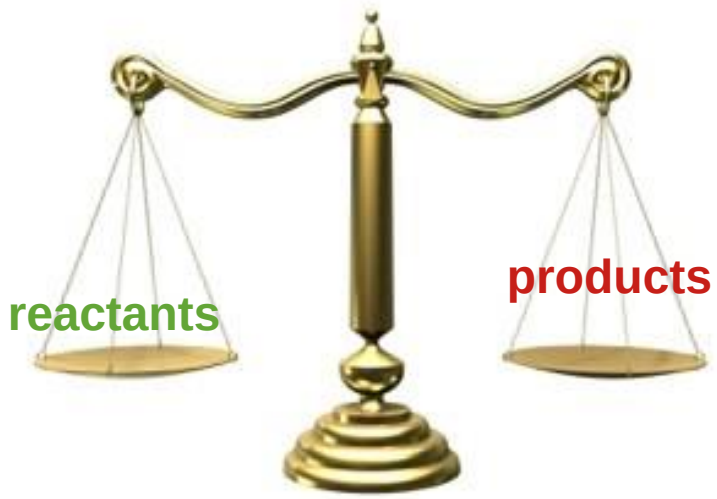


Law of Conservation of Mass

So when you write a chemical equation…

The number of atoms of each type must be the same on each side

Equations must be balanced!



Writing Chemical Equations

A **chemical equation** is a representation of what happens to the reactants and products during a chemical change. There are **three** forms of chemical equations.

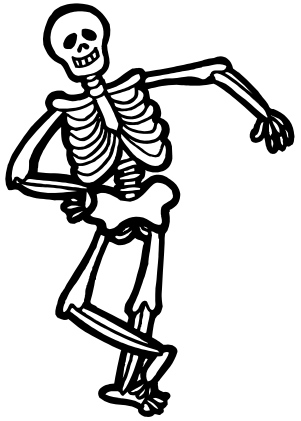
1. Word Equations:

hydrogen + oxygen → water

Writing Chemical Equations

2. Skeleton Equations :

$$H_2 + O_2 \longrightarrow H_2O$$



Writing Chemical Equations

3. Balanced Chemical Equations :

$$2H_2 + O_2 \longrightarrow 2H_2O$$

A COEFFICIENT is a number that is placed in front of a chemical formula in a balanced chemical equation

Balancing Chemical Equations

The only way to balance a chemical equation is to change the **coefficients.**

If you change a **subscript**, you will change the identity of the substance

$$H_2 + O_2 \longrightarrow H_2O_2$$

Writing Chemical Equations

The **states** of the reactants and products may be included. The abbreviations of the states are written after the chemical formula they apply to.

NOTE: Aqueous solution *means that the product or reactant is dissolved in water.*

Table 4.12 Abbreviations for the States of Reactants and Products

State	Abbreviation	Example (at room temperature)
Solid	(s)	sodium chloride: NaCl(s)
Liquid	(ℓ)	water: $H_2O(\ell)$
Gas	(g)	hydrogen: $H_2(g)$
Aqueous solution	(aq)	aqueous sodium chloride solution: NaCl(aq)

How to Balance Chemical Equations

In order to create a balanced chemical equation, you must know how to determine the total number of atoms in a compound.

a) 2 NaCl

a) 6 H_2O

Let's Practice!

Determine the number of atoms of each element in the following compounds:

A) 2NAI

B) $3PCl_5$

C) $2NaNO_3$

D) $(NH_4)_2SO_4$

Tips for Balancing Chemical Equations

- Remember the diatomic molecules: H_2, N_2, F_2, Cl_2, Br_2, I_2 and O_2 (Remember "HOFBrINCl")
- Make sure your chemical formulas are correct
- If a reactant or product is a single element, balance it last
- Do a final check by counting atoms of each element

Example 1: Balancing Chemical Equation

Problem:

A Bunsen burner works when methane gas burns in oxygen to produce carbon dioxide and water.

A) Write the balanced chemical equation for this reaction

Step 1: Write the word Equation

Step 2: Write the Skeleton Equation

Step 3: Count the atoms

Count the number of atoms of each type in reactants (left side) and products (right side)

$CH_4 + O_2 \rightarrow CO_2 + H_2O$

Type of Atom	Reactants	Products	Balanced?
C			
H			
O			

Step 4: Balancing

- Multiply each compound by the appropriate **coefficients** to balance the number of atoms

  (do NOT change subscripts)

- Balance compounds first and elements last

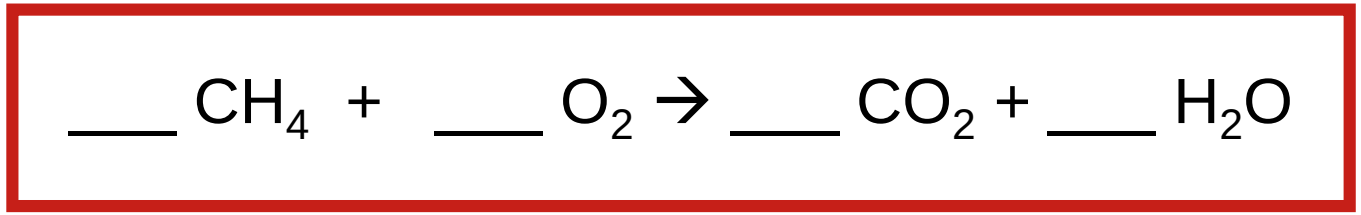
- Balance hydrogen and oxygen last

- If a polyatomic ion appears in both a reactant and a product, think of it as a single unit

Trial and error (be patient ☺)

Step 4: Balancing

Count the number of atoms of each type in reactants (left side) and products (right side)



Type of Atom	Reactants	Products	Balanced?
C	1	1	
H	4		
O	2		

Tips for Balancing Chemical Equations

- Remember that these elements exist as diatomic molecules: hydrogen (H_2), nitrogen (N_2), fluorine (F_2), chlorine (Cl_2), bromine (Br_2), iodine (I_2), and oxygen (O_2), shown in **Figure 4.22**.
- Balance compounds first and elements last.
- Balance hydrogen and oxygen last. They often appear in more than one reactant or more than one product, so they are easier to balance after the other elements are balanced.
- If a polyatomic ion appears in both a reactant and a product, think of it as a single unit to balance the chemical equation faster.
- Once you think the chemical equation is balanced, do a final check by counting the atoms of each element one more time.
- If you go back and forth between two substances, using higher and higher coefficients, double-check each chemical formula. An incorrect chemical formula might be preventing you from balancing the chemical equation.

Let's Practice!

Balance each chemical equation:

A) $Mg\ (s) + O_2\ (g) \longrightarrow MgO\ (s)$

B) $Li\ (s) + Br_2\ (g) \longrightarrow LiBr(s)$

C) $Al\ (s) + CuO\ (s) \longrightarrow Al_2O_3\ (s) + Cu\ (s)$

D) $CaCl_2\ (aq) + AgNO_3\ (aq) \longrightarrow AgCl\ (s) + Ca(NO_3)_2\ (aq)$

Let's Practice!

Write a word equation, a skeleton equation and a balanced chemical equation for each chemical reactions. Include the state of all the reactants/products in the equation.

a) A solid piece of magnesium reacts with oxygen gas to produce solid magnesium oxide.

a) Iron reacts with oxygen to produce rust, Fe_2O_3

HOMEWORK

Complete the sheets given in class.