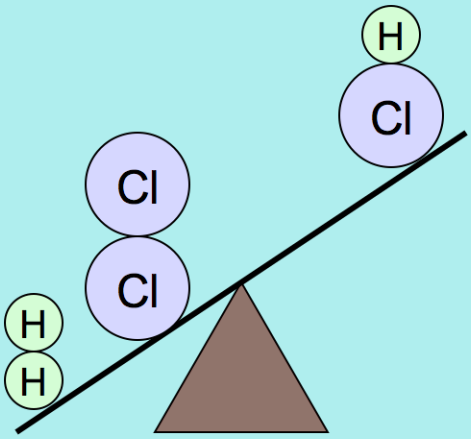
Chemical Equations and Reactions

Objectives:

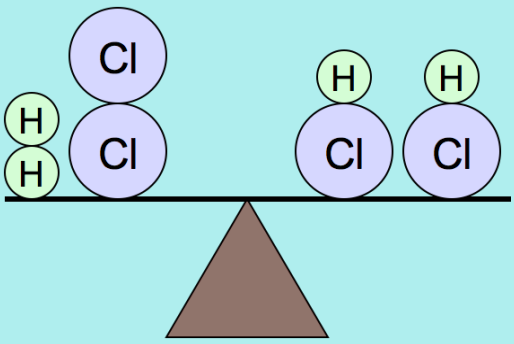
1. I can state and explain how the 1st law of thermodynamics relates to reactions.
2. I can write, identify and understand all the parts of a chemical reaction.
3. I can identify the type of reaction (SR, DR, Combustion, Decomposition, Composition).
4. I can predict products and balance single replacement reactions.
5. I can use an activity series to determine if a single replacement reaction will take place.
6. I can predict products and balance double replacement reactions.
7. I can determine products of a double replacement reaction via solubility chart.
8. I can balance all types of chemical reactions.

Unbalanced and Balanced Equations



$H_2 + Cl_2 \rightarrow HCl$

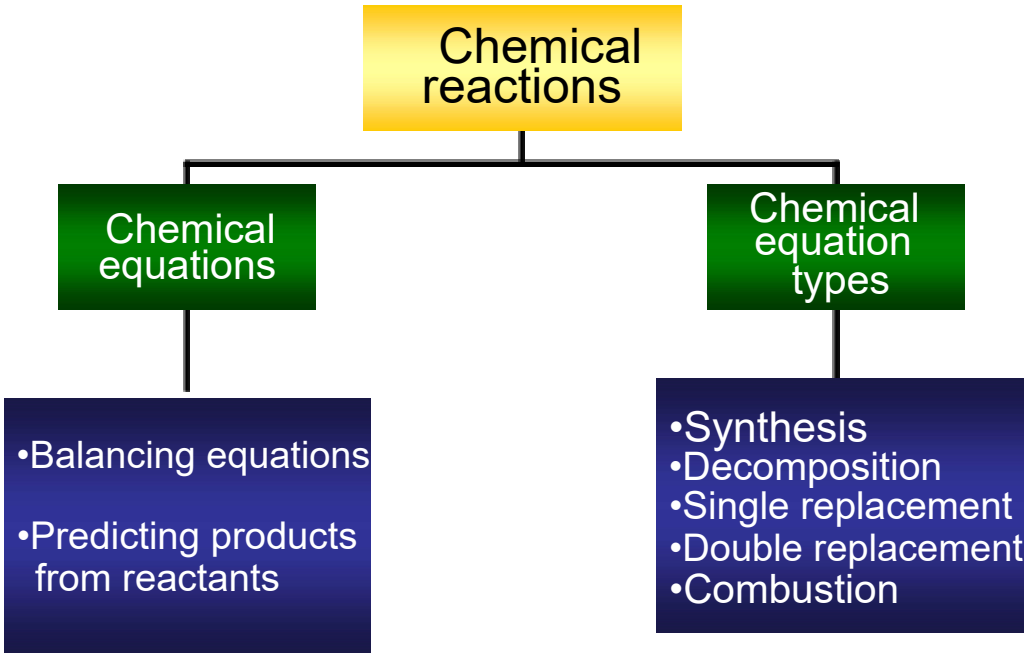
(unbalanced)



$H_2 + Cl_2 \rightarrow 2\,HCl$

(balanced)

Organize Your Thoughts



Packard, Jacobs, Marshall, Chemistry Pearson AGS Globe, page 175

Characteristics of Chemical Equations

1. The equation must represent known facts.

2. The equation must contain the correct formulas for the reactants and products.

3. The 1st Law of Thermodynamics must be satisfied. (Balanced Equations)

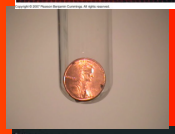
(Law of Conservation of Mass)

1. The equation must represent known fact (must really happen)

Signs of a Chemical Reaction

Four Indicators:

1. Change in energy
2. Production of a gas
3. Formation of a precipitate (solid)
4. Color change

The equation must contain the correct formulas for reactants and products

Parts of the Equations

Reactants –the substances that exist **before** a chemical change (or reaction) takes place.

Products –the substances that exist **after** a chemical change (or reaction) takes place.

REACTANTS ⟶ **PRODUCTS**

(reactants react) ("end-product")

Chemical Equations
depict the kind of **reactants** and **products**
and their relative amounts in a reaction

example: $4\ Al(s) + 3\ O_2\ (g) \longrightarrow 2\ Al_2O_3\ (s)$

reactants **product**

The equation must contain the correct formulas for reactants and products

Physical states of compounds

(s) or ↓ : solid or precipitate

(l) : liquid

(g) or ↑ : gas

(aq) : aqueous or ions in solution

Stoichiometric coefficients:

-The large numbers in the front of the molecules or atoms.

-Are used to balance the equation.

Consider the following equation.

Underline the reactants, circle the products and put a box around the coefficients.

Put an "s" under each subscript.

$$4\,Al(s) + 3\,O_2(g) \longrightarrow 2\,Al_2O_3(s)$$

The equation must contain the correct formulas for reactants and products

Representing Chemical Equations: Formula and Word Equations:

FORMULA EQUATIONS represent the reactant and products of a chemical reaction by their symbols or formulas

example:

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

The equation must contain the correct formulas for reactants and products

WORD EQUATIONS represent the reactant and products of a chemical reaction by their names

Write the word equation for the reaction of methane gas with oxygen gas to form carbon dioxide and water.

Example:

methane + oxygen ⟶ carbon dioxide + water

Reactant **Product**

$$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(g)$$

The Law of Conservation of Mass must be satisfied.

Lavoisier, 1788

Law of Conservation of Matter

MATTER IS NEVER CREATED OR DESTROYED

An equation must be balanced

An equation must have the same number of atoms of the same kind on each side of the equation

How do you balance an equation?

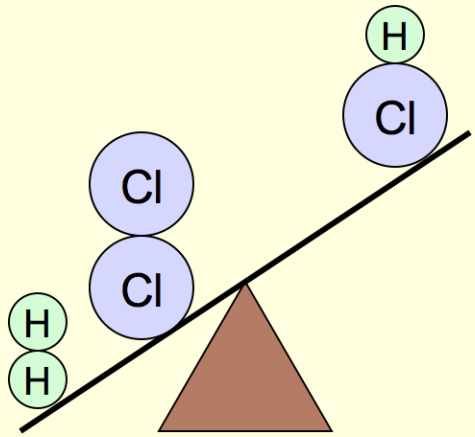
stoichiometric

Balance by adding coefficients in front of formulas.

Do not add or change subscripts in the formulas!

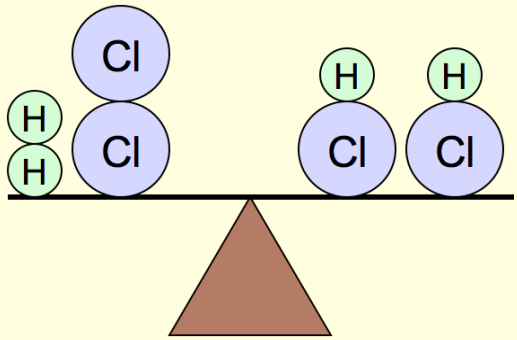
The Law of Conservation of Mass must be satisfied.

Unbalanced and Balanced Equations



$H_2 + Cl_2 \rightarrow HCl$

(unbalanced)



$H_2 + Cl_2 \rightarrow 2\,HCl$

(balanced)

	reactants	products
H	2	1
Cl	2	1

	reactants	products
H	2	2
Cl	2	2

Common mistakes: Are these balanced? Are these OK?

$NO(g) + O_2(g) \rightarrow NO_2(g)$ No-- (more oxygen on right)

$NO(g) + O(g) \rightarrow NO_2(g)$ No-- Oxygen is diatomic, use O_2

$NO(g) + \frac{1}{2} O_2(g) \rightarrow NO_2(g)$ No-- all coefficients must be whole numbers

$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$ YES

TIPS: Change coefficients only, not the subscripts or balanced formulas
Balance different types of atoms one at a time (inventory)

1. ___Na + ___H_2O → ___NaOH + ___H_2

___Na___
___H ____
___O ____

2. ___Na + ___$NaNO_3$ → ___Na_2O + ___N_2

___Na___
___N ____
___O ____

TIP: Balance polyatomic ions that appear on both side of the equation as single units

3. ___K_3PO_4 + ___$Pb(NO_3)_2$ → ___$Pb_{3(}PO_4)_2$ + ___ KNO_3

___K ____
___PO_4___
___Pb ___
___NO_3___

TIP: If an element appears in its pure form, leave it until last to balance (often H and O are last to balance)

TIP: order to balance combustion: C,H, then O

___C_3H_8 + _____ O_2 → _____CO_2 + _____H_20

Check your work—make sure that the same number of each type of atom are on each side of the equation

practice:

$(NH_4)_3PO_4$

N=
H=
P=
O=

$2(NH_4)_3PO_4$

N=
H=
P=
O=

$5(NH_4)_3PO_4$

N=
H=
P=
O=