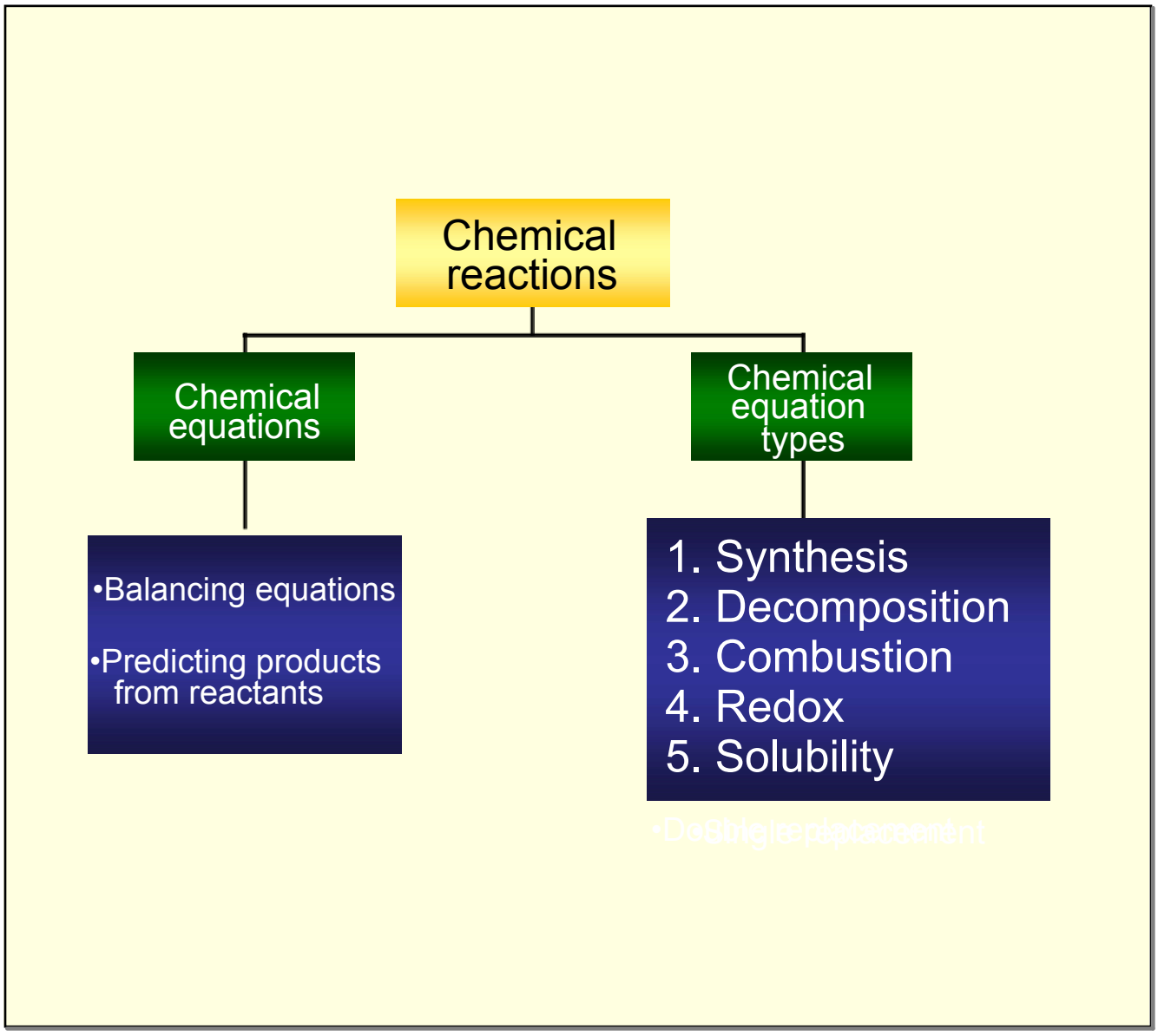
Chemical Reactions

Objectives:

(4-1) How do I model a chemical reaction with a using formulas?

(#4-1) Students can represent/identify chemicals
in terms of reactants and products in a chemical equation format.

(4-1b) Students can represent/identify a
[combination(synthesis)/Decomposition] reactions in terms of a chemical equation.


Chemical reactions
Chemical equations
Chemical equation types
•Balancing equations
•Predicting products from reactants
1. Synthesis
2. Decomposition
3. Combustion
4. Redox
5. Solubility

Characteristics of Chemical Equations

1. Represents known facts.

   4 indicators of chemical rxn:

2. Contains the correct formulas for reactants and products.

3. Satisfies **Law of Conservation of Mass.**

Matter cannot be created nor destroyed

↓

Equations must be balanced.

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 of a word equation:

methane + oxygen ⟶ carbon dioxide + water

Reactant **Product**

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

Example of a formula equation:

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

From word problem to balanced equation:

1. Write word equation.
2. Write each individual symbol or formula correctly according to rules (diatomics, ionic rules, covalent rules)
3. Balance equation with coeffients.

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Write the word equation, formula equation, and balance.

1. When isopropanol (C_3H_8O) burns in oxygen, carbon dioxide, water, and heat are produced.

isopropanol + oxygen → carbon dioxide and water

$C_3H_8O + O_2 \rightarrow CO_2 + H_2O$

(now balance it)

2. When fluorine gas is put into contact with sodium metal at high temperatures, sodium fluoride powder is created in an exothermic reaction.

fluorine + sodium → sodium fluoride

$F_2 + Na \rightarrow NaF$

(now balance it)

Balancing Equations: Change coeffecients, not subscripts.

Tips:

1. Check for diatomic molecules (H_2, O_2, Br_2, F_2, I_2, N_2, Cl_2)
   If these elements appear by themselves in an equation, they must be written with the subscript 2.
2. Balance Metals, then nonmetals,
3. Balance polyatomic ions that appear on both side of the equation as <u>single units</u>
4. Balance O and H last. Any element in pure form should be balanced last.
5. Recount all atoms (Recheck your work)
6. If every coefficient will reduce, rewrite in the simplest whole-number ratio.

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

Physical states of compounds:
symbols in equations - include whenever possible

(s) or ↓: solid or precipitate

(l) : liquid

(g) or ↑ : gas

(aq) : aqueous or ions in solution -- dissolved

Common mistakes:

Are these balanced? Are these OK?

$NO(g) + O_2(g) \rightarrow NO_2(g)$ — No-- not balanced (need 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

$4NO(g) + 2O_2(g) \rightarrow 4NO_2(g)$ — No-- all coefficients must be simplified

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

Predicting Products and balancing

- Combustion
- Decomposition
- Synthesis (Combination or Composition)

Combustion Rxns

(review)

Reactant include:

fuel and oxygen

end products are always

CO_2 and H_2O

C_3H_8 + ____ →

C_4H_9OH + ____ →

Decomposition

decompose: to break apart

AB ---> A + B

only one reactant

examples:

H_2O --> H_2 + O_2

$CaCO_3$ --> $CaO + CO_2$

HgO --> _____ + _____

Write the word and formula equation for the following:

Magnesium chloride breaks down into elemental form.

potassium chloride → potassium + chloride

2 KCl → **2** K + Cl_2

Synthesis (Combination or Composition)

synthesis: to make new

A + B ---> AB

only one product

examples:

Mg + O_2 --> MgO

Na_2O + CO_2 --> Na_2CO_3

K + Cl_2 ---> _____

Write the word and formula equation for the following:

Hydrogen and oxygen react to form water.

hydrogen + oxygen → water

2H_2 + O_2 → **2**H_2O

Review Indicate the type of reaction.

Predict the products (balanced formulas).

Balance the equation.

type

_____1. ___Cu +___O → _____

_____2. ___C_3H_6+___O → _____

_____3. ___MgO → _____

_____4. ___Al + ___Br → _____

_____5. ___NaCl → _____

_____6. ___$C_6H_{12}O_6$ + ___O → _____

7. Write the symbols for the elements that exist as diatomics in their elemental state.

8. Potassium metal and chlorine gas combine to form potassium chloride. Write the balanced equation to show this. What type of reaction is this?