




Chemical Reactions and Stoichiometry

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Topics covered

- Molecular weight and Molar Mass
 - Representation of Compounds
 - Types of Chemical Reactions
 - Net ionic Equations
 - Balancing Equations
 - Applications of Stoichiometry
 - Limiting Reactants
- 




Compounds

- **Compound** – pure substance that is composed of two or more elements in a fixed proportion
 - All elements, except some of the noble gases, can react with other elements to form compound
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Molecular weight and Molar mass

- A **molecule** is a combination of two or more atoms held together by covalent bonds.
 - The **molecular weight** is simply the sum of the weights of the atoms that make up the molecule
 - **MOLAR MASS = MOLECULAR WEIGHT**
 - $\text{Number of moles} = \text{weight of sample (g)} / \text{molar mass (g/mol)}$
- 



Representation of compounds

- **Law of Constant Composition** – any sample of a given compound will contain the same elements in the identical mass ratio
- **Empirical formula** gives the simplest whole number ratio of the elements in the compound.
- The **molecular formula** gives the exact number of atoms of each element in a molecule of the compound

Percent composition

- It is the weight percent of the element in a specific compound.

$$\% \text{ composition} = \frac{\text{mass of X in formula}}{\text{formula weight of compound}} \times 100\%$$



Types of chemical reactions

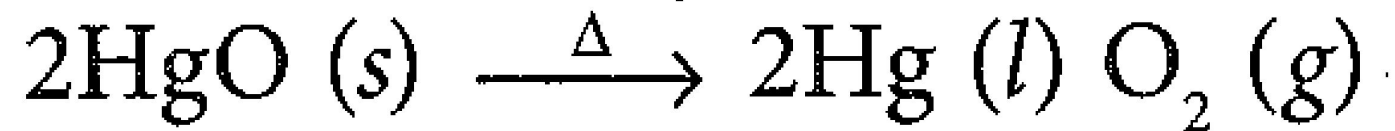
- 1. **Synthesis Reactions**
- Two or more reactants form one product



Types of chemical reactions

□ 2. Decomposition Reactions

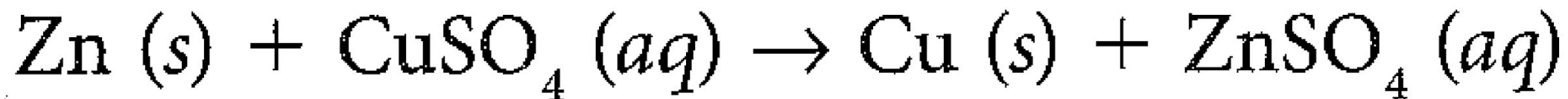
- One in which a compound breaks down into two or more substances, usually as a result of heating



Types of chemical reactions

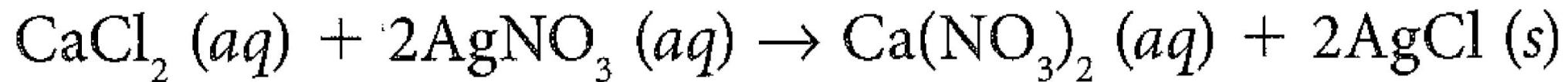
□ 3. Single Displacement Reactions

- An atom of one compound is replaced by an atom of another element



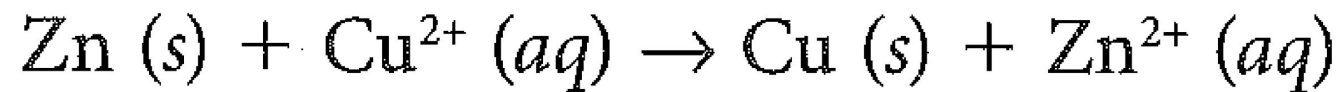
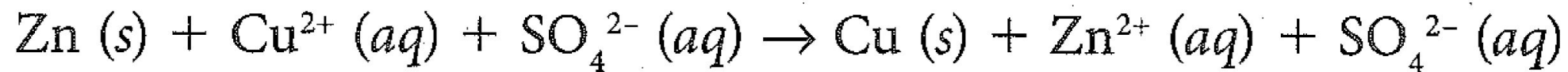
Types of Chemical Reactions

- 4. Double Displacement Reactions
- Elements from two different compounds displace each other to form two new compounds



Net Ionic Equations

- Because reactions such as displacements often involve ions in a solution, they can be written in **ionic form**
- Very important to demonstrate the actual reaction occurring





Balancing Equations

- From the **law of conservation of mass**, the mass of the reactants in a reaction must be **equal** to the mass of the products
- **Stoichiometry** is essentially the study of how the quantities of reactants and products are related in a chemical reaction.

Examples of balancing



$$\text{Fe} = 4$$

$$\text{O} = 6$$

$$\text{C} = 3$$

$$\text{Fe} = 4$$

$$\text{O} = 6$$

$$\text{C} = 3$$

Balance the following equation.



$$\text{C} = 1$$

$$\text{H} = 4$$

$$\text{Cl} = 28$$

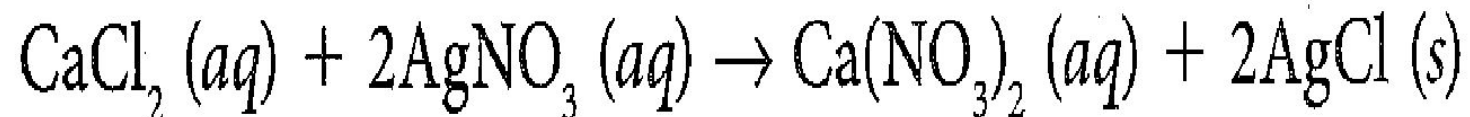
$$\text{C} = 1$$

$$\text{H} = 4$$

$$\text{Cl} = 8$$


Applications of stoichiometry

Example: How many grams of calcium chloride are needed to prepare 72 g of silver chloride according to the following equation?





Limiting Reactants

- **Limiting reactant** limits the amounts of product that can be formed in the reaction
 - The reactant that remains after all of the limiting reactant is used up is called the **excess reactant**
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Yields

- **The yield of a reaction** is the amount of product predicted or obtained when the reaction is carried out.

$$\text{percent yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$



Summary

THINGS TO REMEMBER

- Molecular Weight and Molar Mass
- Law of Constant Composition
- Empirical and Molecular Formulas
- Percent Composition
- Synthesis Reactions
- Decomposition Reactions
- Single Displacement Reactions
- Double Displacement Reactions
- Net Ionic Equations
- Balancing Equations
- Applications of Stoichiometry
- Limiting Reactants
- Yields