Chapter 8 Reactions in Aqueous Solutions

8.1 Understanding Reactions in Aqueous Solutions

Key Terms

precipitation
precipitate
precipitation reaction
strong electrolyte
soluble solid
molecular equation
complete ionic equation
spectator ions
net ionic equation
insoluble solid (slightly soluble solid)

Summary

Reactants have several basic tendencies, or ways of behaving, when they are brought into contact with one another: the tendency to form a solid, to form water, to transfer electrons, or to form a gas. Chemists consider these tendencies as driving forces for chemical reactions because two or more chemical compounds are likely to react with one another if any of these results can occur. Knowing these driving forces can help chemists make predictions about whether a reaction will take place between chemicals and what products may form.

Solids can form in chemical reactions in a process called *precipitation.* The solid that forms is called a *precipitate,* and the reaction is called a *precipitation reaction.* Understanding the general rules on how substances dissolve in water helps chemists predict whether and what type of solid might form when two solutions are mixed.

Three types of equations are used to describe chemical reactions in solution: a *molecular equation,* a *complete ionic equation,* and a *net ionic equation.*

Equations for Reactions in Aqueous Solution		
Molecular Equation	Complete Ionic Equation	Net Ionic Equation
Shows complete formulas for all reactants and products	Shows all reactants and products that are strong electrolytes as ions	Includes only those parts of the solution that undergo a chemical change
$NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$	$Na^+(aq) + Cl^-(aq) + Ag^+(aq) + NO_3^-(aq) \rightarrow AgCl(s) + Na^+(aq) + NO_3^-(aq)$	$Cl^-(aq) + Ag^+(aq) \rightarrow AgCl(s)$

8.2 Other Reactions in Aqueous Solutions

Key Terms

acid
strong acid
base
strong base
salt
oxidation–reduction reaction

Summary

A *strong acid* is a compound in which almost every molecule dissociates (separates) to produce an H^+ ion and an anion when it dissolves in water. A *strong base* is a compound that dissolves in water to produce OH^- (hydroxide) ions and cations. When a strong acid and a strong base react, the H^+ ions from the *acid* combine with the OH^- ions from the *base* to produce water. The other ions react to produce an ionic compound called a *salt.* The reaction of H^+ and OH^- is often called an acid–base reaction.

Reactions of metals with nonmetals, called *oxidation–reduction reactions,* involve a transfer of electrons. In this type of reaction, an ionic compound is formed. The ions are formed when the metal transfers one or more electrons to the nonmetal. As a result, the metal atom becomes a cation, and the nonmetal atom becomes an anion. Two nonmetals also can undergo an oxidation–reduction reaction. When two nonmetals react, the compound formed is not ionic.

8.3 Classifying Reactions

Key Terms

double-displacement reaction	acid–base reaction	single-replacement reaction
combustion reactions	decomposition reaction	synthesis (combination) reaction

Summary

In one type of chemical reaction, the atoms of an element replace the atoms of another element that is part of a compound. This type of reaction is called a *single-replacement reaction* because only one type of anion is exchanged. A single-replacement reaction can be expressed this way: $A + BC \rightarrow B + AC$. In another type of reaction, a precipitation reaction, compounds exchange their anions to form two new compounds. For this reason, a precipitation reaction is also called a *double-displacement reaction.* Such a reaction can be represented this way: $AB + CD \rightarrow AD + CB$.

Oxidation–reduction reactions that involve oxygen and produce heat and flame are called *combustion reactions.* When a compound is formed from simpler materials, such as elements, the reaction is called a *synthesis reaction,* or a *combination reaction.* The opposite also can occur. A reaction can break a compound down into the elements that make it up. This type of reaction is called a *decomposition reaction.*

Additional Active Reading Questions

1. Name four driving forces for chemical reactions.
2. What is the product of a precipitation reaction?
3. How do a complete ionic equation and a net ionic equation differ?
4. Which two types of ions are involved in an acid–base reaction?
5. When are ions formed in an oxidation–reduction reaction?
6. What type of reaction can be represented $A + BC \rightarrow B + AC$? $AB + CD \rightarrow AD + CB$?
7. What is a synthesis reaction?