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Chapter 6 Chemical Bonds

Summary

6.1 Ionic Bonding

When the highest occupied energy level of an atom is filled with electrons, the atom is stable and not likely to react.

- The chemical properties of an element depend on the number of valence electrons.
- An **electron dot diagram** is a model of an atom in which each dot represents a valence electron.

Some elements achieve stable electron configurations through the transfer of electrons between atoms.

- When an atom gains or loses an electron, the number of protons is no longer equal to the number of electrons. The atom is not neutral.
- An atom that has a net positive or negative electric charge is called an **ion.**
- An ion with a negative charge is an **anion.**
- An ion with a positive charge is a **cation.**
- A **chemical bond** is the force that holds atoms or ions together as a unit.
- An **ionic bond** is the force that holds cations and anions together.
- The amount of energy used to remove an electron is called ionization energy. The lower the ionization energy, the easier it is to remove an electron from an atom.
- A **chemical formula** is a notation that shows what elements a compound contains and the ratio of the atoms of ions of these elements in the compound.

The properties of an ionic compound can be explained by the strong attractions among ions within a crystal lattice.

- Solids whose particles are arranged in a lattice structure are called **crystals.**
- The shape of an ionic crystal depends on the arrangement of ions in its rigid framework, or lattice. Crystals are classified into groups based on their shape.

6.2 Covalent Bonding

The attractions between the shared electrons and the protons in each nucleus hold the atoms together in a covalent bond.

- A **covalent bond** is a chemical bond in which two atoms share a pair of valence electrons.
- When two atoms share one pair of electrons, the bond is called a single bond. When two atoms share two pairs of electrons, the bond is called a double bond.
- A **molecule** is a neutral group of atoms that are joined together by one or more covalent bonds.

When atoms form a polar covalent bond, the atom with the greater attraction for electrons has a partial negative charge. The other atom has a partial positive charge.

- A covalent bond in which electrons are not shared equally is called a **polar covalent bond.**
- One atom in a polar covalent bond has a greater attraction for electrons than the other atom. The atom with greater attraction has a partial negative charge. The other atom has a partial positive charge.

The type of atoms in a molecule and its shape are factors that determine whether a molecule is polar or nonpolar.

Attractions between polar molecules are stronger than attractions between nonpolar molecules.

6.3 Naming Compounds and Writing Formulas

The name of an ionic compound must distinguish the compound from other ionic compounds containing the same elements. The formula of an ionic compound describes the ratio of the ions in the compound.

- A compound made from only two elements is a binary compound.
- The name of a binary compound is the name of the cation followed by the name of the anion. Salt is a binary compound made of sodium and chlorine. Its name is sodium chloride.
- The name of the cation is simply the name of the metal. The name of the anion uses part of the name of the nonmetal with the suffix *-ide.*
- A covalently bonded group of atoms that has a positive or negative charge and acts as a unit is a **polyatomic ion.**
- If you know the name of an ionic compound, you can write its formula. Write the symbol of the cation first, and follow that with the symbol of the anion. Use subscripts to show the ratio of the ions in the compound.

The name and formula of a molecular compound describe the type and number of atoms in a molecule of the compound.

- The general rule in naming molecular compounds is that the most metallic element appears first. The name of the second element is changed to end in the suffix *-ide,* as in carbon dioxide. The prefix *di-* shows that there are two carbon atoms in the molecule.
- When writing molecular formulas, write the symbols for the elements in the order the elements appear in the name.
- The prefixes in the compound name indicate the number of atoms of each element in the molecule. The prefixes appear as subscripts in the formula.

6.4 The Structure of Metals

- In a metal, valence electrons are free to move among the atoms. The metal atoms act as though they are cations surrounded by a pool of shared electrons.

The cations in a metal form a lattice that is held in place by strong metallic bonds between the cations and the surrounding valence electrons.

- A **metallic bond** is the attraction between a metal cation and shared electrons that surround it.
- The more valence electrons an atom can contribute to the shared pool of electrons, the stronger the metallic bonds will be.

The mobility of electrons within a metal lattice explains some of the properties of metals.

Scientists can design alloys with specific properties by varying the types and amounts of elements in an alloy.

- An **alloy** is a mixture of two or more elements, at least one of which is a metal. Alloys have the same kinds of properties as metals.
- Bronze was an early alloy made of copper and tin. It is harder and stronger than each element alone.
- Steel is an alloy of iron and small quantities of carbon. The carbon atoms form bonds that help make a stronger lattice than iron bonds alone.