

Section 4.1.

Atomic Theory and Bonding.

Textbook pages 168 to 183.

Before You Read.

What do you already know about Bohr diagrams?

What are atoms?

An **atom** is the smallest particle of any element that retains the properties of the element.

The particles that make up an atom are called **subatomic particles**. Atoms are composed of three subatomic particles: protons, neutrons, and electrons.

Nuclear charge is the electric charge on the nucleus. This charge is always positive, since the protons have a positive charge and the neutrons are not charged. **Atomic number** is the number of protons. The nuclear charge or atomic number is given in the top left hand corner of the element box for each element in the periodic table.

How does the periodic table provide information about elements?

In the periodic table, each element is listed according to its atomic number. Each row is called a **period**. Each column.

Next page.

is called a **group** or **family**. Metals are on the left side and in the middle of the table. Non-metals are in the upper right corner. The metalloids form a staircase toward the right side. The block of elements from groups three through twelve are the transition metals. Elements in the same chemical group or family have similar chemical properties. For example, group seventeen contains very reactive non-metals known as halogens (i.e., fluorine, chlorine, bromine, etc.) Group eighteen contains the non-reactive noble gases.

How do Bohr diagrams represent atoms?

A **Bohr diagram** shows the arrangement of subatomic particles in atoms and ions. Electrons are organized in “shells”. The first shell holds a maximum of two electrons; the second shell a maximum of eight. When this shell is filled, it is called a **stable octet**. The outermost shell containing electrons is called the **valence shell**. The electrons in this shell are called **valence electrons**. These electrons are involved in chemical bonding. When an atom forms a compound, it acquires a full valence shell of electrons and achieves a stable, low energy state. On the periodic table, elements in Group one have one electron

in their valence shell, elements in Group two have two (a **lone pair**), elements in Group three have three, and so on.

What are ionic and covalent compounds?

There are two basic types of compounds: ionic and covalent.

1. Ionic compounds. : When atoms gain or lose electrons, they become electrically charged particles called **ions**. An ionic compound contains a positive ion (usually a metal) and a negative ion (usually a non-metal). In **ionic bonding**, one or more electrons transfer from each atom of the metal.

Next page.

to each atom of the non-metal. The metal atoms lose electrons, forming **cations**. For example, aluminum forms a three positive cation as a result of losing three electrons. Some metals are **multivalent** and can form ions in several ways, depending on the chemical reaction they undergo. For example, iron is multivalent because it can lose two or three electrons to become an iron two positive or iron three positive ion. The nonmetal atoms gain electrons, forming **anions**. Chlorine gains one electron and forms a one negative anion.

The common ions are sometimes shown in the upper right hand corner of the element's box in the periodic table. For a multivalent metal, the most common charge is listed first.

2. Covalent compounds. : In **covalent bonding**, the atoms of a non-metal share electrons with other non-metal atoms. An unpaired electron from each atom will pair together, forming a **covalent bond**. These two electrons are sometimes called a **bonding pair**.

What is a Lewis diagram?

A **Lewis diagram** illustrates chemical bonding by showing only an atom's valence electrons and its chemical symbol. Lewis diagrams can be used to represent elements, ions, and compounds.

This text is copyrighted and has been developed for the educational use of students using McGraw-Hill BC Science 10.