

Name _____ Date _____ Period _____

Chapter 4 Formation of Compounds

Objectives

Distinguish between elements and compounds, describe molecular and ionic compounds and differentiate between them. Write electron dot diagrams of simple molecular compounds.

For test remember also lab: alloys and metal plating

4.1

Elements are made from one type of atoms

Compounds are made from more than one type of atoms. Compounds can be separated into simpler substances only by chemical means.

When compounds form, they have properties that differ greatly from the properties of the elements of which they are made because of differences in what happens to their atoms when they form. **Examples:** Sodium, a dangerously reactive metal, reacts with chlorine, a poisonous gas, to form the stable compound sodium chloride, table salt. Carbon, usually found as a black solid, reacts with oxygen in the air to form carbon dioxide, an unreactive gas that produces the fizz in soda pop. Hydrogen, the lightest gaseous element, reacts explosively with oxygen in the air to form water, a stable compound on which all life depends.

4.2

Noble Gases and Octet Rule

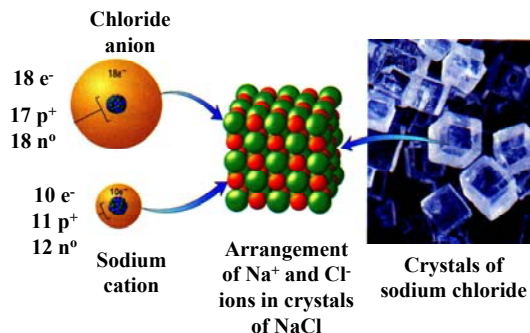
Noble Gas Elements are the only elements that exist as isolated atoms in nature (monoatomic). They are extremely unreactive (inert gases), only very few compounds are known, none in nature.

Noble gas configuration Stable electron configuration of a noble gas with eight valence electrons (He 2)

Octet Rule Atoms become stable by reacting to achieve the outer-level electron structure of a noble gas (Group 18), usually eight valence electrons (except in the first period helium with only 2 valence electrons).

Ionic Compounds

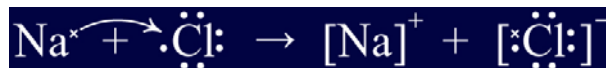
One way to achieve a stable electron structure is to transfer electrons from one atom to another, thus forming charged ions of opposite charge. The ions attract each other to form a crystal lattice. Ionic compounds are electrically neutral, because the total positive charge of the cations is equal to the total negative charge of the anions. They are usually formed from metallic with nonmetallic elements and are crystalline solids at room temperature.



Metals tend to lose electrons and form **cations** (with a positive charge)

Nonmetals tend to gain electrons and form **anions** (with a negative charge)

[anion = *A Negative ION*]

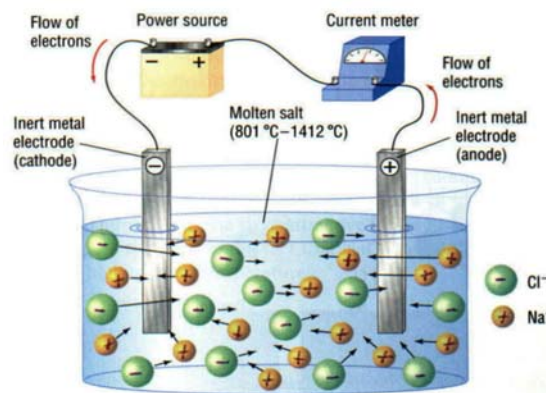


Ionic Compounds: Compounds comprised of ions, usually metal combined with nonmetal.

Ionic bond: The strong attractive force between ions of opposite charge.

Crystal (lattice): A regular, repeating arrangement of particles in three dimensions (usually throughout a solid).

Electrolytes: When melted or in aqueous solution, ionic compounds can conduct electricity because the ions can move freely when a voltage is applied.

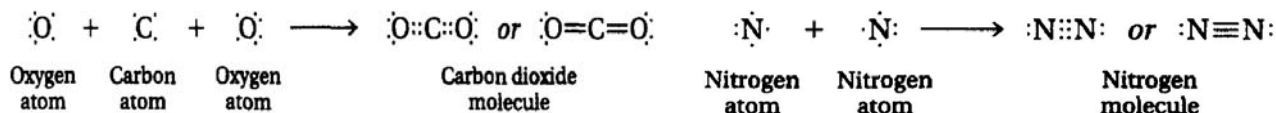
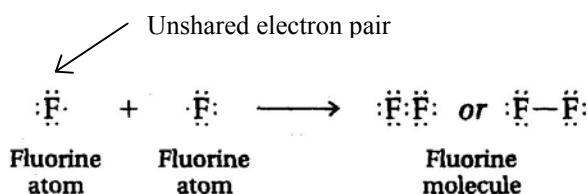
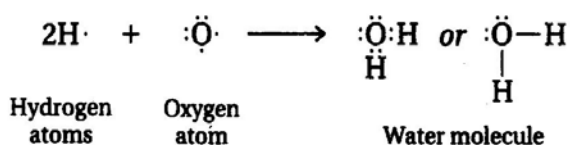


Molecular Compounds (or Covalent Compounds)

Another way that atoms can achieve stability (noble gas configuration) is by sharing electrons with other atoms to form molecules.

Nonmetal atoms form covalent bonds when they share electrons to form an octet. A shared pair of valence electrons constitutes a **single covalent bond**. Pairs of valence electrons that are not shared between atoms are called unshared, free, lone or nonbonding electron pairs.

Sometimes two or three pairs of electrons may be shared to give **double or triple covalent bonds**



A **molecular compound** is a substance that has atoms held together by covalent bonds

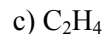
A **covalent bond** is the attraction between two atoms when they share one, two or three pairs of electrons.

A **molecule** is an uncharged group of two or more atoms held together by covalent bonds.

How to draw electron dot diagrams for molecules:

- 1) Make single bond between nonmetal atoms of groups IIIA – VIA, (Hydrogen and all halogens (VIIA) are always at end positions in a molecule),
- 2) fill “open slots” with hydrogen or halogen atoms,
- 3) make double or triple bonds from all remaining single electrons, until all atoms have their octet.

Draw the electron dot formulas for



Where in the periodic table are the metals _____, nonmetals _____

Would the following pairs of atoms combine chemically to give ionic (i) or molecular (m) compounds?

a. Na and Br

b. C and H

c. Al and O

d. Ti and O

e. N and O

Comparing Ionic and Molecular Compounds

In ionic compounds, the electrostatic forces (attractions between ions of opposite charge) are much stronger than the forces between the molecules of covalent compounds. These differences account for many of the differences in physical properties between ionic and covalent compounds.

Characteristics	Molecular Compound	Ionic Compound
From element types	All nonmetals	Metal and nonmetals
Composed of	Molecules	Ions
Formed by ___ electrons	Sharing	Gaining and losing
Type of bonds	Covalent	Ionic
Melting points usually	low	high
Physical state at room temp.	Solid, liquid or gas	Solid
Conducts electricity	Usually not (except acids)	Only when melted or dissolved in water