

Name: _____ Date: _____
Chemistry

Class Notes



Chemical Bonding

Most of the chemicals and substances around us are compounds. These compounds are formed by elements combining to form new substances. The process by which elements combine is called **chemical bonding** and how these elements bond is determined by the element's **electron configuration**, specifically the **valence electrons**.

The valence electrons will determine:

- the oxidation number (charge)
- the number of bonds formed
- electronegativity
- the shape of the molecule

Chemical Bonds

A **chemical bond** is the electrostatic attractive forces between two or more atoms strong enough to allow the atoms to act as a single unit. The attraction between these atoms is determined by the atoms' valence electrons, electronegativity and the octet rule. Therefore, it is important to understand both electron configuration and Lewis dot symbols.

There are two basic types of chemical bonds: ionic bonds and covalent bonds. **The ionic bond is created when an electron is transferred from one atom to another atom**. The atom giving up the electron becomes a cation and the atom receiving the electron becomes an anion creating an attraction (opposites attract) between the two ions. This force of attraction is an ionic bond.

The covalent bond is formed when an atom shares its electron with another atom. When an atom shares its electron with another atom this creates a partial positive charge and a partial negative charge based on each element's electronegativity. The element with the higher electronegativity gets a bigger share of the electron pair than the element with the lower electronegativity. Thus, the high electronegative element has a partial negative charge (δ^-) and the lower electronegative element has a partial positive charge (δ^+) attract each other. The covalent bond can be strong but not nearly as strong as ionic bonds.

Many nonmetallic elements not only have single covalent bonds but multiple covalent bonds as well. Multiple bonds are either double or triple bonds created by sharing more than one pair of electrons. The double is formed when two pairs of electrons are shared and the triple is formed when three pairs of electrons are shared. Since these bonds have greater electron density, the double and triple bond are also shorter and stronger.

Remember, ionic and covalent bonds represent extremes, most bonds between the atoms of different elements tend to have some character of each.

Chemical Compounds

There are two basic types of compounds: ionic compounds and covalent compounds. **Ionic compounds consist of predominately ionic bonds and covalent compounds consist mostly of covalent bonds**. However, ionic and covalent compounds have very different physical and chemical properties.

Ionic Compound Characteristics

1. Mostly solids with **HIGH** melting points
2. Many are soluble in polar solvents (water)
3. Most are insoluble in nonpolar solvents (CCl₄)
4. Molten compounds conduct electricity
5. Aqueous solutions conduct electricity
6. Usually a METAL and NONMETAL

The greater the electronegative difference between the metal and the nonmetal the more ionic the compound. Sodium chloride is much more ionic than copper (I) oxide.

The simplest form of an ionic compound is a formula unit. It is not proper to refer to ionic compounds as molecules.

Covalent Compound Characteristics

1. Gases, liquids or solids with **low** melting points
2. Many are insoluble in polar solvents (water)
3. Most are soluble in non-polar solvents (CCl₄)
4. Molten compounds do not conduct electricity
5. Aqueous solutions are poor conductors of electricity
6. Usually a NONMETAL and NONMETAL

The lower the electronegative difference between the two nonmetals the more covalent the compound. Hydrogen gas (H₂) is more covalent than water. **The simplest form of a covalent compound is a molecule** and when the term "molecular" is used it is referring to a covalent compound.

Polar Bonds

When the electron pair in a covalent bond is not shared equally it is referred to as a polar bond.

The unequal sharing is created because the element with the higher electronegativity pulls the electron pair closer to its nucleus. The lower electronegative element gets a share but not as much. So, if the element with the greater electronegativity gets a bigger share of the electron pair it has **a partial negative charge** and the other element would have **a partial positive charge**.

Metallic Bonding

Although the metallic bond is NOT a true chemical bond, it is an attraction that occurs. The metallic bonding occurs between the atoms of some metals due to the ability of outer electrons (s and d) to move away from the atom to form an electron cloud of "free electrons". This cloud then creates an attraction between the cations and the cloud. Metallic bonding accounts for the physical properties of these metals such as luster, strength, electrical and thermal conductivity, malleability and opacity.

Metallic Characteristics

1. Solids
2. HIGH electrical and thermal conductivity
3. Malleable (hammered into sheets)
4. Ductile (drawn into wires)

Two of the obvious characteristics explained by this view of metallic bonding are ductility and malleability. The sharing of the electron cloud between the metal cations prevents the metal from shattering and allows the metal be hammered or pulled into a new shape.

"Whenever you do a thing, act as if all the world were watching."

- Thomas Jefferson