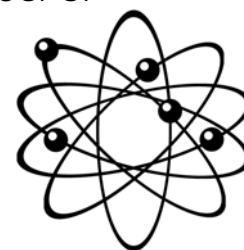


# Types of Chemical Bonds

Everything in the world is made up of atoms, which is why they are known as the “building blocks” of life. Elements are substances that each have the same number of protons in their nucleus (atomic number). Every element has a different atomic number. Chemical bonding is the process by which atoms join together.

The number of electrons each atom has is the same as its number of protons. The electrons orbit the atom's nucleus in layers (shells). Each shell only has room for so many electrons: the first shell holds two, the second holds up to eight, the third holds up to eighteen, and so on.



Most atoms do not have a full outer shell in their natural state, so when they encounter other atoms, they will give or take electrons in order to fill up their outer shell. The electrons in an atom's outer shell are referred to as valence electrons. When electrons move from one atom to another, we call that process chemical bonding.

An atom with very few electrons in its outer shell usually gives up electrons. An atom with an outer shell that is almost full will try to get enough electrons to fill its outer shell. When one element's atom gives up enough electrons for both to have a full outer shell, we call it ionic bonding. When atoms share their valence electrons so that both will have a full outer shell, we call it covalent bonding.

## Ionic Bonds

Metals form ionic bonds with non-metals: the metal always loses electrons to the non-metal atom, which always needs to gain electrons. This makes the metal atom have a positive charge (called a cation) and the non-metal have a negative charge (called an anion). They are both then ions, atoms that have a charge. Atoms become charged when the number of protons in their nucleus no longer equals their number of electrons. An example of an ionic bond between single atoms is common table salt: the metal sodium (Na) bonds with the non-metal chlorine (Cl)

to form NaCl. Complex groups of atoms can also form ionic bonds, such as the carbonate in calcium carbonate.

Ionic bonds have the following characteristics. They have high melting and boiling points. They form three-dimensional structures called an ionic lattice. They can be dissolved in water. They do not conduct electricity in a solid state, but they do when dissolved in water, when the ions are then free to move.

### Covalent Bonds

Two non-metal atoms form covalent bonds. Non-metal atoms tend to gain electrons. An example of a covalent bond is water: Hydrogen (H) and Oxygen (O) bond to become H<sub>2</sub>O. In each molecule of water, the Oxygen atom shares one electron with each Hydrogen atom and the two Hydrogen atoms also share an electron. All three atoms then have full outer shells.

There are two types of covalent bonds. Substances formed from simple covalent bonds have low melting and boiling points because there are no bonds between the molecules. A giant covalent bond is a three-dimensional structure of atoms joined by covalent bonds. Substances formed from giant covalent bonds have high melting and boiling points because the bonds between molecules are very strong. In all cases, though, covalent bonds are weaker than ionic bonds.

### Metallic Bonds

When the atoms of two metals join together, it is called a metallic bond. In a metallic bond, the atoms don't just share electrons to fill up their outer shells; the electrons are attracted to positively charged metal ions. Substances formed by metallic bonds have high melting/boiling points like ionic bonds. Metallic bonds are the reason why metals tend to be strong, malleable, ductile, and lustrous. Substances formed by metallic bonds can conduct both heat and electricity because their electrons move freely. Note that not all metals use metallic bonding; some metals form covalent bonds. Metallic bonds are the weakest of all three types of chemical bonds.

Name \_\_\_\_\_

**QUESTIONS: Types of Chemical Bonds**

1. Why are atoms known as the building blocks of life?

2. What is an element?

3. What is chemical bonding?

4. Match each type of bonding to what it means.

|                     |   |   |
|---------------------|---|---|
| _____ ionic bond    | A | When the atoms of two metals join together  |
| _____ covalent bond | B | When one element's atom gives up enough electrons for both to have a full outer shell |
| _____ metallic bond | C | When atoms share their valance electrons so that both will have a full outer shell    |

5. Put the three types of chemical bonds in order from strongest (1.) to weakest (2.).

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_