

Chapter 13 – Chemical Bonding

Section 2 Ionic Bonds

Essential Questions

- How do ionic bonds form?
- How do positive ions form?
- How do negative ions form?
- Why are ionic compounds neutral?

Definitions

- Ionic bond – bond formed when electrons are transferred from one atom to another
- Ions – charged particles formed when atoms gain or lose an electron
- Crystal lattice – the regular pattern in which a crystal is arranged

Forming Ionic Bonds

- Ionic bonds
 - a type of **chemical bond**
 - formed when **valence electrons** are **given away or accepted**

Charged Particles

- Atoms are **neutral** because the number of **protons equals** the number of **electrons**
- When **electrons are transferred**, atoms are **no longer neutral**
- The atom becomes an **ion** – a **positively or negatively charged particle**

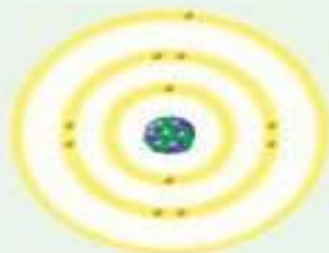
Forming Ions

- When an atom **loses** an **electron**, it becomes **positively** charged
 - It now has more protons than electrons
- When an atom **gains** an **electron**, it becomes **negatively** charged
 - It now has more electrons than protons

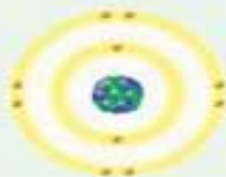
Forming Positive and Negative Ions

Forming Positive Ions

Here's How It Works: During chemical changes, a sodium atom can lose its 1 electron in the third energy level to another atom. The filled second level becomes the outermost level, so the resulting sodium ion has 8 valence electrons.

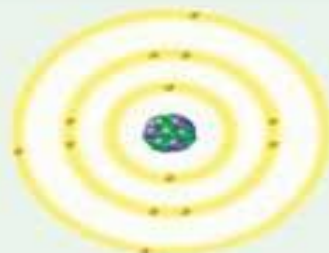


Sodium atom (Na)
11+ protons
11- electrons
0 charge



Sodium ion (Na⁺)
11+ protons
10- electrons
1+ charge

Here's How It Works: During chemical changes, an aluminum atom can lose its 3 electrons in the third energy level to another atom. The filled second level becomes the outermost level, so the resulting aluminum ion has 8 valence electrons.



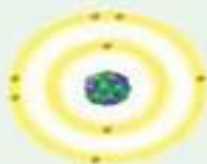
Aluminum atom (Al)
13+ protons
13- electrons
0 charge



Aluminum ion (Al³⁺)
13+ protons
10- electrons
3+ charge

Forming Negative Ions

Here's How It Works: During chemical changes, an oxygen atom gains 2 electrons in the second energy level from another atom. An oxide ion that has 8 valence electrons is formed. Thus, its outermost energy level is filled.

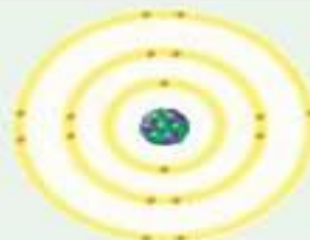


Oxygen atom (O)
8+ protons
8- electrons
0 charge

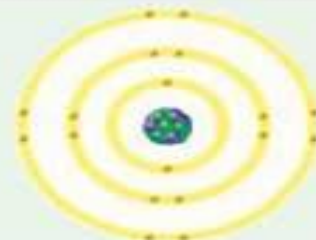


Oxide ion (O²⁻)
8+ protons
10- electrons
2- charge

Here's How It Works: During chemical changes, a chlorine atom gains 1 electron in the third energy level from another atom. A chloride ion that has 8 valence electrons is formed. Thus, its outermost energy level is filled.



Chlorine atom (Cl)
17+ protons
17- electrons
0 charge



Chloride ion (Cl⁻)
17+ protons
18- electrons
1- charge

Metal Atoms

- Most **metals** have few **valence electrons**
 - Therefore, **most metals** are **positively charged ions**
- **Energy** is needed to **pull electrons** from an atom
 - Only a small amount of energy is needed to pull electrons from metals

Nonmetal Atoms

- Atoms of **nonmetals** tend to **gain electrons**
- **Energy is released** when atoms **gain an electron**
 - The more easily an atom gains an electron, the more energy is released

Ionic Compounds

- **ionic bond** - number of **electrons lost** from a **metal equals** the number **gained** by a **nonmetal**
- **ions** are charged, but the compound is **neutral** because together, they still have all electrons

Properties of Ions

- When ions bond, they form a **3-D pattern** called a **crystal lattice**
 - **ionic compounds** are **brittle**, have **high melting points** and **high boiling points**

