

# Chemical Bonding

Chapter 7

- Chemical Bond – a link between atoms or ions resulting from the attraction of their nuclei for electrons
- force of attraction between atoms or ions

## Chemical Bonds

- Octet Rule – atoms tend to gain, lose, or share electrons in order to acquire a full set of valence electrons.

**Octet Rule**

- Ionic Bond – chemical bond resulting from the **transfer of electrons** from one bonding atom to another

Ex. NaCl

- ***Ionic*** Bonds form ***ionic*** compounds which are composed of ***ions***.

**Ionic bond**

- -high melting points (shows a strong bond)
- -brittle
- -dissolve in water
- -good conductors of electricity when in solution

**Characteristics of ionic compound**

- Example of an ionic bond:
- Consider NaCl – (table salt)
  - Na –  $1s^22s^22p^63s^1$
  - Cl –  $1s^22s^22p^63s^23p^5$
- Na loses  $1e^-$  to form an octet
  - becomes  $Na^+$  ion
  - called CATION
- Cl gains  $1e^-$  to form an octet
  - becomes  $Cl^-$  ion
  - called ANION

**What happens?**

- Empirical Formula – chemical formula which gives the simplest whole number ratio of atoms/ions of each element in a compound.
- -Cation ALWAYS written first
- -total “+” must equal total “-”
- Net charge = 0

**Formulas**

- **Monoatomic ions** – made of ONLY 1 element

Must remember the charge of these ions

- Cations:

(cats are PAWSative)

- Group 1: +1
- Group 2: +2
- Aluminum: +3
- Zinc: +2
- Silver: +1

- Anions:

(a negative ion)

- Group 15: -3
- Group 16: -2
- Group 17: -1

**Types of ions**



**Poly**atomic ions - ions which consist of **more than one** atom

- they act as a whole and carry a net charge
- Examples of Polyatomic Ions
  - Hydroxide -  $\text{OH}^-$
  - Acetate -  $\text{C}_2\text{H}_3\text{O}_2^{-1}$
  - Hypochlorite -  $\text{ClO}^{-1}$
  - Sulfate -  $\text{SO}_4^{-2}$
  - Nitrate -  $\text{NO}_3^{-1}$
  - Carbonate -  $\text{CO}_3^{-2}$
  - Bicarbonate -  $\text{HCO}_3^{-1}$
  - Phosphate -  $\text{PO}_4^{-3}$

**More ion types**

- **Binary** ~ contain ions of only 2 elements (two monoatomic ions)
- **Ternary** ~ contain ions of 3 or more elements (at least one polyatomic ion)
  - For BOTH need to know the ratio of ions in compound

## Binary and Ternary Compounds

- Write symbols of the monoatomic or polyatomic ions putting the charge above the symbol
- Put parenthesis around (polyatomic ions)
- Reduce numbers if possible and still have whole numbers
- Criss-cross the numbers (not the charges) and write them as subscripts

## Writing formulas: Criss-Cross method

- Covalent Bond – chemical bond resulting from the sharing of electrons between bonding atoms
- Ex. CO<sub>2</sub>

## Covalent Bonds

- Molecule- a group of atoms held together by covalent bonds.
- Molecular substance – a substance made up of molecules.

**Covalent Bonds (continued)**

- Molecular formula – tells you how many atoms are in a single molecule of the compound.
  - Ex.  $C_6H_{12}O_6$  glucose
- The empirical formula can be written for molecular formulas by reducing ALL subscripts.
  - Ex.  $CH_2O$  glucose

**Molecular vs. Empirical**

- Lower melting points
- Many do not dissolve in water
- Non-conductors when in solutions

## **Properties of Covalent Compounds**