How Atoms Combine

Chapter 3 Section 2

Compounds

- Composed of 2 or more atoms
- Form by chemical bonding
- Has different properties than original elements

Elements	**Compounds**
H_2	H_2O
Na	NaCl
C	CO_2
Ca	$CaCO_3$

Chemical Bonding

- Tendency is to fill valence
- Element combinations that perfectly fill valence will bond
- Once valence is full, stability is reached
- 2 types of bonding
  - Covalent bonding
  - Ionic bonding

Covalent Bonds

- Electrons are **shared** by 2 or more atoms to fill valence
- Molecule - 2 or more atoms held together by covalent bond
- Compound is neutral - # of e^- equals # of p+
- Lewis diagram - shows valence only
- Water example:
- Methane Example:

a molecular compound

Ionic Bonds

- Certain atoms tend to gain or lose electrons
- Ion - atom with a charge
- Cation - atoms with + charge
  - Has valence with fewer than 4 e-
  - Looses valence e- and takes on + charge
  - Na+, K+
  - Mg^{2+} , Ca^{2+} , Al^{3+}
  - valence is read from group on periodic table

Ionic Bonds

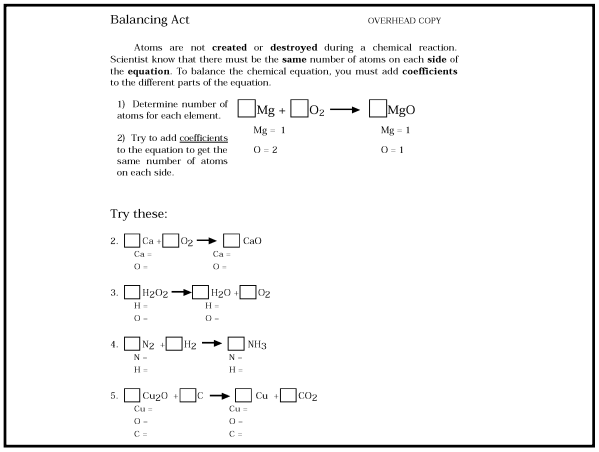
- Anion - atoms with (-) charge
  - Has valence with more than 4 e-
  - Gains valence e- and takes on (-) charge
  - Cl^-, F^-
  - O^{2-}
- Some compounds are ions
  - SiO_4^{4-} - SO_4^{2-}
  - CO_3^{2-}
- Salt Example:
- Others:

Chemical Reactions

- The change of one or more substances into new substances
- Chemical equation - written record of reactions
  - Reactant + Reactant ---------> Products
  - Zn + 2HCl ---------> $ZnCl_2 + H_2$
  - $2H_2$ + O2 ---------> $2H_2O$
  - subscript vs. coefficient
- See hydrogen video

Chemical Reactions

- **Law of conservation of matter** - matter cannot be created nor destroyed but can be transformed into other forms of matter
- **Balancing chemical equations**
  - Fe + O_2 ----------> Fe_2O_3
  - Need equal # of atoms on both sides
  - 4Fe + $3O_2$ ----------> $2Fe_2O_3$
  - Iron + Air ----------> Rust



Balancing Act OVERHEAD COPY

Atoms are not **created** or **destroyed** during a chemical reaction. Scientist know that there must be the **same** number of atoms on each **side** of the **equation**. To balance the chemical equation, you must add **coefficients** to the different parts of the equation.

1) Determine number of atoms for each element.

2) Try to add coefficients to the equation to get the same number of atoms on each side.

□Mg + □O_2 → □MgO

Mg = 1 Mg = 1

O = 2 O = 1

Try these:

2. □Ca + □O_2 → □CaO
   Ca = Ca =
   O = O =

3. □H_2O_2 → □H_2O + □O_2
   H = H =
   O = O =

4. □N_2 + □H_2 → □NH_3
   N = N =
   H = H =

5. □Cu_2O + □C → □Cu + □CO_2
   Cu = Cu =
   O = O =
   C = C =

Mixtures

- A combination of 2 or more components that retain their original properties
- Heterogeneous Mixture - components are easily recognized
  - Soil
  - Raisin bran
  - Bowl of pennies, nickles, dimes

Mixtures

- Homogeneous Mixture - components cannot be distinguished but still retain original properties
- Often called a solution
  - Salt water
  - Coffee
  - Air
  - Alloys –
  - solid solutions / colloids

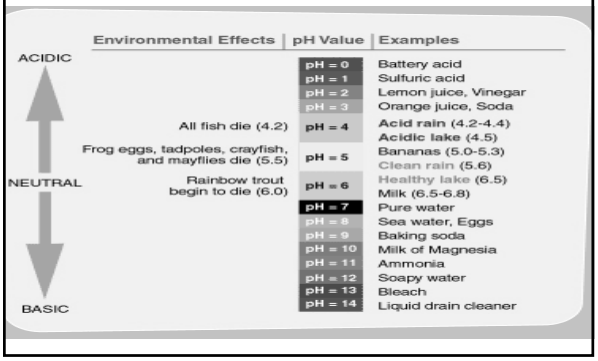
Acids & Bases

- Acid - Solution that contains hydrogen ions (H^+)
- Carbonic acid - occurs when carbon dioxide gets dissolved into water
  - $H_20 + CO_2$ --------> H_2CO_3
  - Water+Carbon dioxide=carbonic acid
  - Other acids
    - Hydrochloric
    - Sulfuric
    - Acetic

Acids and Bases

- Base - solution that contains the hydroxide ion (OH^-)
- Neutralization - a base can mix with an acid to produce water
  - $H^+ + OH^- \text{--------} > H_2O$
- PH Scale
  - 0 to 14 (zero is acidic | 14 is basic)

pH Scale



States Of Matter

- Solids -definite shape and volume
  - Crystalline solid - atoms are arranged in a definite structure
  - Amorphous solid - no structure to atom arrangement, can flow very slowly
  - Atoms are close and can vibrate in place

States of Matter

- Liquids - no definite shape, definite volume
- Molecules are close but can slide past each other
- Molecules have greater energy than solids

States of matter

- Gases - no definite shape or volume
- Molecules are spread apart and move randomly
- Molecules have higher energy than other states
- Can be compressed
- Will expand to fill container