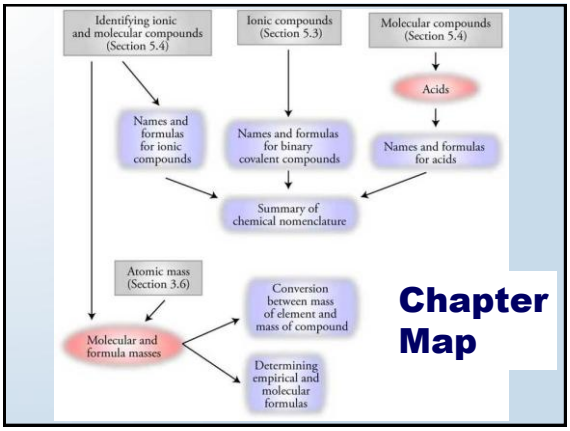
Chapter 6

More on Chemical Compounds



Chapter Map

Monatomic Ion Names

- Monatomic Cations
  - (name of metal)
    - Groups 1, 2, and 3 metals
    - Al^{3+}, Zn^{2+}, Cd^{2+}, Ag^{+}
  - (name of metal)(Roman numeral)
    - All metallic cations not mentioned above
- Monatomic Anions
  - (root of nonmetal name)ide

Roots of Nonmetals

H hydr-	F fluor-
C carb-	Cl chlor-
N nitr-	Br brom-
P phosph-	I iod-
O ox-	
S sulf-	
Se selen-	

Monatomic Anions

Hydride H^{-}	fluoride F^{-}
Nitride N^{3-}	chloride Cl^{-}
Phosphide P^{3-}	bromide Br^{-}
Oxide O^{2-}	iodide I^{-}
Sulfide S^{2-}	
selenide Se^{2-}	

Polyatomic Ions

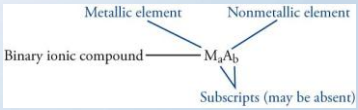
Ion	Name	Ion	Name
NH_4^+	ammonium	NO_3^-	nitrate
OH^-	hydroxide	SO_4^{2-}	sulfate
CO_3^{2-}	carbonate	$C_2H_3O_2^-$	acetate
PO_4^{3-}	phosphate		

Polyatomic Ions with Hydrogen

- HCO_3^- hydrogen carbonate
- HSO_4^- hydrogen sulfate
- HS^- hydrogen sulfide
- HPO_4^{2-} hydrogen phosphate
- $H_2PO_4^-$ dihydrogen phosphate

Recognizing Ionic Compounds

- Metal-nonmetal…binary ionic compound



- Metal-polyatomic ion
- Ammonium-nonmetal or ammonium polyatomic ion

Converting Ionic Formulas to Names

- Name
  - (name of cation) (name of anion)

Cation Names

Metals with one possible charge (Al, Zn, Cd, and Groups 1, 2, 3)	name of metal
Metals with more than one possible charge (the rest)	name(Roman numeral)
polyatomic cations (e.g. ammonium)	name of polyatomic ion

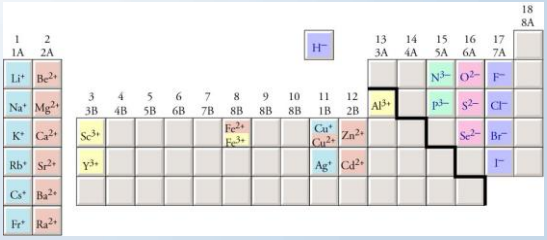
Anion Names

monatomic anion	(root of nonmetal name)ide
polyatomic anion	name of polyatomic ion

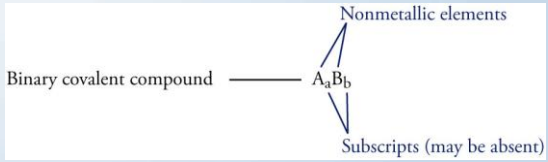
Converting Ionic Names to Formulas

- Determine the formula, including charge, for the cation and anion.
- Determine the ratio of the ions that yields zero overall charge.

Monatomic Ions



Binary Covalent



Common Names

–H_2O, water
–NH_3, ammonia
–CH_4, methane
–C_2H_6, ethane
–C_3H_8, propane

Naming Binary Covalent Compounds

- If the subscript for the first element is greater than one, indicate the subscript with a prefix.
  - We do not write mono- on the first name.
  - Leave the "a" off the end of the prefixes that end in "a" and the “o” off of mono- if they are placed in front of an element that begins with a vowel (oxygen or iodine).
- Follow the prefix with the name of the first element in the formula.

Naming Binary Covalent Compounds

- Write a prefix to indicate the subscript for the second element.
- Write the root of the name of the second symbol in the formula.
- Add -ide to the end of the name.

Prefixes

mon(o)	hex(a)
di	hept(a)
tri	oct(a)
tetr(a)	non(a)
pent(a)	dec(a)

Roots of Nonmetals

H hydr-	F fluor-
C carb-	Cl chlor-
N nitr-	Br brom-
P phosph-	I iod-
O ox-	
S sulf-	
Se selen-	

Forms of Binary Covalent Names

- prefix(name of nonmetal) prefix(root of name of nonmetal)ide
- (for example, dinitrogen pentoxide)
- or (name of nonmetal) prefix(root of name of nonmetal)ide
- (for example, carbon dioxide)
- or (name of nonmetal) (root of nonmetal)ide
- (for example, hydrogen fluoride)

Writing Binary Covalent Formulas

- Write the symbols for the elements in the order mentioned in the name.
- Write subscripts indicated by the prefixes. If the first part of the name has no prefix, assume it is mono-.

Arrhenius Acid Definition

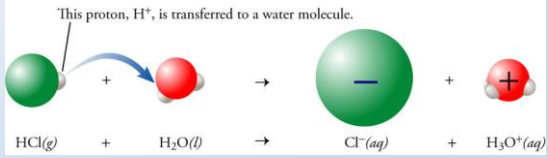
- An ***acid*** is a substance that generates hydronium ions, H_3O^+ (often described as H^+), when added to water.
- An ***acidic solution*** is a solution with a significant concentration of H_3O^+ ions.

Characteristics of Acids

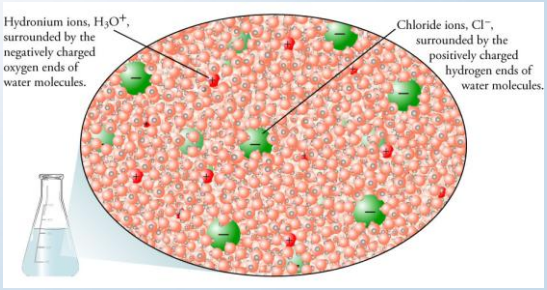
- Acids have a sour taste.
- Acids turn litmus from blue to red.
- Acids react with bases.

Strong Acid and Water

When HCl dissolves in water, hydronium ions, H_3O^+, and chloride ions, Cl^-, ions form.



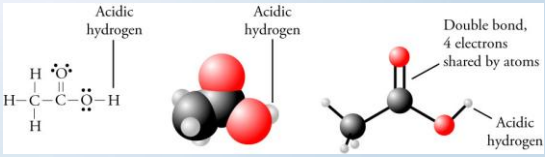
Solution of a Strong Acid



Types of Acids

- Binary acids have the general formula of HX(aq)
  - HF(*aq*), HCl(*aq*), HBr(*aq*), and HI(*aq*)
- Oxyacids have the general formula $H_aX_bO_c$.
  - HNO_3 and H_2SO_4
- Organic (carbon-based) acids
  - $HC_2H_3O_2$

Acetic Acid



Monoprotic and Polyprotic Acids

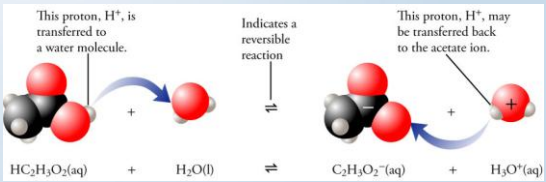
- If each molecule of an acid can donate one hydrogen ion, the acid is called a **monoprotic acid**.
- If each molecule can donate two or more hydrogen ions, the acid is a **polyprotic acid**.
- A **diprotic acid**, such as sulfuric acid, H_2SO_4, has two acidic hydrogen atoms.
- Some acids, such as phosphoric acid, H_3PO_4, are **triprotic acids**.

Strong and Weak Acids

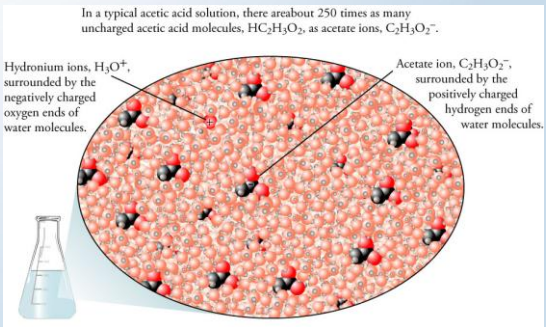
- ***Strong Acid*** = due to a completion reaction with water, generates close to one H_3O^+ for each acid molecule added to water.
- ***Weak Acid*** = due to a reversible reaction with water, generates significantly less than one H_3O^+ for each molecule of acid added to water.

Weak Acid and Water

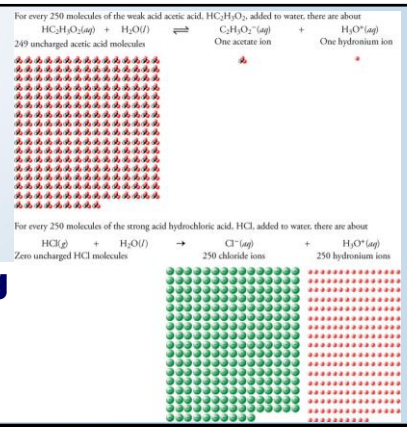
Acetic acid reacts with water in a reversible reaction, which forms hydronium and acetate ions.



Solution of Weak Acid



Strong and Weak Acids



Sulfuric Acid

$H_2SO_4(aq) + H_2O(l) \rightarrow H_3O^+(aq) + HSO_4^-(aq)$

$HSO_4^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + SO_4^{2-}(aq)$

Acid Summary

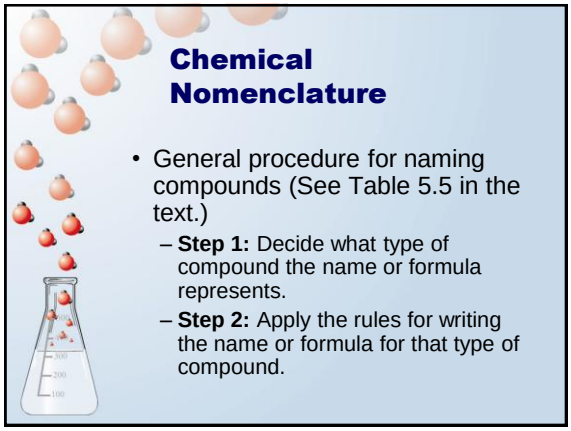
	Strong	Weak
Binary acid	hydrochloric acid, HCl(aq)	hydrofluoric acid
Oxyacid	nitric acid, HNO_3 sulfuric acid, H_2SO_4	other acids with $H_aX_bO_c$
Organic acid	none	acetic acid, $HC_2H_3O_2$

Names and Formulas of Binary Acids

- Names have the general form of *hydro(root)ic acid*, such as hydrochloric acid.
- The formulas are usually followed by (*aq*), such as HCl(*aq*).

Names and Formulas for Oxyacids

- If enough H^+ ions are added to a (root)ate polyatomic ion to completely neutralize its charge, the (root)ic acid is formed.
  - Nitrate, NO_3^-, goes to nitric acid, HNO_3.
  - Sulfate, SO_4^{2-}, goes to sulfuric acid, H_2SO_4. (Note the -ur- in the name.)
  - Phosphate, PO_4^{3-}, goes to phosphoric acid, H_3PO_4. (Note the -or- in the name.)


Chemical Nomenclature
• General procedure for naming compounds (See Table 5.5 in the text.)
– **Step 1:** Decide what type of compound the name or formula represents.
– **Step 2:** Apply the rules for writing the name or formula for that type of compound.