

Acids, Bases and Salts

Acids - produce H⁺ or H₃O⁺ in water

react with bases and some metals

sour, corrosive if strong

Bases - produce OH⁻ in water

react with acids

slippery, bitter

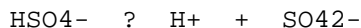
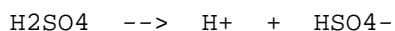
Salts - ionic compounds, electrolytes if soluble

Examples: Acids

Hydrochloric Acid	HCl
Nitric Acid	HNO ₃
Acetic Acid	CH ₃ CO ₂ H
Sulfuric Acid	H ₂ SO ₄

Notice that sulfuric acid can provide two H⁺'s - Diprotic acid,
 The other acids can provide only one H⁺ - Monoprotic acid.

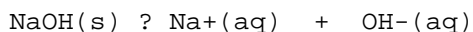
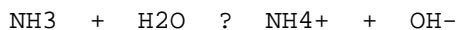
Diprotic Acid (dissociation in water)



Examples: Bases

Examples:

ammonia	NH ₃
sodium hydroxide	NaOH

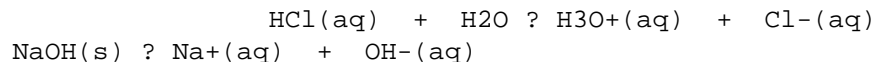
Metal hydroxides (NaOH for example) provide OH⁻ by disassociation.Bases like ammonia make OH⁻ by reacting with water (ionization)

Strong and Weak Acids and Bases

Strong acids and bases

ionize completely in water

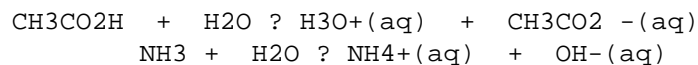
strong electrolytes.



Weak acids and bases

ionize only partially (equilibrium)

weak electrolytes.



Strong Acids

- The strength of acids and bases are concerned with the ionization (or dissociation) of the substance, not its chemical reactivity.

Example:

Hydrofluoric acid (HF) is a weak acid, but it is very chemically reactive.

- this substance can't be stored in glass bottles because it reacts with glass (silicon dioxide).

Common Strong Acids

Hydrochloric Acid	HCl
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Hydrobromic Acid		HBr
Hydroiodic acid	HI	
Nitric Acid		HNO ₃
Perchloric Acid	HClO ₄	
Chloric Acid		HClO ₃
Sulfuric Acid		H ₂ SO ₄

Common Strong Bases

Lithium Hydroxide	LiOH
Sodium Hydroxide	NaOH
Potassium Hydroxide	KOH
Rubidium Hydroxide	RbOH
Cesium Hydroxide	CsOH
Calcium Hydroxide	Ca(OH) ₂
Strontium Hydroxide	Sr(OH) ₂
Barium Hydroxide	Ba(OH) ₂

Types of Reactions

There are several classification systems.

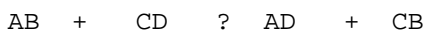
This chapter mixes some of them.

Already discussed the following:

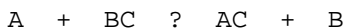
- Decomposition $A \rightarrow B + C + \text{etc.}$
- Combination $A + B \rightarrow C$
- Combustion $\text{fuel} + \text{O}_2 \rightarrow \text{products}$

This chapter adds:

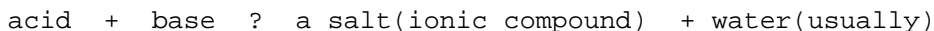
1. Metathesis (double displacement)(switch your partners)



2. Single displacement



3. Neutralization (acid-base)



4. Oxidation-Reduction - transfer of electrons
5. Precipitation Reactions - a solid is produced
6. Reactions that produce gases

Metathesis Reactions



• Three driving forces:

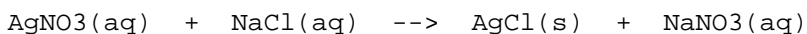
- an insoluble solid is formed (precipitate),
- weak or nonelectrolytes are formed, or
- an insoluble gas is formed.

• When two solutions are mixed and a solid is formed, the solid is called a precipitate.

See Table 4.1 for solubilities of various ionic compounds

Precipitation Reaction

- A reaction which forms a solid (precipitate)



- AgCl is classified as an insoluble substance

Solubility - amount of substance that can be dissolved in a specific amount of water (g/L or mg/L)

- for this textbook, any substance with a solubility less than 0.01mol/L is considered insoluble.

Solubility Guidelines for Ionic Compounds

1. Most nitrates (NO₃⁻) and acetates (CH₃CO₂⁻) are soluble in water.

2. All chlorides are soluble except: Hg⁺, Ag⁺, Pb²⁺, Cu⁺

3. All sulfates are soluble except: Sr²⁺, Ba²⁺, Pb²⁺

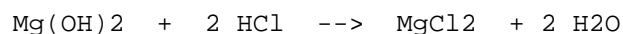
4. Carbonates (CO₃²⁻), Phosphates (PO₄³⁻), Borates (BO₃³⁻), Arsenates (AsO₄³⁻), and Arsenites (AsO₃³⁻) are insoluble.

5. Hydroxides (OH⁻) of group Ia and Ba²⁺ and Sr²⁺ are soluble.

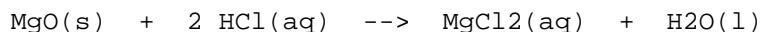
6. Most sulfides (S²⁻) are insoluble.

Reactions Which Form Weak and Non-electrolytes

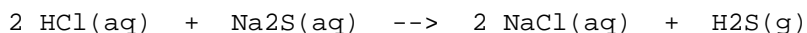
- One example of this type of reaction is a neutralization reaction.



- Insoluble metal oxide (base) and a strong acid.

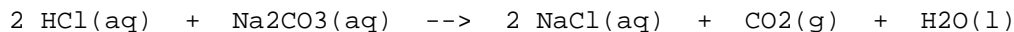


Reactions Which Form Gases

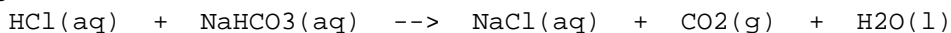


- Carbonates and Hydrogen Carbonates decompose to give CO₂

- Carbonate and Acid



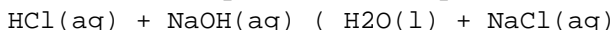
- Hydrogen Carbonate and Acid



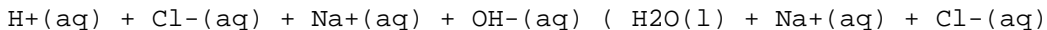
Ionic Equations

• Ionic equation: used to highlight reaction between ions.

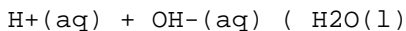
• Molecular equation: all species listed as molecules:



• Complete ionic equation: lists all ions:



• Net ionic equation: lists only unique ions(cancel repeated ones):



Oxidation-Reduction Reactions

Oxidation-Reduction Reactions