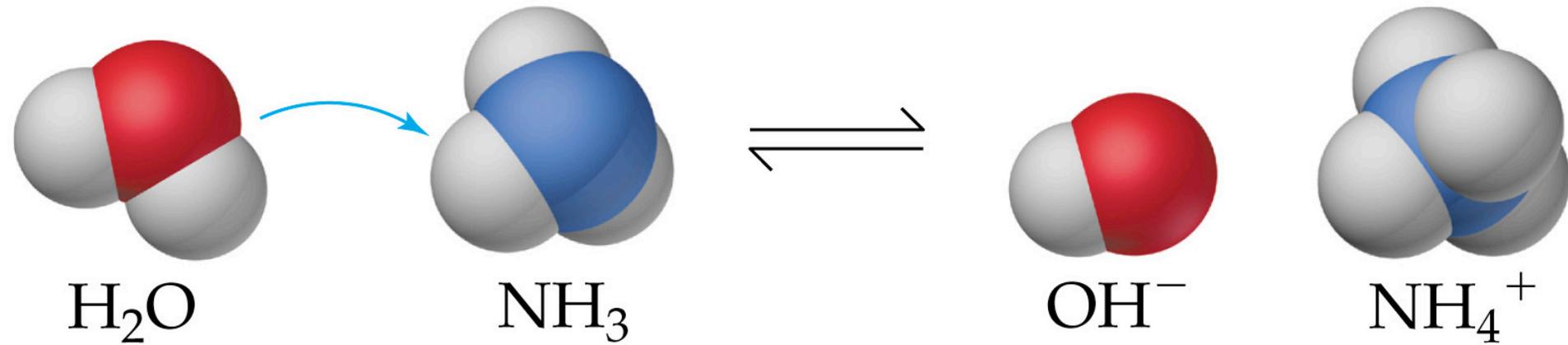


Acids

- Dissociation = pre-formed ions in solid move apart in solution.
- Ionization = neutral substance forms ions in solution.
- **Acids** = substances that ionize to form H^+ in solution (e.g. HCl , HNO_3 , $\text{CH}_3\text{CO}_2\text{H}$, lemon, lime, vitamin C). Proton donors.
- Acids with *one* acidic proton are called *monoprotic* (e.g., HCl).
- Acids with *two* acidic protons are called *diprotic* (e.g., H_2SO_4).
- Acids with *many* acidic protons are called *polyprotic*.

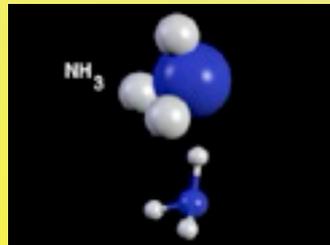
Bases

- **Bases** = substances that react with the H^+ ions formed by acids (e.g. NH_3 , Drano™, Milk of Magnesia™). Proton acceptors.



Strong and Weak Acids and Bases

- Strong acids and bases are strong electrolytes.
 - They are completely ionized in solution.
 - Strong acids are HCl, HBr, HI, HNO₃, H₂SO₄, and HClO₄.
 - Strong bases are group 1 hydroxides and soluble group 2 hydroxides.
- Weak acids and bases are weak electrolytes.
 - They are partially ionized in solution.



Identifying Strong and Weak Electrolytes

- Water soluble and ionic = strong electrolyte
- Water soluble and not ionic, but is a strong acid or base = strong electrolyte.
- Water soluble and not ionic, and is a weak acid or base = weak electrolyte.
- Otherwise, the compound is probably a nonelectrolyte.

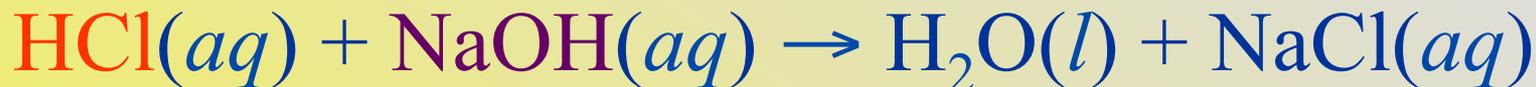
Identifying Strong and Weak Electrolytes

TABLE 4.3 Summary of the Electrolytic Behavior of Common Soluble Ionic and Molecular Compounds

	Strong Electrolyte	Weak Electrolyte	Nonelectrolyte
Ionic	All	None	None
Molecular	Strong acids (see Table 4.2)	Weak acids (H...) Weak bases (NH ₃)	All other compounds

Neutralization Reactions and Salts

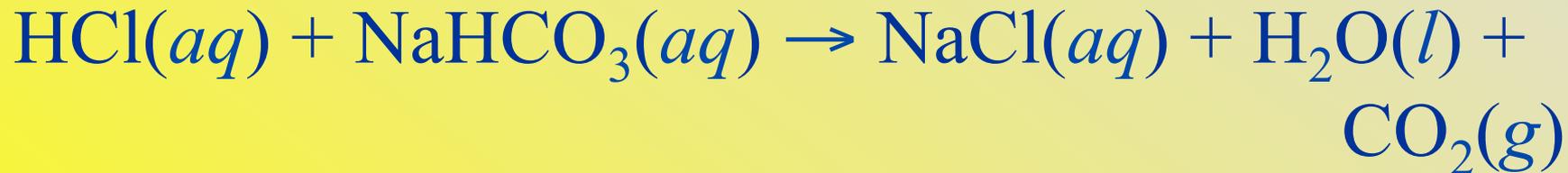
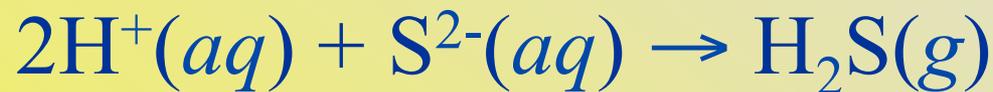
- Neutralization occurs when a solution of an **acid** and a **base** are mixed:



- Notice we form a salt (**NaCl**) and water.
- Salt = ionic compound whose cation comes from a base and anion from an acid.
- Neutralization between acid and metal hydroxide produces water and a salt.
- In net ionic equations, strong acids and bases are written dissociated, while weak acids and bases are written associated (non-dissociated)

Acid-Base Reactions with Gas Formation

- Sulfide and carbonate ions can react with H^+ in a similar way to OH^- .



Examples: Write complete ionic and net ionic equations for the following:

1. Ammonia reacts with hydrobromic acid.
2. Hydrofluoric acid reacts with sodium hydroxide.
3. Nitric acid reacts with calcium hydroxide.
4. Lithium hydroxide reacts with acetic acid.



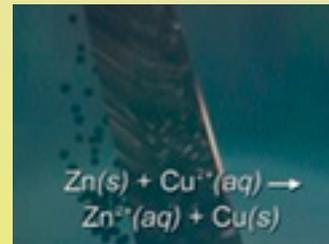
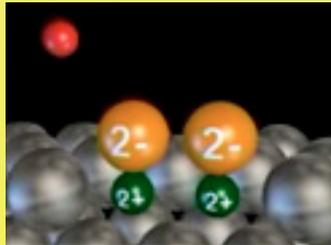
Oxidation and Reduction

- When a metal undergoes corrosion it loses electrons to form cations:

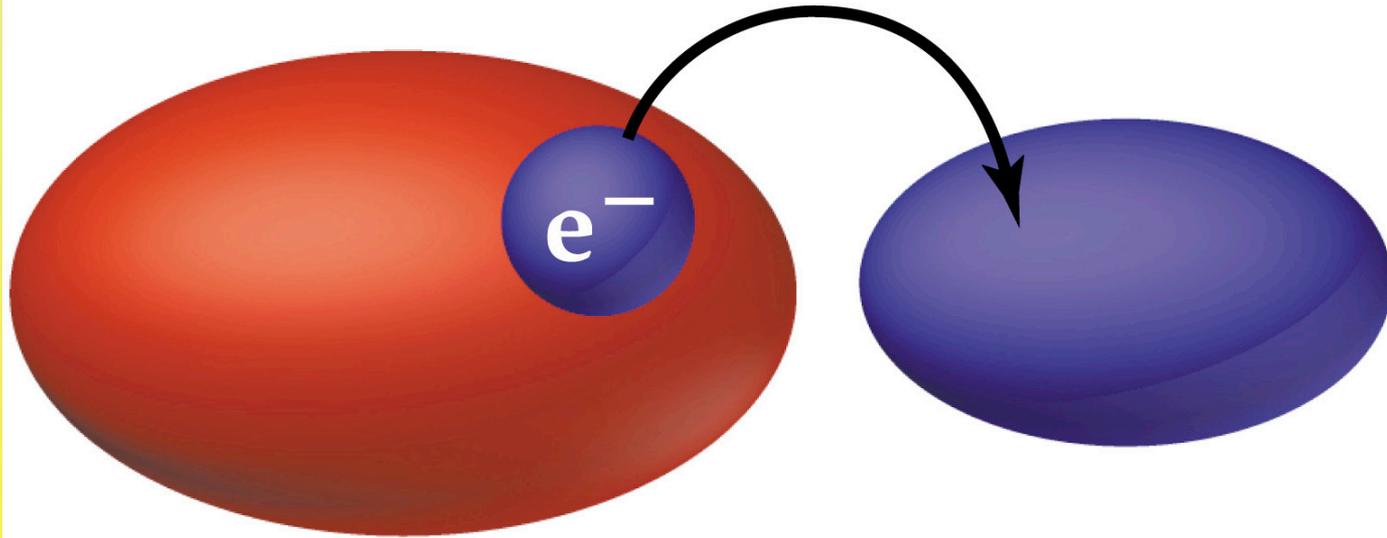


- Oxidized: atom, molecule, or ion becomes more positively charged.
 - Oxidation is the loss of electrons.
- Reduced: atom, molecule, or ion becomes less positively charged.
 - Reduction is the gain of electrons.

Oxidation and Reduction



Oxidation and Reduction



Substance
oxidized
(loses
electron)

Substance
reduced
(gains
electron)

Oxidation Numbers

- **Oxidation number for an ion:** the charge on the ion.
- **Oxidation number for an atom:** the hypothetical charge that atom would have if it was an ion.
- Oxidation numbers are assigned by a series of rules:
 1. If the atom is in its elemental form, the oxidation number is zero. e.g., Cl_2 , H_2 , P_4 .
 2. For a monoatomic ion, the charge on the ion is the oxidation state.

Oxidation Numbers

3. Nonmetals *usually* have negative oxidation numbers:
 - a) Oxidation number of O is usually -2 . The peroxide ion, O_2^{2-} , has oxygen with an oxidation number of -1 (H_2O_2 , Na_2O_2).
 - b) Oxidation number of H is $+1$ when bonded to nonmetals and -1 when bonded to metals.
 - c) The oxidation number of F is -1 .
4. Metals will have positive oxidation numbers:
 - a) Group 1 metals and Ag will be $+1$
 - b) Group 2 metals, Zn, Cd will be $+2$
 - c) Al will be $+3$

5. The sum of the oxidation numbers for the atom is the charge on the molecule (zero for a neutral molecule).

Examples: Determine the oxidation numbers of each element in each of the following:



Examples: Determine the oxidation numbers of each element in each of the following:

