Wessner Chemistry Weeks 5 and 6

April 27 Through May 8th

Due Monday May 11th

Chapter 14

Acids and Bases

Section 1

Properties of Acids and Bases

- Acid properties
- 1. aqueous solutions of acids have a sour taste – acids are corrosive and many are poisons.
- 2. acids change the color of acid-base indicators.
- 3. some acids react with active metals and release hydrogen gas.
- 4. acids react with bases to produce salts and water – the acid is "neutralized" during this reaction and the 3 properties above disappear.
- 5. acids conduct electric current – acids can form strong electrolytes.
- Acid nomenclature:
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- A binary acid – is an acid that contains only two different elements: hydrogen and one of the more electronegative elements.
- Many common inorganic acids are binary acids
- HF, HCl, HBr, HI

Naming binary acids

- 1. binary acids begin with prefix – hydro
- 2. the root name of the second element follows the prefix
- 3. name ends with suffix - ic
- HF would be hydrofluoric acid
- HI would be hydroIodic acid
- HP would be hydrophosphoric acid

Oxyacid

- An oxyacid is an acid that is a compound of hydrogen, oxygen, and a third element, usually a nonmetal.
- Nitric acid, HNO_3, is an oxyacid, it is also a tertiary acid – an acid that contains three different elements.
- Oxyacids are usually a hydrogen followed by a polyatomic anion.
- Oxyacids names follow a pattern – the name of their anion followed by acid (page 469)
- HNO_3 – hydrogen + Nitrate (ic) + acid – nitric acid
- HIO_3 – hydrogen + iodite (ic) - Iodic acid

Common industrial acids

- Sulfuric Acid
- Most commonly produce industrial acid
- Contained in automobile batteries.
- Also it's a good "dehydrator" (water removing agent)
- Can cause serious chemical burns to skin

- Nitric Acid
- Pure nitric acid is volatile and unstable, dissolving it in water increases the stablility.
- Used to make explosives
- Has a strong odor, stains skin yellow, and can cause serious chemical burns.

- Phosphoric acid
- Used in manufacturing fertilizers and animal feed.
- Important in detergent manufacture

- Hydrochloric acid
- Produced in the stomach to digest food
- Industrial cleaning agent
- Used to maintain ph in swimming pools
- Acetic acid
- Clear, colorless, strong smelling
- White vinegar contains 4-8% acetic acid
- Used in synthesizing chemicals used in the manufacture of plastics.

Bases

- Properties:
- 1. aqueous solutions of bases taste bitter
- 2. bases change the color of acid-base indicators
- 3. dilute aqueous solutions feel slippery
- 4. react with acids to produce salts and water
- 5. conduct electric current
- 6. a lot of bases contain the OH- ion

Bases

- Common strong bases:
- $Ca(OH)_2$
- $Sr(OH)_2$
- NaOH
- $Ba(OH)_2$
- KOH
-

- Ammonia NH3 (weak base)

Arrhenius Acids and bases

- Svante Arrhenius, a Swedish chemist, theorized acids and bases must produce ions in solution.
- An Arrhenius Acid – is a chemical compound that increases the concentration of hydrogen ions, H+ , in aqueous solution.
- an Arrhenius base – is a chemical compound that increases the concentration of hydroxide ions , OH- , in aqueous solution.

Aqueous solutions of acids

- Acid molecules are sufficiently polar so that one or more hydrogen ions are attracted by water molecules. Negatively charged anions are left behind. Hydrogen ion in aqueous solution are represented by H3O+
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- The ionization of HNO3, nitric acid, molecule reacts with water
- HNO3(l) + H2O (l) —≥ H3O+ (aq) + NO3-(aq)
- Acid water hydrogen ion polyatomic ion
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- HNO3(l) + H2O (l) —≥ H3O+ (aq) + NO3-(aq)
- Acid water hydrogen ion polyatomic ion
-
- Write the chemical equation for the ionization of HCl and water.
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- HCl(g) + H2O —≥ H3O+(aq) + Cl-(aq)

Strength of acids

- Strong acid – is one that ionizes completely in aqueous solution
- HI + H2O —≥ H3O+ + I –
- HClO4 + H2O —≥ H3O+ + ClO-

Notice that hydrogen and the compound bonded to it separate completely in solution.

A week acid does not:

- Weak acid – an acid that releases few hydrogen ions in aqueous solution
- H3PO4 + H2O —≥ H3O+ + H2PO4-

Aqueous solutions of bases

- Most bases are ionic compounds containing metal cations and the hydroxide anion, OH-.
- Because these bases are ionic, they dissociate when dissolved in water. When this happens completely, bases yield OH- ions, so the solution is referred to as strongly basic (strong base).

- Sodium Hydroxide NaOH dissociates/decomposes as shown below:
- NaOH(s) —≥ Na+ (aq) + OH-(aq)
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- The metals from group 1 Li, Na, K, Rb, Cs all form alkaline (basic) solutions.
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- Strong bases: Ca(OH)2, NaOH, Sr(OH)2

- Not all bases are ionic compounds. NH3, ammonia is a molecular compound. Ammonia produces hydroxide ions OH- and ammonium ions NH4+ when it reacts with water molecules
- NH3 + H2O —≥ NH4+ + OH-
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- Ammonia is a weak base, it does not completely ionize.
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- Strong bases, like potassium hydroxide completely ionizes and produces a potassium ion and a hydroxide ion
- KOH —≥ K+ + OH-

- Bronsted-Lowry bases – is a molecule or ion that is a proton acceptor.
- HCl + NH3 —≥ NH4+ + Cl-
- ammonium, NH4+, is a Bronsted-Lowry base because it is a proton acceptor, H+ , notice the positive charge

HCl + H2O —≥ H3O+ + Cl -

- HCl is a Bronsted-Lowry acid, donates it's H+ proton to water, H3O+ is a Bronsted-Lowry base, accepted the H+ proton from HCl

Monoprotic and Polyprotic acid

- **Monoprotic acid** – acids that can donate only one proton (hydrogen ion) per molecule
- HClO4, HCl, HNO3
- **Polyprotic acid** – acids that can donate more than one proton per molecule
- H2SO4, H3PO4
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- H2SO4 sulfuric acid is a **Diprotic acid** – type of polyprotic acid that donates 2 protons per molecule
- H3PO4 phosphoric acid is a **Triprotic acid** – type of polyprotic acid that donates 3 protons per molecule

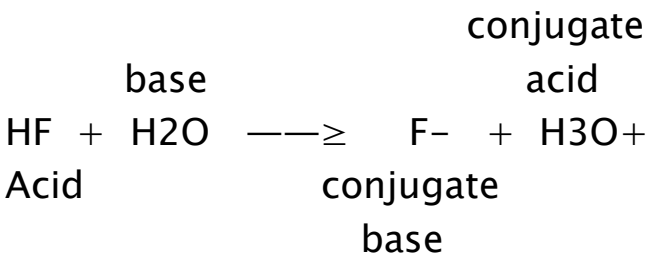
Lewis Acids and Bases

A Lewis acid – is an atom, ion, or molecule that accepts an electron pair to form a covalent bond. This acid is based on bonding and structure of substances that do not contain hydrogen, which means, Lewis acids can accept any proton, does not have to be a hydrogen ion.

Lewis base – is atom, ion, or molecule that donates an electron pair to form a covalent bond.

Conjugate Acids and Bases

the substance that remains after a Bronsted-Lowry acid has given up a proton is the conjugate base of that acid. The substance formed when a bronsted-lowry base gains a proton is the conjugate acid of that base.



- an react as either an acid or a base, is described as amphoteric.
- Water is a good example. If water reacts with a stronger acid than water, then water acts as a base;
- If water reacts with a weaker acid than water, then water acts as an acid, and the weak acid acts as the base.
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- Neutralization is the reaction of hydronium ions and hydroxide ions to form water molecules.
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- A Salt is an ionic compound composed of a cation from a base and an anion from an acid.

Acid Rain

- NO, NO2, CO2, SO2, SO3 are gases produced by many industries.
- These compounds can dissolve in atmospheric water to produce acidic solutions that fall to the ground in the form of rain or snow.
- Ex. SO2 – sulfur dioxide is converted to SO3 – sulfur trioxide, the SO3 reacts with water in the atmosphere to produce H2SO4 – sulfuric acid.
- SO3(g) + H2O(l) ——≥ H2SO4(aq)

Week 5 work Due Date one week May 4th

CHAPTER 14 REVIEW

Acids and Bases

SECTION 1

SHORT ANSWER Answer the following questions in the space provided.

1.Name the following compounds as acids:

a.H_2SO_4

b.H_2SO_3

c.H_2S

d.$HClO_4$

e.hydrogen cyanide

2.Which (if any) of the acids mentioned in item **1** are binary acids?

3.Write formulas for the following acids:

a.nitrous acid

b.hydrobromic acid

c.phosphoric acid

d.acetic acid

e.hypochlorous acid

4.Calcium selenate has the formula $CaSeO_4$.

a.What is the formula for selenic acid?

b.What is the formula for selenous acid?

5.Use an activity series to identify two metals that will not generate hydrogen gas when treated with an acid.

6.Write balanced chemical equations for the following reactions of acids and bases:

a.aluminum metal with dilute nitric acid

b.calcium hydroxide solution with acetic acid

7. Write net ionic equations that represent the following reactions:

a. the ionization of $HClO_3$ in water

b. NH_3 functioning as an Arrhenius base

8. a. Explain how strong acid solutions carry an electric current.

b. Will a strong acid or a weak acid conduct electricity better, assuming all other factors remain constant? Explain why one is a better conductor.

CHAPTER 14 REVIEW **Due Date Monday May 4th one week**

Acids and Bases

SECTION 2

SHORT ANSWER Answer the following questions in the space provided.

1.a.Define Bronsted-Lowry acid and Bronsted-Lowry base.

b.Define monoprotic and polyprotic acids.

2.a.Define diprotic and triprotic acids.

b.Define a Lewis acid and Lewis Base

3.Identify the Brønsted-Lowry acid and the Brønsted-Lowry base on the reactant side of each of the following equations for reactions that occur in aqueous solution. Explain your answers.

a. $H_2O(l) + HNO_3(aq) \rightarrow H_3O^+(aq) + NO_3^-(aq)$

b. $HF(aq) + HS^-(aq) \rightarrow H_2S(aq) + F^-(aq)$

SECTION 2 continued

4.a. Give a lewis dot structure example for a Bronsted-Lowry acid and base.

b. Briefly explain what is happening in the above two examples.

c. What is the name for a substance, such as H_2CO_3, that can donate two protons?

5.a. How many electron pairs surround an atom of boron (B, element 5) bonded in the compound BCl_3?

b. How many electron pairs surround an atom of nitrogen (N, element 7) in the compound NF_3?

c. In 5 a and b which element is donating an electron pair and which element is excepting an electron pair?

d. Assuming that the B and the N are covalently bonded to each other in the product, which of the reactants is the Lewis acid? Is this reactant also a Brønsted-Lowry acid? Explain your answers.

e.Which of the reactants is the Lewis base? Explain your answer.

More practice worksheets Due Date two weeks, Monday Apr 11th

Which of the following are acids or bases

H_2CO_3_____$Mg(OH)_2$_____

NH_3_____$H_3C_6H_5O_7$_____

$NaHCO_3$ _____HF _____

HIO_3_____$Al(OH)_3$_____

What is binary acid? Give an example

What is an oxyacid? Give an example

What is a tertiary acid? Give an example

Name the following acids:

HBr

$HClO_2$

$HClO_3$

H_3PO_4

List three properties of acids:

Write and balance the neutralization equation for the following.

$HClO_2$ + KOH

$H_2SO_4 + Ca(OH)_2$

practice worksheets continued, Due Monday Apr 11th

Define the following:

Acid

Base

Binary acid

Oxyacid

Give 3 examples of acids in industry

List the properties of bases

What is an Arrhenius acid? Give an example

What is an Arrhenius base? Give an example

What makes an acid, a strong acid? Give an example

What is a Bronsted-Lowery Acid? Give an example

What is a Bronsted-Lowery Base? Give an example

What is a Monoprotic acid? Give an example

What is a polyprotic acid? Give an example

What is a triprotic acid? Give an example

Define Lewis Acid and Lewis base, give examples of each.

Write an equation and label the equation showing a conjugate base

Write an equation and label the equation showing a conjugate acid

Write and explain a acid base neutralization equation.

Explain a possible cause for acid rain.