Acids and Bases

Properties

Good website to visit for project

- http://www.chemheritage.org/explore/explore.html
- http://www.chemheritage.org/classroom/chemach/forerunners/boyle.html

Acids and Bases

- Are very important in many aspects of daily life.
- Most manufacturing processes
- You body needs them to function properly
- Many foods contain acid
- Many cleaning products are bases
- Cooking

Acids

- taste sour
- Electrolytes (conduct electricity in solution)
- Cause indicators to change color
- React with many metals to produce Hydrogen gas ($HCl + Zn \longrightarrow ZnCl_2 + H_2$)
- React with compounds containing OH to form a salt and water $HCl + Ca(OH)_2 \longrightarrow H_2O + CaCl_2$
- An acid is a compound that produces hydrogen ions H^+ when dissolved in water
- PH < 7

- Have general formula HX

EXAMPLES:

- **HF-Hydrofluoric**
- **HBr- Hydrobromic**
- **H_2SO_4 - Sulfuric acid**
- **HNO_3- Nitric Acid**

Bases

- react with acids to form a salt and water
- Taste bitter
- Feel slippery
- Electrolytes
- Change color of indicators
- A base is a compound that produces OH^- ions (hydroxide ions) in water.
- Something basic is also called alkaline
- pH > 7

Bases

- General formula- XOH

- Examples: NaOH –Sodium Hydroxide
  $Mg(OH)_2$- Magnesium hydroxide

Strong vs. Weak

- Acids and bases are classified as strong or weak depending on the degree to which they ionize in water. (Break up into ions)

- Strong acids and bases completely ionize or break up into ions. These are strong electrolytes.

- Weak acids and bases ionize slightly or don't dissolve completely. These are weak electrolytes.

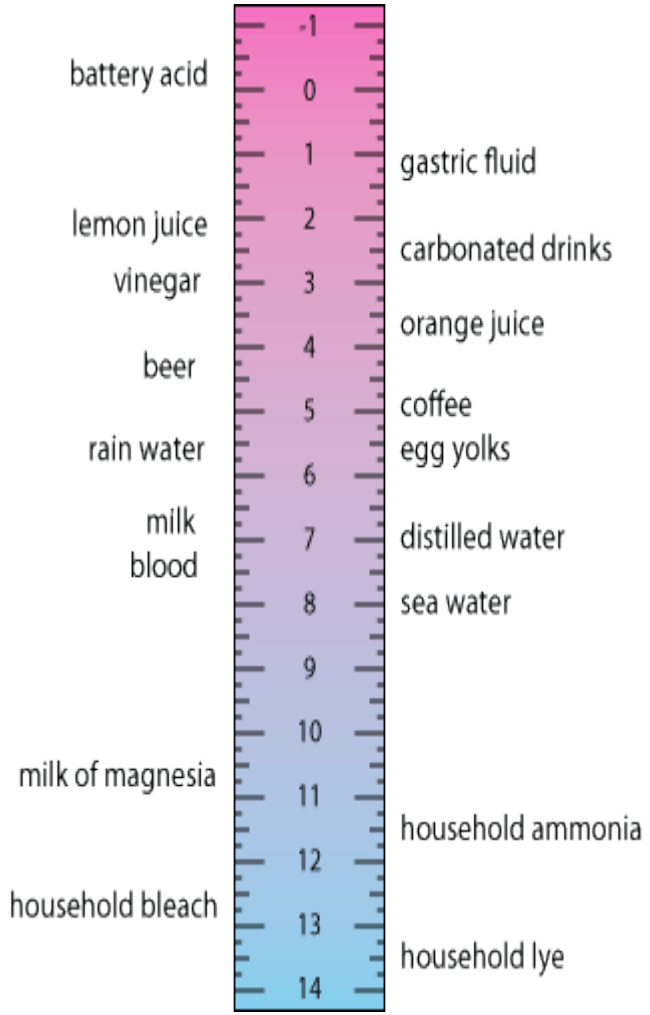
- Movie

pH

- a way to express the H^+ concentration instead of molarity
- $[H^+]$ – this says H^+ concentration
- pH scale range 0-14

- 0 7 14

Most acidic neutral most basic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battery acid
gastric fluid
lemon juice
carbonated drinks
vinegar
orange juice
beer
coffee
egg yolks
rain water
milk
blood
distilled water
sea water
milk of magnesia
household ammonia
household bleach
household lye

- Pure water is a neutral solution
- In pure water the concentration of hydrogen and hydroxide are equal so it is a neutral solution.
- Water ionizes slightly to form hydroxide ions and hydrogen ions (sometimes written as H_30^+ which is called the hydronium ion)
- $H_2O \rightarrow H^+ + OH^-$ or

  $2\ H_2O \rightarrow H_3O^+ + OH^-$

pH

- pH is the measure of the H^+ concentration or $[H^+]$
- We can also measure the pOH of OH^- concentration $[OH^-]$
- Water which is considered neutral, neither acidic or basic, has a pH of 7.
- The concentration of H^+ or H_3O+ = concentration of OH^-

  $[H^+]=[OH^-]$
- This concentration is $1.0 \times 10^{-7}M$

- When you add an acid to water the hydrogen ion concentration becomes greater than the hydroxide ion concentration so it is an acidic solution.

- When a base is added the hydroxide ion concentration is greater than the hydrogen ion concentration so the solution becomes basic or alkaline.

- http://phet.colorado.edu/simulations/sims.php?sim=pH_Scale

pH

- $pH = - \log[H^+]$
- pH < 7 acid more Hydrogen ions than hydroxide ions

  $[H^+] > [OH^-]$
- pH > 7 base more hydroxide ions than hydrogen ions

  $[H^+] < [OH^-]$
- pH= 7 is a neutral solution

  hydrogen ions = hydroxide ions

  $[H^+] = [OH^-] = 1.0 \times 10^{-7}$ M

What are the pH values for the following?

- $[H^+] = 1.0 \times 10^{-11}$ M

  $-\log[1.0 \times 10^{-11}] =$ pH 11

$[H^+] = 1.0 \times 10^{-8}$ M

$-\log[1.0 \times 10^{-8}] =$ pH 8

$[H^+] = 0.000001$ M

$-\log[0.000001] =$ pH 6

pOH

- $pOH = -\log[OH^-]$

Determine the pH or pOH

- $[H^{+}] = 1 \times 10^{-6}$ mole /L
- $[H^{+}] = 0.001$ M
- $[OH^{-}] = 1 \times 10^{-2}$ mol/L
- $[OH^{-}] = 1 \times 10^{-11}$ mol/L

Calculate the pH for the following hydrogen ion concentrations.

- $[H^+] = 5.0 \times 10^{-5}$ M

  $-\log[5.0 \times 10^{-5}] = \text{pH } 4.3$

$[H^+] = 7.3 \times 10^{-11}$ M

$-\log[7.3 \times 10^{-11}] = \text{pH } 10.1$

$[H^+] = 2.8 \times 10^{-6}$ M

$-\log[2.5 \times 10^{-11}] = \text{pH } 10$

Are the above solutions acids or bases?

Calculate the pOH

- $[OH^-] = 2.5 \times 10^{-11}$ M

$-\log[2.5 \times 10^{-11}] = pOH\ 10.6$

$[OH^-] = 6.4 \times 10^{-8}$ M

$-\log[6.4 \times 10^{-8}] = pOH\ 7.2$

$[OH^-] = 8.8 \times 10^{-5}$ M

$-\log[8.8 \times 10^{-5}] = pOH\ 4.1$

pH to pOH and pOH to pH

- $pH + pOH = 14$

What is the pH

- If pOH= 10.6

14-10.6 =3.4 is the pH

If pOH = 7.2

14-7.2 = 6.8 is the pH

If pOH = 4.1

14 – 4.1 = 9.9 is the pH

Finding concentration from pH

- $[H^+] = 10^{-pH}$

What is the [H+] concentration if pH =

pH=2.60 $[H^+]= 10^{-2.60} = .0025$ M

pH=4.5 $[H^+]= 10^{-4.5} = .000032$ M

pH=11.2 $[H^+]=10^{-11.2} = 6.3 \times 10^{-12}$ M

Finding concentration from pOH

- $[OH^-] = 10^{-OH}$
- **What is the $[OH^-]$ if, what is the $[OH^-]$**

pOH = 2.6

$[OH^-] = 10^{-2.6} = .0025$ M

pOH = 4.5

$[OH^-] = 10^{-4.5} = .00003$ M

- What is the hydrogen ion concentration for solutions with the following pH values?

- a. 4.0
- b. 11.0
- c. 8.0
- d. 3.2

- What is the hydroxide ion concentration for the above solutions.

How do we measure pH

- Acid base indicators
- pH meters

Indicators

- acid base indicator- an acid or base that undergoes dissociation in a known pH range- color changes
- a substance that changes color at certain pH.

- different indicators are used to test for pH and change color in different pH's.

- pH meters- measures electronically

Neutralization Process

- The reaction of an acid + base yields water and a salt
- Salts-compounds consisting of an anion from an acid and cation from a base

Just because you add an acid to a base does not mean the solution is neutral.

Why?

- All neutralization reactions are double replacements
- Titration-The process of adding a known amount of solution of known concentration to determine the concentration of another solution.

- How many moles of HCl are required to neutralize these bases? Assume all the bases ionize completely.
  - 0.2 mole NaOH
  - 2 mol NH_4OH
  - 0.1 mol $Ca(OH)_2$