Acids and Bases

Review: What is an acid?

Brønsted/Lowry acid: a proton donor

proton donor?...

a proton is also an H^+ ion

in water, H_2O + donated $H^+ \rightarrow H_3O^+$

- H_3O^+ = “hydronium ion”

Review: Acid Strength

- Strong acids release all of their H^+ ions
  - [strong acid] = $[H^+]$
  - Strong acids are strong electrolytes
- Weak acids hold on to most of their H^+ ions
  - [weak acid]>>>$[H^+]$
  - Weak acids are weak electrolytes
  - Weak acids reach equilibrium with "neutralization" products

What is a base?

Brønsted/Lowry base: a proton acceptor

proton acceptor?...

any substance that will take an H^+ ion

in water, H_2O + base $\rightarrow$ OH^- + $Hbase^+$

Properties of bases

- Commonly called “antacids”
- React with fats and oils to produce soap
- feel slippery
- taste bitter
- damage living tissues
- pH 7 - 14
- neutralize acids

Common bases

There are three common varieties of bases:

1) Hydroxide compounds (OH^-)

   ex: $NaOH$, $Ba(OH)_2$

2) Carbonates (CO_3^{2-}) and bicarbonates (HCO_3^-)

   ex: Na_2CO_3, $NaHCO_3$, $CaCO_3$

3) Ammonia (NH_3) and amines

pOH calculation

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

$$[OH^-] = 10^{-pOH}$$

pH & pOH relationship

In pure water at 25°C:

$[H+] = 1x10^{-7}M$

$[OH-] = 1x10^{-7}M$

Therefore, $[H^+] \times [OH^-] = 1x10^{-14}$

And $pH + pOH = 14$

“the Big 5”

$$pH = -\log [H^+]$$

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

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

$$[OH^-] = 10^{-pOH}$$

$$pH + pOH = 14$$

Hydroxide bases

- Soluble hydroxides release OH^- directly into the water
- $NaOH(s) \rightarrow Na^+_{(aq)} + OH^-_{(aq)}$
- *Strong bases = 100% of the OH^-'s released into water*
- Alkali metals hydroxides + $Ba(OH)_2$

“Arrhenius” Neutralization

- **Works for the reaction of a <u>strong acid</u> with a <u>strong base (OH^- compounds)</u>**
- Remember – acid (or base strength) has to do with how much of the acid (or base) ionizes in water, not directly how many H+ or OH- are present
- **100% ionization = “strong”**
- HCl, HBr, HI, H_2SO_4, HNO_3, $HClO_4$

Arrhenius Neutralization

Hydroxide base – general form

- **Strong Acid + Strong Base → Salt + H_2O**
- what's actually happening?
  - $H^+ + OH^- \rightarrow H_2O$
  - Salt = the anion from the acid + the cation from the base
- pH = 7 at the "end point"
  - (no excess reagents)
    - Both products are "neutral"

Arrhenius Neutralization

Examples with a hydroxide base

$$NaOH + HCl \rightarrow NaCl + H_2O$$

$$H_2SO_4 + Ba(OH)_2 \rightarrow BaSO_4 + 2\ H_2O$$

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