

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, $\text{H}_2\text{O} + \text{donated } \text{H}^+ \rightarrow \text{H}_3\text{O}^+$

- H_3O^+ = “hydronium ion”

Review: Acid Strength

- Strong acids release all of their H^+ ions
 - $[\text{strong acid}] = [H^+]$
 - Strong acids are strong electrolytes
- Weak acids hold on to most of their H^+ ions
 - $[\text{weak acid}] \gg \gg [H^+]$
 - 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, $\text{H}_2\text{O} + \text{base} \rightarrow \text{OH}^- + \text{Hbase}^+$

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 , $\text{Ba}(\text{OH})_2$

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

$$\text{pOH} = -\log [\text{OH}^-]$$

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

pH & pOH relationship

In pure water at 25°C:

$$[\text{H}^+] = 1 \times 10^{-7} \text{M}$$

$$[\text{OH}^-] = 1 \times 10^{-7} \text{M}$$

Therefore, $[\text{H}^+] \times [\text{OH}^-] = 1 \times 10^{-14}$

And $\text{pH} + \text{pOH} = 14$

“the Big 5”

$$\text{pH} = -\log [\text{H}^+]$$

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

$$\text{pOH} = -\log [\text{OH}^-]$$

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

$$\text{pH} + \text{pOH} = 14$$

Hydroxide bases

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

“Arrhenius” Neutralization

- ◆ Works for the reaction of a strong acid with a strong base (OH⁻ compounds)
- ◆ 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, H₂SO₄, HNO₃, HClO₄

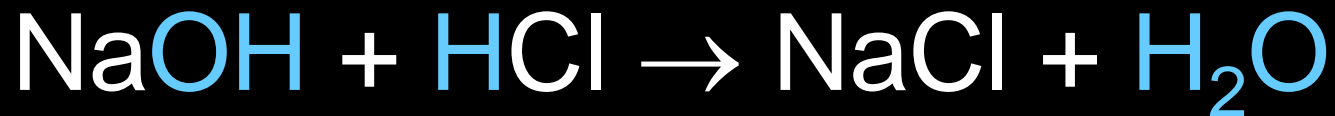
Arrhenius Neutralization

Hydroxide base – general form

- **Strong Acid + Strong Base → Salt + H₂O**
- what's actually happening?
 - $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$
 - **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



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