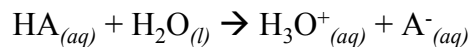


Acids and Bases 14.2

The strengths of acids and bases

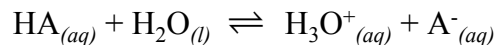
Acid Strength

Strong Acids completely dissociate in water



- One way arrow, as equilibrium lies far to the right

Weak Acids partially dissociate



- Two way arrow, as equilibrium lies to the left or ~ middle

The “Big Six” Strong Acids

The only acids that completely dissociate in water.
Memorize these! You need to know them!



Strong Bases

Soluble compounds containing the hydroxide ion.

Possible Cations:

- All Group 1A Cations
- Ca^{2+} , Sr^{2+} , or Ba^{2+}

Strength of Acids and Bases

- Strong acids always have very weak conjugate bases.
- Very weak acids always have very strong conjugate bases.
- Acids with mid-range strengths have conjugate bases with mid-range strengths.

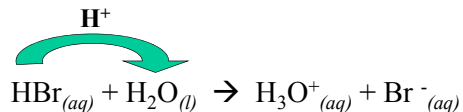
Strengths of Acids and Bases

	<u>ACID</u>	<u>BASE</u>	
Acid Strength Increases ↑	HCl	Cl^-	↓ Base Strength Increases
	HNO_3	NO_3^-	
	HF	F^-	
	NH_4^+	NH_3	
	H_2O	OH^-	
	CH_4	CH_3^-	

Strengths of Acids and Bases

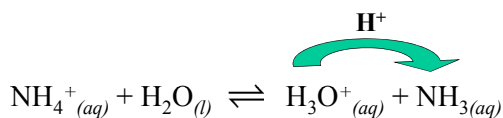
- The stronger base always accepts the most protons in an acid/base reaction.
 - There are always two bases.
 - The Base on the reactants side of the equation, and...
 - The Conjugate Base on the products side on the equation.

Strong Acids Have Weak Conjugate Bases



- H_2O and Br^- compete for protons.
- H_2O is the stronger base, so it wins most of the time, and the reaction goes to completion.

Weak Acids Have Strong Conjugate Bases



- H_2O and NH_3 compete for protons.
- NH_3 is the stronger base, so it wins most of the time, and the reaction lies to the left.

What determines the strengths of different acids?

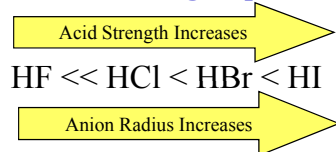
Why are some acids stronger than others?

We say they want to lose protons, but they don't actually 'want' anything.

It has to do with forces of attraction between elements.

Binary Acid Strengths

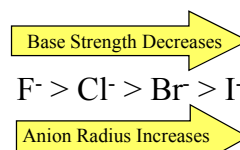
Acid strength increases when moving down a group.



The greater the distance between the nucleus of the anion and its outermost electrons, the smaller the attractive force on the H^+ ion.

Conjugate Base Strengths of Binary Acids

Conjugate base strength decreases when moving down a group.



A small radius has a greater ability to attract and accept H^+ ions.

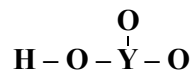
Oxoacid Strengths

There are two types of Oxoacids

- 1) An OH group bonded to an element that is not bound to other Oxygens (HOY acids)



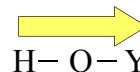
- 2) An OH group bonded to an element that is bound to other Oxygens (HYO_n acids)



HOY Oxoacids

Acid strength increases as the electronegativity of Y increases.

Electron density pulled toward electronegative Y

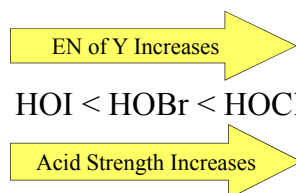


Electrons are pulled out of O-H bond

- Makes the Oxygen a little bit positive
- This weakens the bond between O and H
- H⁺ breaks off easily

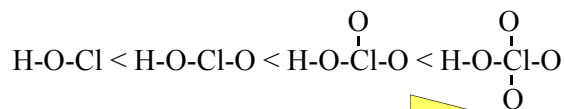
HOY Oxoacids

Acid strength increases as the electronegativity of Y increases.



HYO_n Oxoacids

Acid strength increases as more Oxygens are added to the central Y.

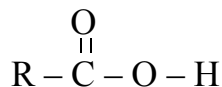


Acid Strength Increases as Oxygens are Added

Increasing the number of electronegative oxygen atoms increases the electron density around the Y. This reduces the electron density between the Hydrogen and the Oxygen in the O-H bond.

Carboxylic Acid Strengths

Carboxylic acids are weak organic acids. They take the form:



Where 'R' can be just about anything.

Denoted as RCOOH or RCO₂H

Carboxylic Acid Strengths

Again, the more electronegative the elements that make up 'R', the stronger the acid.



Weaker acid

Stronger Acid