

# Acids and bases. Ch 19.1 Acid base theory

Date: Notes!

Acids	Bases
<p>examples <u>HCl</u> &amp; <u>H<sub>2</sub>SO<sub>4</sub></u>  <u>Sour tasting</u> (lemon)</p> <p><u>Electrolytes</u> - aqueous solutions of acids conduct electricity, some are strong electrolytes (like those in car batteries) some are weak electrolytes. (<u>weak acids</u>)</p> <p>- Will change the color of various <u>indicators</u> example litmus will change from blue to red in an acid</p> <p>- acids react with <u>metals</u> produce <u>hydrogen gas</u>  <math>HCl_{(aq)} + Mg_{(s)} \rightarrow MgCl_{2(aq)} + H_{2(g)}</math> <u>gas!</u>                      (single replacement reaction)</p> <p>- neutralize bases, react with compounds containing <u>hydroxide ions</u> to produce <u>salts</u> (ionic compound)  <math>HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}</math>                      acid base salt water                      - can be <u>corrosive</u></p>	<p><u>bitter tasting</u></p> <p>- <u>feels slippery</u>.</p> <p>- <u>Electrolytes</u> aqueous solutions of bases conduct electricity</p> <p>- will change color of various <u>indicators</u> example: litmus will change from red to blue</p> <p>- will neutralize acids, reacts with compounds containing <u>hydrogen ions</u> to produce <u>salt</u> (ionic compound)                      - can be <u>corrosive</u></p>

## Theory- Arrhenius

Swedish chemist Svante Arrhenius (1859-1927) proposed a way of explaining the behavior of acids and bases

### Acids

- Hydrogen containing compounds that ionize to yield hydrogen ions in aqueous solution.
- The formula of an acid will be H \_\_\_\_\_ or an organic acid ex. HCl
- Acids can be monoprotic HCl(aq), or polyprotic like the diprotic H<sub>2</sub>SO<sub>4</sub>(aq) or the triprotic H<sub>3</sub>PO<sub>4</sub>(aq)
- Example of a Arrhenius acid HCl or HNO<sub>3</sub> Ex  $HCl_{(aq)} \rightarrow H^+ + Cl^-_{(aq)}$

### Bases

- Compounds that ionize to yield hydroxide ions.
- The formula will be a ionic hydroxide that easily dissociates like sodium hydroxide
- Example LiOH

Arrhenius definition of an acid and base isn't a very comprehensive one. It does not include certain substances that have acidic and basic properties such as sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>) and ammonia (NH<sub>3</sub>).

### Problems with Arrhenius theory

1. H<sup>+</sup> prob. not in solution. (attracted to polar water molecule to make H<sub>3</sub>O<sup>+</sup>)
2. Ionic salts should produce neutral solutions.
3. Water is imp. in acidic & basic properties.
4. NH<sub>3</sub> is a base! (Arrhenius definition) could not explain this

Bronsted-Lowry Acids and Bases

Danish chemist Johannes Bronsted (1879-1947) and English chemist Thomas Lowry proposed a new definition.

Acids:  $H^+$  donors

Base:  $H^+$  acceptor

$NH_3(aq)$ Ammonia Hydrogen ion <u>acceptor</u>	+	$H_2O(l)$ Water Hydrogen ion <u>donor</u>	$\leftrightarrow$	$NH_4^+(aq)$ Ammonium ion	+	$OH^-(aq)$ Hydroxide ion
<u>ACID</u>		<u>BASE</u>		<u>ACID</u>		<u>BASE</u>

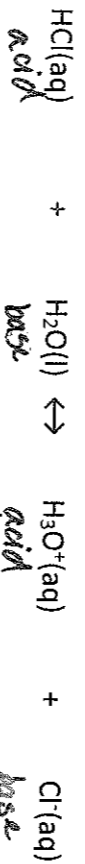
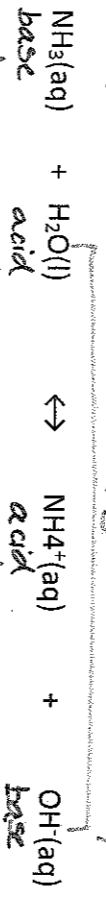
Conjugate Acids and Bases

conjugate acid is the particle formed when a base gains a hydrogen ion.

conjugate base is the particle that remains when an acid donates a hydrogen ion.

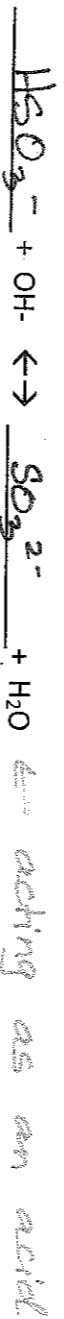
conjugate acid-base pair consist of substances related by the loss or gain of a single hydrogen ion.

Examples



Amphoteric/Amphiprotic — is a substance that behaves as an acid in some reactions and a base in others.

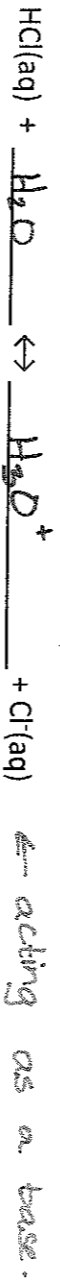
Examples



$HSO_3^-$  is amphiprotic, as are hydrogen carbonate and hydrogen sulfate. What do they have in common?

$HCO_3^-$  ,  $HSO_4^-$  , both can give or take a  $H^+$ .

Another amphiprotic Example:



A water molecule that gains a hydrogen ion becomes a positively charged hydronium

In chemistry we might refer to  $H^+$  in solution but what we actually are referring to Hydronium Ion ( $H_3O^+$ )

Questions

Identify the following acids as monoprotic, diprotic, or triprotic.

- a.  $H_2CO_3$  *diprotic*
- b.  $H_3PO_4$  *triprotic*
- c.  $HCl$  *monoprotic*
- d.  $H_2SO_4$  *diprotic*

Identify each reactant in the following equations as a hydrogen-ion donor(acid) or hydrogen ion acceptor(base). Label the conjugate acid-base pairs.

