

Acids and bases. Ch 19.1 Acid base theory

Date: Notes!

Acids	Bases
<p>examples <u>HCl</u> & <u>H₂SO₄</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> $HCl_{(aq)} + Mg_{(s)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$ ← gas! (single replacement reaction)</p> <p>-neutralize bases, react with compounds containing <u>hydroxide ions</u> to produce <u>salts</u> (ionic compound)</p> <p>$HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$ acid base salt water</p> <p>-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)</p> <p>-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 H₂SO₄(aq) or the triprotic H₃PO₄(aq)
- Example of a Arrhenius acid HCl or HNO₃ 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 (Na₂CO₃) and ammonia (NH₃).

Problems with Arrhenius theory

1. H⁺ prob. not in solution. (attracted to polar water molecule to make H₃O⁺)
2. Ionic salts should produce neutral solutions.
3. Water is imp. in acidic & basic properties.
4. NH₃ 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

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

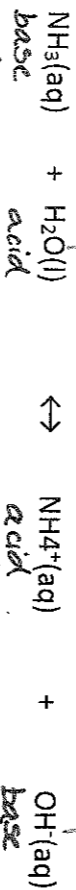
Conjugate Acids and Bases

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.

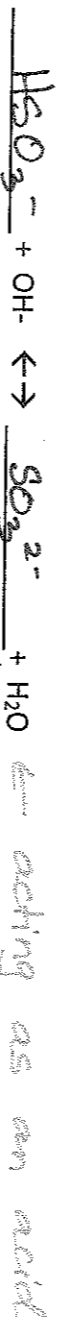
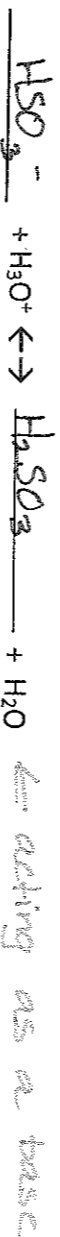
conjugate acid-base pair consist of substances related by the loss or gain of a single hydrogen ion.

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.

