

# Properties of Acids

- taste sour
- not slippery
- solution conducts electricity
- causes blue litmus paper to turn red
- will react with some metals to produce H<sub>2</sub> gas
- pH < 7

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# Properties of Bases

- taste bitter
- slippery, like soap
- will not react like acids
- causes red litmus paper to turn blue
- pH > 7
- solution conducts electricity

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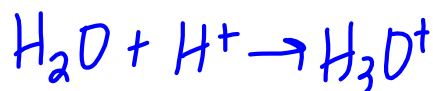
# Acid/Base Solutions

- **aqueous solutions** (*solutions with  $H_2O$* ) all contain  $H^+$  (*hydrogen ions*) and  $OH^-$  (*hydroxide ions*)
- **acidic solutions**: contain more  $H^+$  ions
- **basic solutions**: contain more  $OH^-$  ions
- **neutral solutions**: contain equal amounts of  $H^+$  and  $OH^-$  (water, pH = 7)

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## The Proton: $H^+$

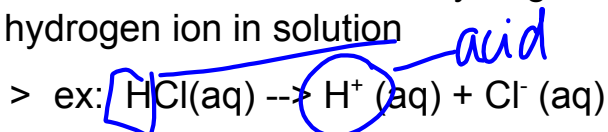
- an  $H^+$  is just a proton
- cannot exist in solution by itself
- will join with a water molecule to become  $H_3O^+$
- $H_3O^+$  is called the hydronium ion
- $H^+$  and  $H_3O^+$  can be used interchangeably in chemical reactions



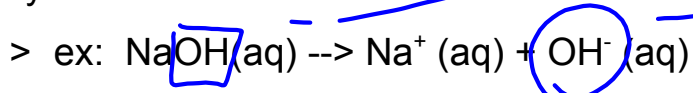
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# Arrhenius Acids/Bases

- Arrhenius Acid: contains hydrogen, ionizes to form a hydrogen ion in solution



- Arrhenius Base: contains hydroxide, ionizes to form a hydroxide ion in solution



- Works for some acids and bases, but not all the time

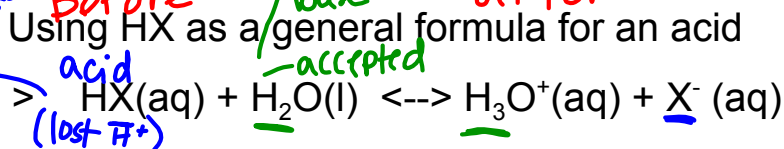
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# Bronsted-Lowry Acids/Bases

- *more inclusive model*
- **Bronsted - Lowry Acid:** hydrogen ion (proton) donor
- **Bronsted - Lowry Base:** hydrogen ion (proton)

acceptor

- Using HX as a general formula for an acid



> Bronsted-Lowry Acid:  $\text{HX}$

> Bronsted Lowry Base:  $\text{H}_2\text{O}$

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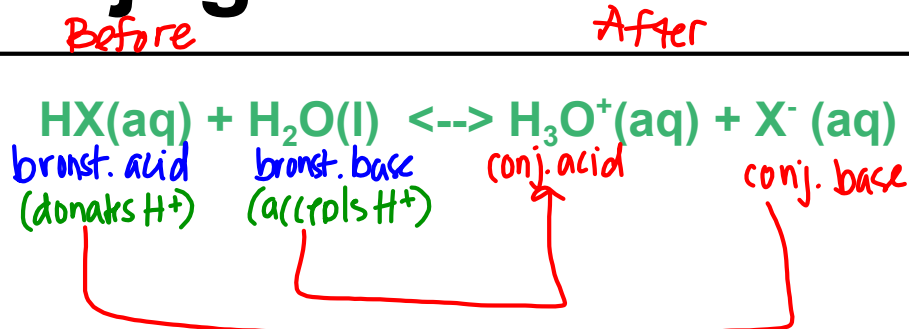
# Conjugate Acids/Bases



- Both the forward and the reverse reactions are acid-base reactions
- **Conjugate Acid:** substance produced when a base accepts a proton ( $\text{H}_3\text{O}^+$ )
- **Conjugate Base:** substance produced when an acid donates a hydrogen ion ( $\text{X}^-$ )

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# Conjugate Pairs



**Conjugate acid-base pairs:** substances related to each other by donating and accepting a single hydrogen ion

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# Conjugate Pairs



What are the conjugate acid-base pairs?

Does NH<sub>3</sub> fit the Arrhenius model of a base?

Arrh. - OH<sup>-</sup>

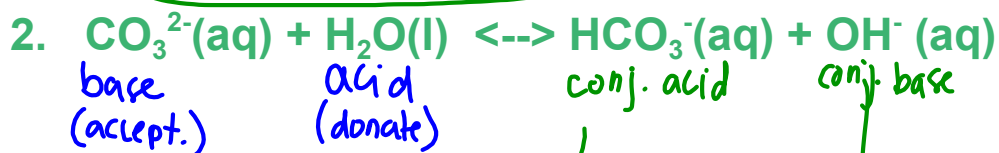
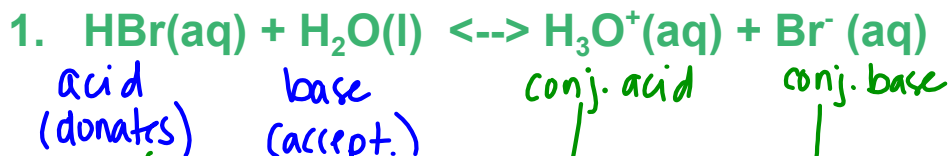
Is water an acid or a base? both

Amphoteric (Amphoprotic): substances that can act as both an acid and a base. *example: water*

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# Practice:

Identify the acid-base pairs in the following reactions



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# Monoprotic and Polyprotic Acids:



*For a hydrogen ion to be donated, it must be bonded to a highly electronegative element. (F, Cl, Br, I, O, N, S)*

**Monoprotic Acids:** a substance that can only donate 1 hydrogen ion per molecule

ex: HBr, HCl, HI, <sup>acetate</sup> CH<sub>3</sub>COOH

**Polyprotic Acids:** a substance can donate more than 1 hydrogen ion per molecule

ex: H<sub>3</sub>PO<sub>4</sub> and H<sub>2</sub>SO<sub>4</sub>

-- will ionize in steps, not all at once

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