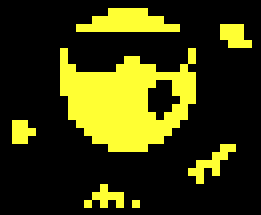


Acid Base Tutorial

CREATED BY
SCHWEITZER

BASICS OF ACIDS

- ALL ACIDS HAVE AN “H” IN THE FRONT OF THEIR FORMULA…HCl….HF….HNO_3
- ALL ACIDS WILL NEED TO BE IN WATER
- AQUEOUS (aq)

ACIDIC NOMENCLATURE

- OXYACIDS
  - CONTAIN OXYGEN
  - FOLLOW PATTERN
    - HX WHERE “X” IS A POLYATOMIC ANION
    - EXAMPLES: HNO_3 or H_3PO_4
  - [root of polyatomic + “ic” or “ous” + acid]
    - In order to indicate which polyatomic ion
      - “ic” stands for the “ate” version
      - “ous” stands for the “ite” version

ACIDIC NOMENCLATURE

- NON-OXYACIDS
  - DO NOT CONTAIN OXYGEN
  - FOLLOW PATTERN "HX"
    - "X" = Monatomic ion
  - $HF_{(aq)}$ Hydrofluoric acid
  - [hydro + root of "x" + ic + acid]

How many Hydrogens ??

- HYDROGENS WILL BALANCE OVERALL CHARGE TO ZERO…. ($PO_4^{-3} \rightarrow H_3PO_4$)

Practice Naming acids

- $H_2SO_{4\,(aq)}$
- $HBr_{(aq)}$
- $HIO_{2\ (aq)}$
- $HI_{(aq)}$

Practice Naming acids

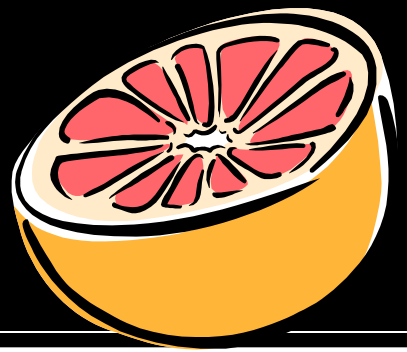
- H_2SO_4 Sulfuric acid
- HBr Hydrobromic acid
- HIO_2 Iodous Acid
- HI(aq) HydroIodic acid
-

PROPERTIES OF BASES

- BASES
  - BITTER TASTE
  - SLIPPERY TO TOUCH
  - CORROSIVE
  - DISSOLVE BIOLOGICAL MATERIALS(Caustic)
  - ALKALINE (ANOTHER NAME)

Properties of Acids

- ACIDS
  - SOUR
  - RXN WITH METAL FORMING H_2 GAS
  - CONDUCT ELECTRICITY
  - CORROSIVE
  - pH ($7 \leftrightarrow 0$)



What makes something Acidic?

- Anything that can produce H+ ions
- (H^+ or H_3O^+ = hydronium ion)
  - Or consume OH^-

What makes something Basic?

- Anything that can produce OH^- ions
  - Or consume H_3O^+ ions

Arrhenius Acid/Base Definition

- Acids contain H and produce H_3O^+ ions
- Bases contain OH^- produce OH^-
- Example
  - $HCl + H_2O \rightarrow H_3O^+ + Cl^-$
  - $NaOH_{(s)} + H_2O \rightarrow Na^+_{(aq)} + OH^-_{(aq)}$

Svante Arrhenius

- Svante Arrhenius

Svante August Arrhenius was born on February 19, 1859.

Problems with Arrhenius

- NH_3 is Basic.
- According to Arrhenius all bases must contain OH^-
- So a new definition was needed!

Bronsted-Lowery Acid base Definition.

- Acid: Proton donor (H^+ donor)
- Base: Proton Acceptor (H^+ acceptor)

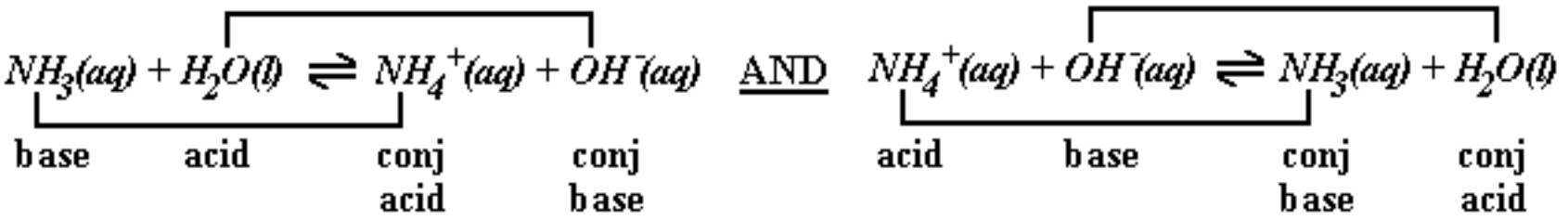
What does this mean?

- Every acid base reaction is simply an exchange of an H^+
- So every reaction contains an acid and every reaction contains a base.

- $NH_4^+ + H_2O \Rightarrow NH_3 + H_3O^+$
- Who is the acid? Who is the base?

CONJUGATE

- CONJUGATE: SUBSTANCE AFTER H^+ HAD BEEN DONATED OR ACCEPTED??
- ESSENTIALLY SAME ELEMENT…EXCEPT FOR H^+
- NOTICE: ANY ACID BECOMES A BASE (VISE-VERSA)
- EXAMPLE:



Pick out the acid and the base.

- $NH_3 + H_2O \rightarrow NH_4^+ + OH^-$
- $HCl + F^- \rightarrow Cl^- + HF$
- $CO_3^{-2} + 2HI \rightarrow H_2CO_3 + 2I^-$

Determine the Conjugates

$HCN + H_2O \rightarrow H_30^+ + CN^-$

Acid Base conj. Conj.
acid base

$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$

Base acid conj. Conj.
acid base

AP Question

Consider the three acids: HF, HSO_4^- , and $H_2PO_4^-$

Which list includes only conjugate bases of the acids given above?

a. OH^-, HPO_4^{3-} and H_3O^+
b. F^-, SO_4^{2-}, and HPO_4^{2-}
c. OH^-, SO_4^{2-}, and PO_4^{3-}
d. OH^-, SO_4^{2-} , and HPO_4^{2-}
e. H_2F^+, H_2SO_4, and H_3PO_4

Amphiprotic

- Substance which can act like an acid or a base.

$HCN + H_2O \rightarrow H_30^+ + CN^-$

Acid Base conj. acid Conj. base

$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$

Base acid conj. acid Conj. base

AP Question

Each list contains at least one species that could illustrate amphoteric behavior Except:

a. HNO_3, HCl, HS^-
b. CO_3^{2-}, Br^-, NH_4^+
c. HCO_3^-, HSO_4^-, NH_3
d. $H_2PO_4^-$, NH_2^-, ClO_3^-
e. H_3PO_3, $Al(OH)_3$, $Zn(OH)_2$

How many protons can an acid donate?

- Polyprotic
- Diprotic
- Monoprotic

- These terms describe the number of protons that can be donated.

AP Question

Which of the following is the best description of the changes that occur in each molecule of H_3PO_4 when H_3PO_4 is neutralized in water solution to form PO_4^{3-}

a. Three electrons are accepted

b. Three protons are transferred

c. The oxidation number of phosphorus decreases by three units.

d. Three protons are transferred and three electrons are accepted.

e. Three protons are transferred and the oxidation number of phosphorus decreases by three units.

AP Question

- Which is a polyprotic acid in water?
- I. $Ca(NO_3)_2$
- II. Na_2HPO_4
- III. H_3AsO_4
- a. I only
- b. III only
- c. II and III only
- d. I and II only
- e. I, II, and III

Common Acid Base Conjugates

- Ammonia: NH_3
- Ammonium: NH_4^+

- This is a common acid/base pair. complete the following reaction.
- NH_3 + strong acid $\rightarrow$ NH_4^+
- NH_4^+ + Strong base $\rightarrow$ NH_3