Acids & Bases

General Properties:

Acid	Base
pH < 7.00	pH > 7.00
taste sour	taste bitter
feel wet	feel slippery (fat + base = soap) ← from skin oils
most reactive w/ metals	most reactive w/ wool
corrosive	caustic

Definitions:

① Arrhenius

Arrhenius Acid – contains H^+ and creates H^+ in water

Arrhenius Base – contains OH^- and creates OH^- in water

*Limitations of Definitions:

requires H_2O, requires OH^- for bases

② Bronsted-Lowry

Bronsted-Lowry Acid – Proton Donor (H^+ Donor)

Bronsted-Lowry Base – Proton Acceptor (H^+ Acceptor)

$$HBr + H_2O \rightarrow H_3O^+ + Br^-$$

B-L Acid — donates H^+ to H_2O

B-L Base (accepts H^+)

$$\underset{\text{Acid}}{HBr} + \underset{\text{Base}}{H_2O} \rightarrow \underset{\text{Acid}}{H_3O^+} + \underset{\text{Base}}{Br^-}$$

Conjugate Acid-Base Pairs:

HBr, Br^-

H_2O, H_3O^+

Conj. A-B Pairs

$HC_2H_3O_2 + H_2O \rightleftharpoons H_3O^+ + C_2H_3O_2^-$
Acid Base Acid Base

$HC_2H_3O_2$, $C_2H_3O_2^-$
H_2O, H_3O^+

$NH_3 + H_2O \rightleftharpoons OH^- + NH_4^+$
Base Acid Base Acid

NH_3, NH_4^+
H_2O, OH^-

Conjugate Acid-Base Pairs

1) One member of pair is a reactant, one member is a product
2) only differ in composition by 1 H
3) opposite in strength (strong acid makes weak base & vice versa)

Strong Acids (ionize 100%)

HCl	HNO_3
HBr	H_2SO_4
HI	$HClO_4$

Strong Bases

LiOH	$Ca(OH)_2$
NaOH	$Mg(OH)_2$
KOH	$Ba(OH)_2$

* All other acids are weak (ionize 1-3%)

Practice

Brønsted-Lowry, Conj. A-B Pairs

$NH_{3(aq)} + H_3O^+_{(aq)} \rightleftharpoons NH_4^+_{(aq)} + H_2O_{(l)}$

Base Acid Acid Base

$HSO_4^- + H_2O \rightleftharpoons H_3O^+ + SO_4^{-2}$

Acid Base Acid Base

$H_2O + HS^- \rightleftharpoons H_3O^+ + S^{-2}$

Base Acid Acid Base

$NH_4^+ + CO_3^{-2} \rightleftharpoons NH_3 + HCO_3^-$

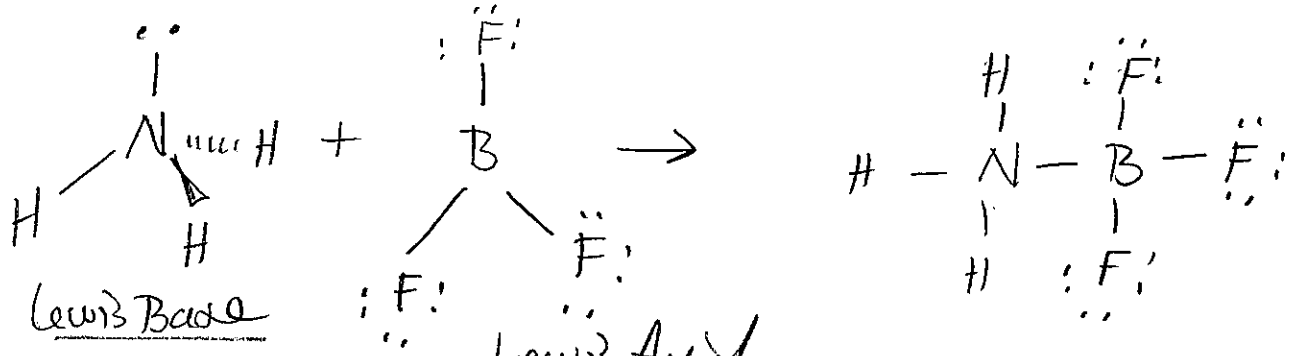
Acid Base Base Acid

(3) Lewis

Lewis Acid — e- pair acceptor

Lewis Base — e- pair donor

$NH_3 + BF_3 \longrightarrow BF_3NH_3$



Lewis Base

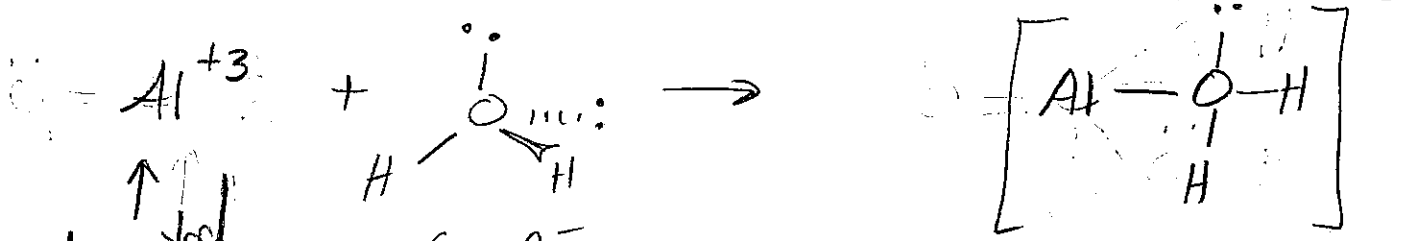
NH_3 donated e- pair to create bond with BF_3

Lewis Acid

(accepted e- pair to make bond)

*No conj. acid-base pairs

$Al^{+3} + H_2O \longrightarrow Al(H_2O)^{+3}$



Accepted e- pair

Lewis Acid

Gave e- pair

Lewis Base

"Amphoteric"

Species that can act both as acid & base

Ex: H_2O

$$HCl + H_2O \rightarrow H_3O^+ + Cl^-$$

Base

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

Acid

Ex: HSO_4^-

$$HSO_4^- + H_2O \rightleftharpoons H_3O^+ + SO_4^{-2}$$

Acid

$$HSO_4^- + H_2O \rightleftharpoons OH^- + H_2SO_4$$

Base

Auto Ionization of H_2O

$$H_2O_{(l)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + OH^-_{(aq)}$$

Why H_2O is neutral ~ equally acid & base!

From studies of the above reaction, the following equation was established:

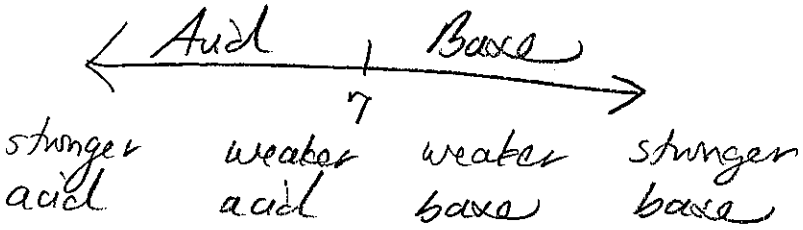
$$K_w = 1.0 \times 10^{-14}\ M^2 = [H_3O^+][OH^-]$$

"K_w" Self-Ionization Constant of H_2O

concentration in Molarity

+ Can use to find $[H_3O^+]$ if know $[OH^-]$ and vice versa

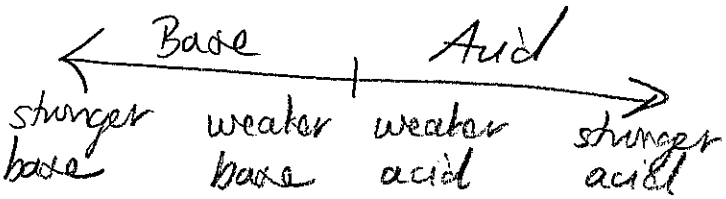
pH



$$pH = -\log [H_3O^+]$$

*When take logarithym, SF increase by 1

pOH



$$pOH = -\log [OH^-]$$

$$pH + pOH = 14.00$$