Acids and Bases

What is an acid?

Brønsted/Lowry acid: a proton donor

proton donor?...

a proton is also an H^+ ion

in water, H_2O + donated $H^+ \rightarrow H_3O^+$

- H_3O^+ = “hydronium ion”

What is a base?

Brønsted/Lowry base: a proton acceptor

proton acceptor?...

any substance that will take an H^+ ion

in water, H_2O + base $\rightarrow$ OH^- + Hbase

Brønsted /Lowry "neutralization"

For **weak acids** and **weak bases**

$$Acid_1 + Base_1 \rightleftarrows Acid_2 + Base_2$$

what's actually happening?

Note the "double arrow"

$Acid_1 + Base_1 \rightleftarrows Acid_2 + Base_2$

- $Acid_1 \rightarrow H^+ + Base_2$

  $Acid_1$ donates H^+ and becomes $Base_2$, its "conjugate base"

- $H^+ + Base_1 \rightarrow Acid_2$
  - $Base_1$ accepts the H+ from $Acid_1$ and becomes $Acid_2$, its "conjugate acid"

Brønsted /Lowry "neutralization"

Examples…

$$HF + H_2O \rightleftarrows F^- + H_3O^+$$

HF donates an H^+ $\Rightarrow$ is an "acid"

H_2O takes the H^+ from the HF

$\Rightarrow$ it is the "base"

Brønsted /Lowry "neutralization"

$$HF + H_2O \rightleftarrows F^- + H_3O^+$$

Look at the "reverse" reaction

which donates an H+ ?$\Rightarrow$ it is an "acid"

H_3O^+

which takes the H+ from the H_3O^+ ?$\Rightarrow$ it is the "base"

F^-

Brønsted /Lowry "neutralization"

$$HF + H_2O \rightleftarrows F^- + H_3O^+$$

- HF – a weak acid – becomes F^-, a base
- H_2O, acting as a base, becomes H_3O^+, an "acid"

The acid becomes its "conjugate base"

The base becomes its "conjugate acid"

Brønsted /Lowry “neutralization”

Examples…

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

H_2O donates an H+ $\Rightarrow$ is an “acid”

NH_3 takes the H+ from the H_2O

$\Rightarrow$ it is the “base”

Brönsted /Lowry "neutralization"

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

Look at the "reverse" reaction

which donates an H+ ?⇒ it is an "acid"

NH_4^+

which takes the H+ from the NH_4^+ ?⇒ it is the "base"

OH^-

Brönsted /Lowry "neutralization"

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

- H_2O – a weak acid – becomes OH^-, a base
- NH_3, acting as a base, becomes NH_4^+, an "acid"

The acid becomes its "conjugate base"

The base becomes its "conjugate acid"

Brønsted /Lowry "neutralization"

a weak acid + a weak base ⇄ their conjugate acid and base

Weak acids lose an H^+ and become their conjugate bases

Weak bases gain an H^+ and become their conjugate acids

- In Brønsted/Lowry Theory, "neutralization" *only means an acid and a base react together*
- It says ***NOTHING*** about the pH after they react!!

B/L Neutralization $\Longrightarrow$ **pH $\neq$ 7**

What is the conjugate base of…

HCl?

Cl^-

HNO_3?

NO_3^-

HNO_2?

NO_2^-

NH_4^+?

NH_3

CH_3COOH?

CH_3COO^-

H_2CO_3?

HCO_3^-

HCO_3^-?

CO_3^{2-}

H_3O^+?

H_2O

What is the conjugate acid of…

PO_4^{3-}?

HPO_4^{2-}

HPO_4^{2-}?

$H_2PO_4^-$

$H_2PO_4^-$?

H_3PO_4

NH_2^-?

NH_3

NH_3?

NH_4^+

CH_3COO^-?

CH_3COOH

HCO_3^-?

H_2CO_3

H_2O?

H_3O^+

Did you notice…

…that H_2O was listed as an *acid*, and as a *base* $\Rightarrow$ but a pure H_2O solution has pH = 7?

H_2O can act as an acid (lose an H^+) or a base (accept an H^+) depending on what it is combined with

AMPHOTERIC: act as an acid when with a base; act as a base when with an acid

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