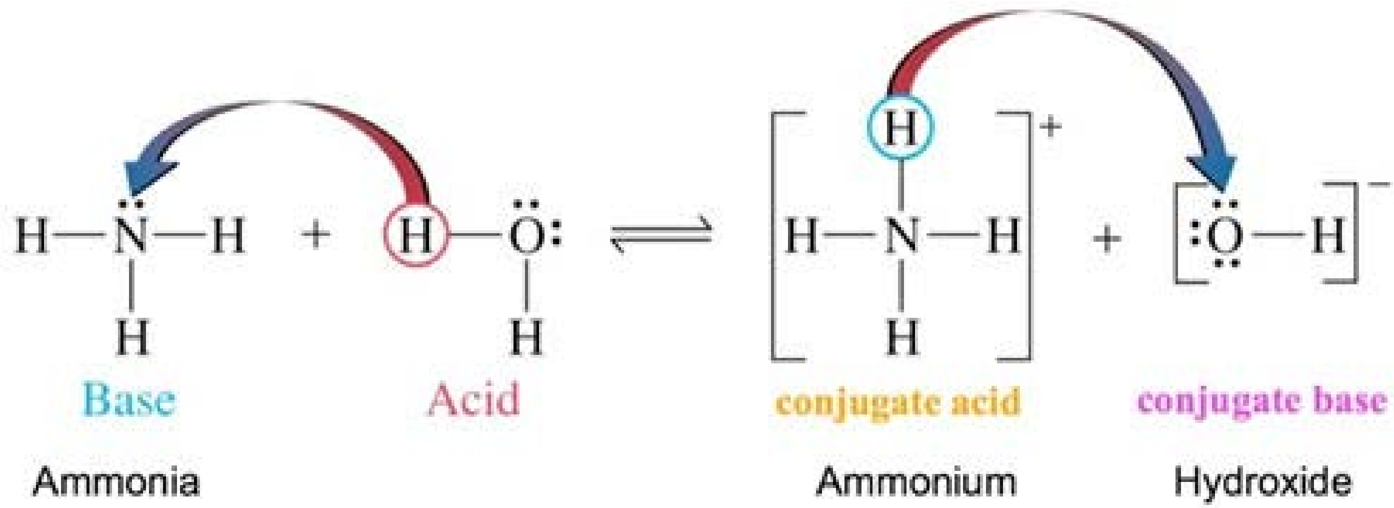
Conjugate Acid & Base Pairs…



Outcomes:

- Write acid/base chemical equations. Include conjugate pairs, amphoteric behaviour.

Conjugate Acid & Base Pairs

The general form of a Bronsted-Lowry acid-base reaction is:

Acid + Base ←→ Conjugate acid + Conjugate Base

- The **CONJUGATE ACID** is what remains after a **BASE** has **ACCEPTED** a **PROTON**, and the **CONJUGATE BASE** is what remains after the **ACID** has **DONATED** its **PROTON**.

Ex) Reaction of ammonia and water

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

The reverse reaction would be:

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

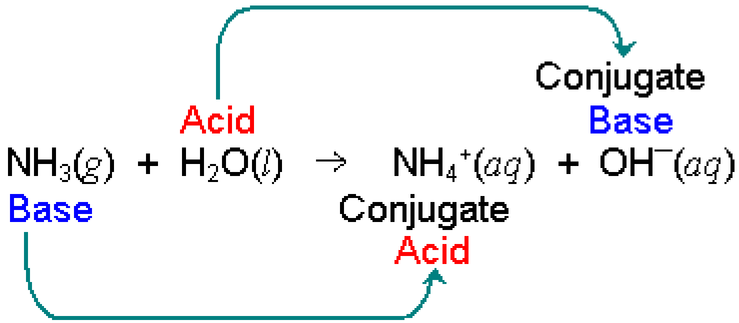
Conjugate Acid & Base Pairs

- Notice that an **ACID RESULTS** when **NH_3 ACCEPTS** a **PROTON** from **WATER**. However, the **NH_4^+** can **DONATE** a **PROTON** to the **HYDROXIDE**.

- In the **FIRST REACTION**, NH_3 is the **BASE**, and NH_4^+ is its **CONJUGATE ACID**. **WATER** is the **ACID**, and **OH^-** is its **CONJUGATE BASE**.

- Therefore,
  - NH_3 and NH_4^+ are a **CONJUGATE ACID-BASE PAIR**, as are H_2O and OH^-.

So for this reaction:



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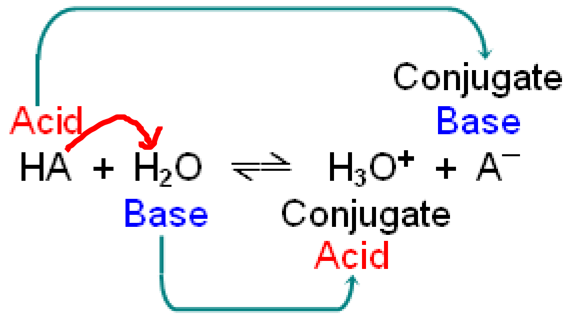
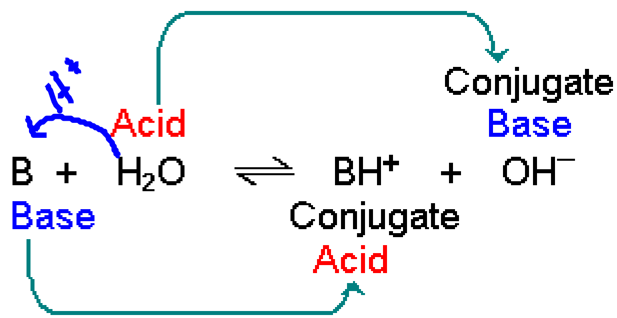
In general,

For some acid HA:



And for some base B:



Conjugate Pairs Example:

Given the reaction: HIO_3 + NO_2- ←→ HNO_2 + IO_3-

- The **HIO_3** must **LOSE ONE PROTON** (H+) to become **IO_3^-**
- **HIO_3** is acting as an **ACID** while **IO_3^-** is acting as a **BASE**.
- **HIO_3** and **IO_3^-** form what is called a **CONJUGATE ACID-BASE PAIR**.
- The only difference between these two is the **IO_3^-** has **ONE LESS "H"** and **ONE MORE (-) CHARGE** than the **HIO_3**. All conjugate acid-base pairs are like this.
- The form with **ONE MORE H^+** (HIO_3) is called the **CONJUGATE ACID**.
- The form with **ONE LESS H** (IO_3-) is called the **CONJUGATE BASE.**

Out of every acid-base reaction, you always get 2 **CONJUGATE PAIRS**. For example, in the above reaction the two conjugate pairs are:

Pair 1	**Pair 2**
HIO_3 & IO_3^-	NO_2^- & HNO_2

NOTE: *The "1" and the "2" in "conjugate pair 1" etc. has no special meaning.*

Try these ones:

Identify the conjugate acid-base pairs in each of the following reactions:

a) $NH_3 + CH_3COOH \leftrightarrow NH_4^+ + CH_3COO^-$

B A A B

Acetate

Pair 1: (acid) CH_3COOH (base) CH_3COO^-

$HC_2H_3O_2$ $C_2H_3O_2^-$

Pair 2: (acid) NH_4^+ (base) NH_3

H^+ H^+

b) $H_2SO_3 + H_2PO_4^- \leftrightarrow H_3PO_4 + HSO_3^-$

A B A B

Pair 1: (acid) H_2SO_3 (base) HSO_3^-

Pair 2: (acid) H_3PO_4 (base) $H_2PO_4^-$

Try these ones:

Identify the conjugate acid-base pairs in each of the following reactions:

c) $HC_2O_4^-$ + HNO_2 $\leftrightarrow$ NO_2^- + $H_2C_2O_4$

B A B A

Pair 1: (acid) HNO_2 (base) NO_2^-

Pair 2: (acid) $H_2C_2O_4$ (base) $HC_2O_4^-$

d) $Al(H_2O)_6^{3+}$ + HCO_3^- $\leftrightarrow$ $Al(H_2O)_5(OH)^{2+}$ + H_2CO_3

A B B A

H^+ H^+

Al^{3+}

Pair 1: (acid) $Al(H_2O)_6^{3+}$ (base) $Al(H_2O)_5(OH)^{2+}$

Pair 2: (acid) H_2CO_3 (base) HCO_3^-