

Topic 8: Acids and bases

8.1 Theories of acids and bases

- 8.1.1 A Brønsted-Lowry acid is a proton/ H^+ donor and a Brønsted-Lowry base is a proton/ H^+ acceptor
- 8.1.2 Amphiprotic species can act as both Brønsted-Lowry acids and bases
- 8.1.3 A pair of species differing by a single proton is called a conjugate acid-base pair
- 8.1.4 Deduction of the Brønsted-Lowry acid and base in a chemical reaction
- 8.1.5 Deduction of the conjugate acid or conjugate base in a chemical reaction

Brønsted-Lowry theory

- According to the Brønsted-Lowry theory, a substance behaves as an acid when it donates a proton to a base. A substance behaves as a base when it accepts a proton from an acid. Thus:
 - A Brønsted-Lowry acid is a proton (H^+) donor
 - A Brønsted-Lowry base is a proton (H^+) acceptor
- Acids can be a combination of **hydrogen ions (H^+)** and an anion. Examples include: HCl , HNO_3 , $HC_2H_3O_2$
- Bases can be a combination of **hydroxide ions (OH^-)** and metal cations. Examples include: $NaOH$, KOH
 - However, sometimes a hydrogen next to a metal signifies a base such as NaH
- Acid-Base Conjugate Pairs: A conjugate pair is two species which differ by a single proton:
 - The acid will become the conjugate base
 - The base will become the conjugate acid

Conjugate-Base Pair Question:

Label the conjugate acid-base pairs in the following reactions:



Conjugate pair 1: CH_3COOH/CH_3COO^-

CH_3COOH is the acid because it donates a H^+ , so CH_3COO^- is conjugate base

Conjugate pair 2: H_2O/H_3O^+

H_2O is the base because it accepts a H^+ , so H_3O^+ is the conjugate acid

- To find the conjugate acid of a species, add one H^+
- To find the conjugate base of a species, take away one H^+
- Before the Brønsted-Lowry theory acids and bases were distinguished by their taste, acids tasted sour

Amphiprotic

- Some substances can behave as either acids and bases, depending on what they react with, and can therefore donate or receive protons. Such substances are said to be amphiprotic
 - **Amphiprotic:** A chemical species capable of accepting and donating protons, thus able to act as a Brønsted-Lowry acid and a base
- This means the species must be able to accept or donate a proton to another species
- H_2O is amphiprotic as it is able to donate a proton to form a OH^- or accept a proton to form H_3O^+ therefore acting as a Brønsted-Lowry acid or base



Amphiprotic Species Question:

Write an equation to show hydrogen phosphate acting as and an acid and a base in water

Acting like an Acid: $HPO_4^{2-} + H_2O(l) \rightleftharpoons PO_4^{3-} + H_3O^+$

Acting like a Base: $HPO_4^{2-} + H_2O(l) \rightleftharpoons H_2PO_4^- + OH^-$

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