8.4 Acid-Base Theories

Definitions

- Hydrogen polyatomic ion
- Hydronium ion
- Strong base
- Weak base
- Acid base
- Amphiprotic
- Conjugate base
- Conjugate acid
- Conjugate acid-base pair

General Properties

- Know the properties of acids and bases from Table 1.

Strong and Weak Acids

- Strong acid has a much greater than 99% ionization.
  - E.g. $HCl \rightarrow H^+ + Cl^-$ (>>90% ionization)
  - Hydrochloric, sulfuric, nitric
- Weak Acids have a less than 50% ionization
  - E.g. $HC_2H_3O_2 \rightarrow H^+ + C_2H_3O_2^-$ (1.3% ionization)
  - Acetic acid
- Review summary on page 379

The Arrhenius Concept of Acids and Bases

- Ionic compounds ionize in water. Compounds that release $H^+_{(aq)}$ ions are acids and compounds that release $OH^-_{(aq)}$ ions are bases.
- General equations:
  - Acids $HA_{(aq)} \rightarrow H^+_{(aq)} + A^-_{(aq)}$
  - Bases $BOH_{(aq)} \rightarrow B^+_{(aq)} + OH^-_{(aq)}$
  - Salts ionization without the productions of $H^+_{(aq)}$ or $OH^-_{(aq)}$

Revision of Arrhenius' Definitions

- The Arrhenius definition falls apart for some compounds: hydrogen polyatomic ions ($NaHCO_3$), oxides of metals and nonmetals ($CaO_{(aq)}$), non-hydroxide bases ($NH_{3(aq)}$), non-hydrogen acids ($Al(NO_3)_{3(aq)}$).
- $H^+_{(aq)}$ actually does not exist in solution because when it comes in contact with $H_2O_{(l)}$ a new ion is formed, the Hydronium ion $H_3O^+_{(aq)}$.
  - Acids $HA_{(aq)} + H_2O_{(aq)} \rightarrow H_3O^+_{(aq)} + A^-_{(aq)}$
  - Bases $B_{(aq)} + H_2O_{(aq)} \rightarrow HB^+_{(aq)} + OH^-_{(aq)}$

Strong and Weak Bases

- Strong base: $NaOH_{(s)} \rightarrow Na^+_{(aq)} + OH^-_{(aq)}$
- Weak base: $Na_2CO_{3(s)} \rightarrow 2Na^+_{(sq)} + CO_3^{2-}{}_{(aq)}$
  $CO_3^{2-}{}_{(aq)} + H_2O_{(l)} \rightarrow OH^-_{(aq)} + HCO_3^-{}_{(aq)}$
- Review Summary on page 385.

The Brønsted-Lowry Concept

- A redefinition of acids and bases
- A Brønsted-Lowry acid is a proton donor and a Brønsted-Lowry base is a proton acceptor.
- E.g. $H_2O_{(l)} + HCl_{(g)} \rightarrow H_3O^+_{(aq)} + Cl^-_{(aq)}$ *(water forms the hydronium ion)*

$H_2O_{(l)}$ is the Brønsted-Lowry base and $HCl_{(g)}$ Brønsted-Lowry acid.

- E.g. $NH_{3(g)} + H_2O_{(l)} \rightarrow NH_4^+{}_{(aq)} + OH^-{}_{(aq)}$ *(water forms the hydroxide ion)*
  $H_2O_{(l)}$ is the Brønsted-Lowry acid and $NH_{3(g)}$ Brønsted-Lowry base.
- Water is amphoteric (amphiprotic) which is a substance capable of acting as an acid or a base in different chemical reactions.

Reversible Acid-Base Reactions

- In a reversible reaction there is an acid and a base in each of the 2 reactions. They are known as conjugate acid-base pairs (difference of only a single proton)
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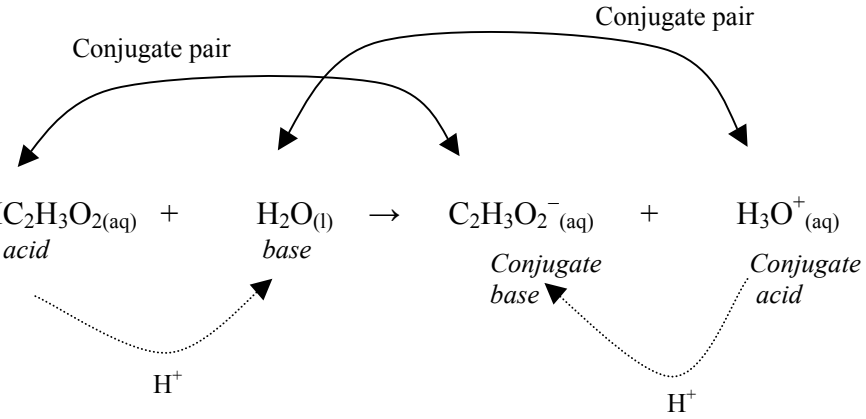

Acetic Acid is a weak acid and mostly stays in its non ionic form

- In the reaction above the acetic acid is a weak acid and the reactants are favoured. HCl is a strong acid and products are favoured.
- The stronger the acid, the weaker its conjugate base, and conversely, the weaker an acid, the stronger its conjugate base.
- Review the summary on page 388.

Changing Ideas on Acids and Bases/Changes in Knowledge

- Read and review the history of acid-base chemistry

Homework

- Practice Q's: 1-9, 12-16, 17-20
- Section Q's: 1-11