

8.3 Acid-Base Properties of Salt Solutions

- Salts can form solutions with a wide range of pH.
- Even though the salts do not contain H^+ or OH^- they affect pH by interacting with H_2O . The concentrations are very low but it does affect the pH.
- Hydrolysis: a reaction of an ion with water to produce an acidic or basic solution (hydronium or hydroxide ions).
- E.g. $\text{NaCl} \rightarrow \text{Na}^+ + \text{Cl}^-$ *Neutral pH*

In the presence of H_2O Na^+ would like to form NaOH . However NaOH is a strong base and completely disassociates.

In the presence of H_2O Cl^- would like to form HCl . However HCl is a strong acid and completely disassociates.

- E.g. $\text{Na}_2\text{CO}_3 \rightarrow 2\text{Na}^+ + \text{CO}_3^{2-}$ *High pH*

In the presence of H_2O Na^+ would like to form NaOH . However NaOH is a strong base and completely disassociates.

In the presence of H_2O CO_3^{2-} would like to form H_2CO_3 . CO_3^{2-} is a conjugate base of an acid and removes H^+ from the solution and raises the pH.
 $\text{CO}_3^{2-} + \text{H}_2\text{O} \rightarrow \text{OH}^- + \text{HCO}_3^-$

- E.g. $\text{NH}_4\text{Cl} \rightarrow \text{NH}_4^+ + \text{Cl}^-$ *Low pH*

In the presence of H_2O NH_4^+ would like to form NH_3 . NH_4^+ is a conjugate acid of a base and releases H^+ into the solution and lowers the pH.
 $\text{NH}_4^+ + \text{H}_2\text{O} \rightarrow \text{NH}_3 + \text{H}_3\text{O}^+$

In the presence of H_2O Cl^- would like to form HCl . However HCl is a strong acid and completely disassociates.

Salts that form Neutral Solutions

- Cations of strong bases and anions of strong acids do not act appreciably with H_2O and therefore are neutral.

Salts that form Acidic Solutions

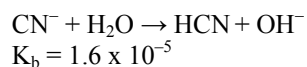
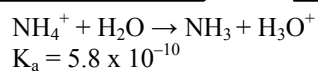
- Cations of weak bases act as acids (e.g. NH_4^+)
- Certain metals also act as acids. They are usually small atoms that are highly charged. See Table 3 on p. 582 (e.g. Al^{3+})

Salts that form Basic Solutions

- Anions of weak acids act as bases (e.g. $\text{C}_2\text{H}_3\text{O}_2^-$ acetate).

Salts that form Acidic and Basic Solutions

- Need to determine K_a and K_b (remember you can calculate K_b by manipulating the equation $K_a K_b = K_w$).
- E.g. $\text{NH}_4\text{CN} \rightarrow \text{NH}_4^+ + \text{CN}^-$



$K_b > K_a$
therefore
Basic

Hydrolysis of Amphoteric Ions

- Both act as acid and base.
- E.g. $\text{NaHCO}_3 \rightarrow \text{Na}^+ + \text{HCO}_3^-$

In the presence of H_2O Na^+ would like to form NaOH . However NaOH is a strong base and completely disassociates.

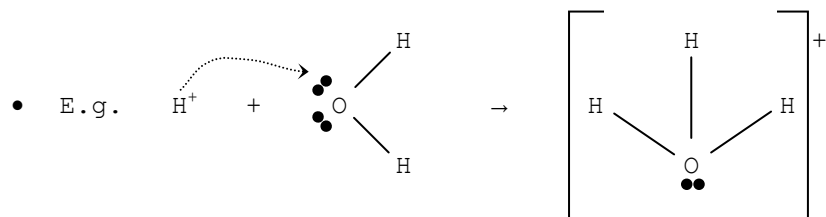
HCO_3^- acts as both an acid and base.
 $\text{HCO}_3^- + \text{H}_2\text{O} \rightarrow \text{CO}_3^{2-} + \text{H}_3\text{O}^+$ *acid*
 $\text{HCO}_3^- + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 + \text{OH}^-$ *base*
 Find K_a and K_b
 $K_a = 4.7 \times 10^{-11}$ & $K_b = 2.7 \times 10^{-8}$
 $K_b > K_a$ therefore basic

Hydrolysis of Metal and Non-Metal Oxides

- metal oxide_(s) + $\text{H}_2\text{O}_{(l)} \rightarrow$ basic solution_(aq)
- E.g. $\text{CuO}_{(s)} + \text{H}_2\text{O}_{(l)} \rightarrow \text{Cu}^{+2}_{(aq)} + 2\text{OH}^-_{(aq)}$
- nonmetal oxide_(s) + $\text{H}_2\text{O}_{(l)} \rightarrow$ acidic solution_(aq)
- E.g. $\text{SO}_{2(s)} + 2\text{H}_2\text{O}_{(l)} \rightarrow \text{H}_3\text{O}^+_{(aq)} + \text{HSO}_3^-_{(aq)}$

Lewis Acids and Bases

- Lewis Acid: a compound that is an electron pair acceptor (e.g. H^+)
- Lewis Base: a compound that is an electron pair donor (e.g. OH^-)



Homework

- Practice 1,2,3,4,5,8,9,10,12
- Questions 1,2,3,4,5