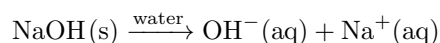
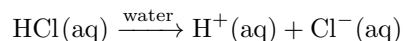


8 The nature of Acids and Bases — Elston Almeida

8.1 Arrhenius

Acid H^+ ions

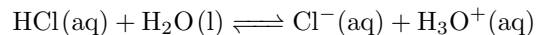
Bases OH^- ions



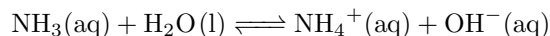
Brønsted Theory

Acid is a hydrogen donor. Base is a hydrogen acceptor.

8.2 Brønsted lowry acids



Water can be both acids and bases depending on the reaction. In the reaction above, it acts as an base to accept the hydrogen ion. (HCl donates the H ion to the water)



NH3 is an base, H2O acts as an acid, NH4 is the conjugate acid, OH is the conjugate base

Conjugate acid is when the substance that forms then a base accepts a hydrogen ion. Conjugate base is when the substance that forms when an acid loses a hydrogen ion.

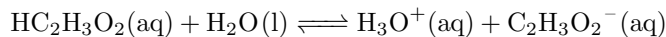
Amphiprotic is a substance that can donate and accept a hydrogen ion. Water is a Amphiprotic as you can get Hydronium, and Hydroxide.

K_a value is the eq constant for the ionization of an acid (called the acid dissociation constant)

General Equation:

$$K_a = \frac{[\text{H}_3\text{O}^+(\text{aq})][\text{A}^-(\text{aq})]}{[\text{HA}(\text{aq})]} \quad (1)$$

Example:



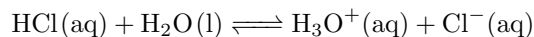
$$K_a = \frac{[\text{H}_3\text{O}^+(\text{aq})][\text{C}_2\text{H}_3\text{O}_2^-(\text{aq})]}{[\text{HC}_2\text{H}_3\text{O}_2(\text{aq})]}$$

HW492 #1, 493 #1.

8.3 Strong and Weak Acids

A strong acid ionizes almost completely in water

A weak acid is one that only partially ionizes in water



| Property | Strong Acid | Weak Acid |
|---|--|--|
| Value of acid ionization constant, K_a | K_a is large | K_a is small |
| Position of the ionization equilibrium | far to the right | far to the left |
| Equilibrium concentration of $\text{H}^+(\text{aq})$ compared with the original concentration | $[\text{H}^+(\text{aq})]_{\text{eq}} \approx [\text{HA}(\text{aq})]_i$ Equal. pH \approx Initial pH | $[\text{H}^+(\text{aq})]_{\text{eq}} \ll [\text{HA}(\text{eq})]_i$ Equal. pH \ll Initial pH |

8.4 Strong and Weak Bases

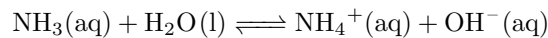
Strong base dissociates completely in water

Weak base partially dissociates in water

The base ionization constant(K_b) is the base equilibrium constant for the ionization of a base(it is also called the base dissociation constant)

$$K_b = \frac{[\text{BH}^+(\text{aq})][\text{OH}^-(\text{aq})]}{[\text{B}(\text{aq})]} \quad (2)$$

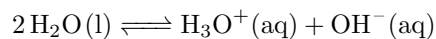
Example:



$$K_b = \frac{[\text{OH}^-(\text{aq})][\text{NH}_4^+(\text{aq})]}{[\text{NH}_3(\text{aq})]}$$

Chart for K_b for weak acids: pg 727

The autoionization of water is the transfer of a hydrogen ion from one water molecule to another.



$$K_w = [\text{H}_3\text{O}^+(\text{aq})][\text{OH}^-(\text{aq})]$$

$$K_w = [1.0 \cdot 10^{-7}][1.0 \cdot 10^{-7}]$$

$$K_w = 1.0 \cdot 10^{-14}$$

K_w is always $1.0 \cdot 10^{-14}$ at SATP

| | |
|--------------|-------------------------|
| $[H] = [OH]$ | Neutral solution |
| $[H] > [OH]$ | Acidic solution |
| $[H] < [OH]$ | Basic solution |

Example to find the $[\text{H}_3\text{O}^+(\text{aq})]$

$$K_w = [\text{H}_3\text{O}^+(\text{aq})][\text{OH}^-(\text{aq})]$$

$$[\text{H}_3\text{O}^+(\text{aq})] = \frac{K_w}{[\text{OH}^-(\text{aq})]}$$

$$K_w = K_a \cdot K_b$$

$$pH = -\log[H]$$

$$[H] = 10^{-pH}$$

$$pOH = -\log[OH]$$

$$[OH] = 10^{-pOH}$$

$$14 = pH + pOH$$

$$pK_w = pH + pOH$$

pH meter is an electronic device that measures the acidity of a solution and displays the result as a pH value.

An acid base indicator is a substance that changes color specific to the pH range

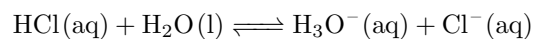
pg 495-509

pg 502 #1,2; pg 505 #1-3; pg 508 #1-4; pg 509 #1-10

8.5 Calculations involving acidic solutions

Since strong acids almost completely ionize in water, we can assume that the concentration of hydrogen ions is equal to the concentration of the acid.

Ex a solution of hydrochloric acid has a concentration of 0.1M. Calculate:



$$[\text{H}^+] = 0.1\text{M}$$

$$[\text{OH}^-] = 1 \times 10^{-13}$$

$$\text{pH} = 1$$

$$\text{pOH} = 13$$

Percentage ionization is the percentage of a solute that ionizes when it dissolves in a solvent.

Calculate the K_a hydrofluoric acid HF, if a 0.100M solution at equilibrium has a percentage ionization.

