

Name: Key
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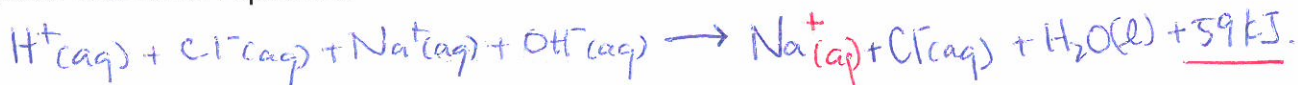
CHEMISTRY 12
 ACID BASES UNIT
 Lesson #7-8
 K_w, K_a and K_b

When a STRONG ACID and a STRONG BASE react a great amount of HEAT is RELEASED, therefore the reaction is said to be exothermic.

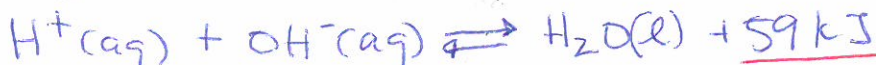
Formula Equation for NaOH and HCl:



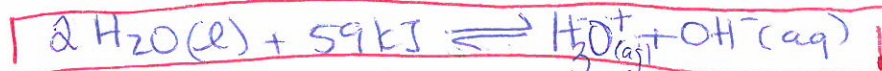
Complete Net Ionic Equation:



Net Ionic Equation:



By CONVENTION, the SELF-IONIZATION reaction of water is written as:



an endothermic rxn.
 \bar{c} hydronium ion

The EQUILIBRIUM EXPRESSION for the self-ionization of water is:

$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1.00 \times 10^{-14} @ 25^\circ\text{C}$$

specialized K_{eq}

Because the only thing that affects K_{eq} is TEMPERATURE, what would happen to the K_w value if heat was ADDED to the system? If heat was removed from the system?

if \uparrow heat $\rightarrow K_w \uparrow$ & both H_3O^+ & OH^- increase equally
 if \downarrow heat $\rightarrow K_w \downarrow$ & both OH^- & H_3O^+ decrease equally

SOME IMPORTANT RELATIONSHIPS:

In a NEUTRAL SOLUTION- $[\text{H}_3\text{O}^+] = [\text{OH}^-]$

In an ACIDIC SOLUTION- $[\text{H}_3\text{O}^+] > [\text{OH}^-]$

In a BASIC SOLUTION- $[\text{H}_3\text{O}^+] < [\text{OH}^-]$

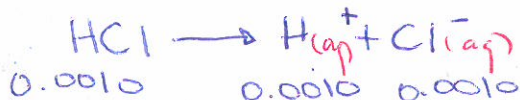
Recall: In an aqueous solution the [Strong acid] = $[\text{H}_3\text{O}^+]$

In an aqueous solution the [Strong base] = $[\text{OH}^-]$

} due to levelling effects of H_2O .

Example 1. What is the $[\text{H}_3\text{O}^+]$ and $[\text{OH}^-]$ in 0.0010 M HCl (aq)?

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



$$[\text{H}_3\text{O}^+] = 0.0010 \text{ M} \quad \text{(SA?)}$$

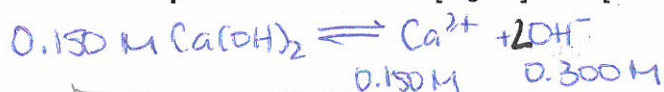
$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$$

$$[\text{OH}^-] = \frac{K_w}{[\text{H}_3\text{O}^+]} = \frac{1.00 \times 10^{-14}}{0.0010} = \boxed{1.0 \times 10^{-11} \text{ M OH}^-}$$

SB

$$K_w = [H_3O^+][OH^-] = 1.00 \times 10^{-14}$$

Example 2. What is the $[H_3O^+]$ and $[OH^-]$ in 0.150 M $Ca(OH)_2$?



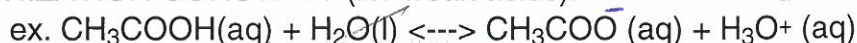
$$\therefore [OH^-] = 0.300 \text{ M}; [H_3O^+] = \frac{K_w}{0.300} = \frac{1.00 \times 10^{-14}}{0.300} = 3.33 \times 10^{-14} \text{ M } H_3O^+$$

To solve problems for $[H_3O^+]$ or $[OH^-]$ using the $K_w = 1.00 \times 10^{-14}$ note that if the $[H_3O^+]$ increases then the $[OH^-]$ decreases, and vice versa so that the K_w value is kept CONSTANT!!! @ 25°C $\frac{1}{2}$ must be of either SA or SB.

IMPT: unless you are told otherwise, assume the temperature is at @25°C and therefore the value of K_w is 1.00×10^{-14}

$$K_{eq} = \frac{[Products]}{[Reactants]} \rightarrow K_a = \frac{[Products]}{[Reactants]}$$

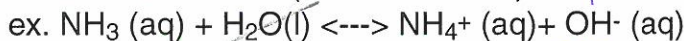
THE ACID IONIZATION CONSTANT (for weak acids):



$$K_a = \frac{[CH_3COO^-][H_3O^+]}{[CH_3COOH]} = 1.8 \times 10^{-5} \text{ from the table}$$

The value for K_a is called the ACID IONIZATION CONSTANT. The larger the K_a the STRONGER the acid and vice versa.

THE BASE IONIZATION CONSTANT (for weak bases):



$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]} \Rightarrow K_b(NH_3) = \frac{K_w}{K_a(NH_4^+)} = \frac{1.00 \times 10^{-14}}{5.6 \times 10^{-10}} = 1.8 \times 10^{-5} \text{ must solve}$$

The value for the K_b is called the BASE IONIZATION CONSTANT. The larger the K_b the STRONGER the base and vice versa.

NOTICE: the TABLE OF RELATIVE STRENGTHS OF ACIDS and BASES only gives the K_a values, in the next lesson we will learn how to use the K_a to calculate the K_b .

SEATWORK/HOMEWORK: Exercises 28-34

PLO's: L1-L7 also from previous lessons you are able to do K10-K12