

## CONCEPT: K<sub>a</sub> AND K<sub>b</sub> OF COMPOUNDS

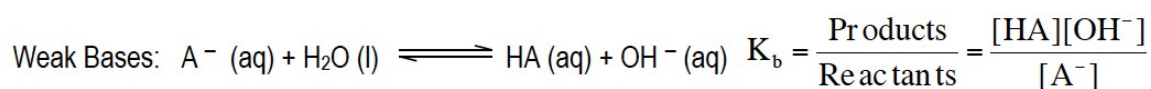
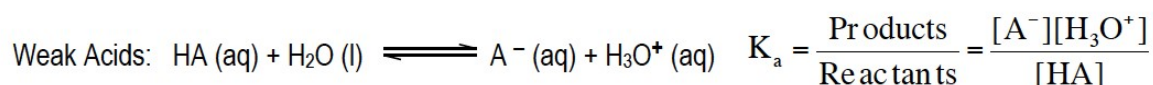
Associated with any weak acid or weak base is a K<sub>a</sub> or K<sub>b</sub> value respectively.

- K<sub>a</sub> represents the \_\_\_\_\_ dissociation constant and it measures the strength of weak acids.
- K<sub>b</sub> represents the \_\_\_\_\_ dissociation constant and it measures the strength of weak bases.

In general, the \_\_\_\_\_ the K<sub>a</sub> the \_\_\_\_\_ the pK<sub>a</sub> then the stronger the acid and \_\_\_\_\_ the concentration of H<sup>+</sup>.

- Weak acids possess K<sub>a</sub> values \_\_\_\_\_ 1, while weak bases possess K<sub>b</sub> values \_\_\_\_\_ 1.

The equilibrium expressions of K<sub>a</sub> and K<sub>b</sub> are the same as other equilibrium constants you've seen.



K<sub>a</sub> and K<sub>b</sub> are connected by the following equation:

$$K_w = K_a \cdot K_b$$

Recall that at 25 °C, K<sub>w</sub> the ion-product constant of water equals \_\_\_\_\_.

**EXAMPLE:** Consider two aqueous solutions of equal concentration. Which statement is true?

chlorous acid (HClO<sub>2</sub>, K<sub>a</sub> = 1.1 x 10<sup>-2</sup>) and phenol (HC<sub>6</sub>H<sub>5</sub>O, K<sub>a</sub> = 1.3 x 10<sup>-10</sup>)

- a) HClO<sub>2</sub> produces more [H<sub>3</sub>O<sup>+</sup>] than HC<sub>6</sub>H<sub>5</sub>O
- b) HClO<sub>2</sub> is basic compared with HC<sub>6</sub>H<sub>5</sub>O
- c) HClO<sub>2</sub> produces less [H<sub>3</sub>O<sup>+</sup>] than HC<sub>6</sub>H<sub>5</sub>O
- d) HClO<sub>2</sub> is a strong acid
- e) ClO<sub>2</sub><sup>-</sup> produces more [OH<sup>-</sup>] than C<sub>6</sub>H<sub>5</sub>O<sup>-</sup>

## **PRACTICE: $K_a$ AND $K_b$ OF COMPOUNDS CALCULATIONS 1**

**EXAMPLE 1:** Which of the following compounds has the strongest conjugate acid?

- a)  $C_2H_5NH_2$  ( $K_b = 5.6 \times 10^{-4}$ )
- b)  $H_2NNH_2$  ( $K_b = 1.3 \times 10^{-6}$ )
- c)  $NH_3$  ( $K_b = 1.75 \times 10^{-5}$ )
- d)  $HONH_2$  ( $K_b = 1.1 \times 10^{-8}$ )

**EXAMPLE 2:** At 0 °C, the ion product constant of water is  $1.2 \times 10^{-15}$ . The pH of pure water at this temperature is:

- a) 6.88
- b) 7.00
- c) 7.46
- d) 7.56

**PRACTICE:**  $(CH_3)_2NH$  is a weak base. Which equilibrium corresponds to the acid dissociation constant  $K_a$  for  $(CH_3)_2NH_2^+$ ?

- a)  $(CH_3)_2NH(aq) + H_2O(l) \rightleftharpoons (CH_3)_2N^+(aq) + H_3O^+(aq)$
- b)  $(CH_3)_2NH_2^+(aq) + H_3O^+(aq) \rightleftharpoons (CH_3)_2NH(aq) + H_2O(aq)$
- c)  $(CH_3)_2NH_2^+(aq) + H_2O(l) \rightleftharpoons (CH_3)_2NH(aq) + H_3O^+(aq)$
- d)  $(CH_3)_2NH_2^+(aq) + OH^-(aq) \rightleftharpoons (CH_3)_2NH(aq) + H_2O(aq)$
- e)  $(CH_3)_2NH_2^+(aq) \rightleftharpoons (CH_3)_2NH(aq) + H^+(aq)$