CONCEPT: Ka AND Kb OF COMPOUNDS

Associated with any weak acid or weak base is a K_a or K_b value respectively.

- K_a represents the _____ dissociation constant and it measures the strength of weak acids.
- K_b represents the _____ dissociation constant and it measures the strength of weak bases.

In general, the _____ the K_a the _____ the pK_a then the stronger the acid and _____ the concentration of H^+.

- Weak acids possess K_a values _____ 1, while weak bases possess K_b values _____ 1.

The equilibrium expressions of K_a and K_b are the same as other equilibrium constants you've seen.

Weak Acids: $HA\,(aq) + H_2O\,(l) \rightleftharpoons A^-\,(aq) + H_3O^+\,(aq)$ $\quad K_a = \dfrac{\text{Products}}{\text{Reactants}} = \dfrac{[A^-][H_3O^+]}{[HA]}$

Weak Bases: $A^-\,(aq) + H_2O\,(l) \rightleftharpoons HA\,(aq) + OH^-\,(aq)$ $\quad K_b = \dfrac{\text{Products}}{\text{Reactants}} = \dfrac{[HA][OH^-]}{[A^-]}$

K_a and K_b are connected by the following equation:

$$K_W = K_a \cdot K_b$$

Recall that at 25 ^oC, Kw the ion-product constant of water equals _____.

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

chlorous acid ($HClO_2$, $K_a = 1.1 \times 10^{-2}$) and phenol (HC_6H_5O, $K_a = 1.3 \times 10^{-10}$)

a) $HClO_2$ produces more $[H_3O^+]$ than HC_6H_5O

b) $HClO_2$ is basic compared with HC_6H_5O

c) $HClO_2$ produces less $[H_3O^+]$ than HC_6H_5O

d) $HClO_2$ is a strong acid

e) ClO_2^- produces more $[OH^-]$ than $C_6H_5O^-$

PRACTICE: Ka AND Kb 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 1.2×10^{-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) $(CH_3)_2NH_2^+\ (aq) \rightleftharpoons (CH_3)_2NH\ (aq) + H^+\ (aq)$