Ch. 16.6 Weak Acids

-- most acids are weak

-- For a weak acid HX... $HX(aq) \rightleftharpoons H^+(aq) + X^-(aq)$

-- <u>acid-dissociation constant</u> **K_a =**

large K_a:

small K_a:

The % of a weak acid that is ionized is given by the equation:

For organic acids (containing only C, H, and O) the "donated" H was connected to...

<u>EX.</u> A 0.020 M niacin solution has pH 3.26.

(a) What % of the acid is ionized?

(b) What is K_a?

<u>EX.</u> If K_a for niacin is 1.6×10^{-5}, find the pH of a 0.010 M niacin solution.

(READ: Strengths of Acids printout)

<u>% ionization of a weak acid at a given temperature...does what?</u>

Rationale:

Recall that $\%\ ion. = \frac{[H^+]\ at\ eq.}{[HX]\ orig.} \times 100$ for the weak acid $HX(aq) \rightleftharpoons H^+(aq) + X^-(aq)$

If we increase [HX], particle [ ] increases. System doesn't "want" higher [ ] of particles, so it shifts LEFT to reduce the number of particles (one vs. two). [H^+] <u>will</u> increase, but not as much as [HX]. Therefore, % ionization decreases.

-- The opposite is true if we dilute the solution.

REVIEW: pH of a mixture of Weak Acids

***Which is the dominant equilibrium?** **(When that is solved, the problem reduces to a pH of what**

is effectively 1 species in solution)

EX. **Calculate the % of HF molecules ionized in a 0.10 M HF solution. ($K_a = 6.8 \times 10^{-4}$)**

Ch. 16 Sec 7 Bases:

Weak Bases

weak base + H_2O ⇌ conjugate acid + OH^-

K_b =

*Weak bases are often nitrogen-containing molecules ("amines") or anions.

Example: $H{-}\ddot{N}{-}CH_3\,(aq) + H_2O(l) \rightleftharpoons \left(H{-}\overset{H}{\overset{|}{N}}{-}CH_3\right)^+\,(aq) + OH^-(aq)$

Review of SB: Totally dissociate in solution; What are the strong bases?

pH of a WB

ICE diagram (use them!!!)

EX. What is the [NH_3] in a solution having pH 9.35?

Ch.16 sec 6-p. 688 Polyprotic acids – like sulfurous acid, H_2SO_3 – have more than one ionizable H+.

$H_2SO_3(aq) \rightleftharpoons H^+(aq) + HSO_3^-(aq)$ ($K_{a1} = 1.7 \times 10^{-2}$)

$HSO_3^-(aq) \rightleftharpoons H^+(aq) + SO_3^{2-}(aq)$ ($K_{a2} = 6.4 \times 10^{-8}$)

-- Usually, K_{a2} is at least 1000X smaller than K_{a1}. In such cases, one can calculate [H^+]and pH based only on K_{a1} (i.e., ignore K_{a2} and pretend you have a monoprotic acid).

Monoprotic versus Polyprotic acids

- **MONOPROTIC** with a single H^+ ion to donate.

In general, acids with more than one H^+ ion availible to be donated are called **POLYPROTIC** acids

- **DIPROTIC** acids have two H^+ ions which it can donate.
  - e.g. H_2SO_4 and H_2CO_3

- **TRIPROTIC** acids have three H^+ ions which it can donate.
  - e.g. H_3PO_4

Polyprotic acids undergo a **stepwise-dissociation** in water, in which one H^+ ion is lost at a time.

EX. Find the pH of a 0.0037 M carbonic acid solution. ($K_{a1} = 4.3 \times 10^{-7}$, $K_{a2} = 5.6 \times 10^{-11}$)