Acids & Bases

Part 2

Acid & Base Ionization Constants

- A weak acid or base produces a reaction that only partially goes forward.
- The acid or base ionization constant measures the degree of ionization (or the strength)
- **The smaller the Ka, the weaker the acid**
- **The smaller the Kb, the weaker the base**
- $K_{eq} = \frac{[products]}{[reactants]}$
- $1 \times 10^{-14} = K_a \times K_b$

Acid & Base Ionization Constants

- Write the Ka expressions for the following reactions:
- $HClO_2 + H_2O \leftrightarrow H_3O^+ + ClO_2^-$

- $HIO + H_2O \leftrightarrow H_3O^+ + IO^-$

Acid & Base Ionization Constants

- Write the Kb expression for CH_3NH_2

Common K_a Values

(You may need this for some of the homework problems!)

TABLE 14.2 Values of K_a for Some Common Monoprotic Acids

Formula	Name	Value of K_a*
HSO_4^-	Hydrogen sulfate ion	1.2×10^{-2}
$HClO_2$	Chlorous acid	1.2×10^{-2}
$HC_2H_2ClO_2$	Monochloracetic acid	1.35×10^{-3}
HF	Hydrofluoric acid	7.2×10^{-4}
HNO_2	Nitrous acid	4.0×10^{-4}
$HC_2H_3O_2$	Acetic acid	1.8×10^{-5}
$[Al(H_2O)_6]^{3+}$	Hydrated aluminum(III) ion	1.4×10^{-5}
$HOCl$	Hypochlorous acid	3.5×10^{-8}
HCN	Hydrocyanic acid	6.2×10^{-10}
NH_4^+	Ammonium ion	5.6×10^{-10}
HOC_6H_5	Phenol	1.6×10^{-10}

↑ Increasing acid strength

*The units of K_a are customarily omitted.

Using pH to Calculate Ka

- Suppose you measure the pH of a 0.100 M solution of HCOOH (formic acid) and found it to be 2.38. Calculate the K_a.

Using pH to Calculate Ka

$HCOOH + H_2O \leftrightarrow COOH^- + H_3O^+$

I				
C				
E				

Using pH to Calculate Ka

- Calculate the K_a of a 0.220 M solution of H_3AsO_4 with a pH of 1.50. Calculate the pK_a

% Ionization

- A 0.10 M solution of a weak acid (HX) is 17.5% ionized. Calculate K_a.

% Ionization

- $HX + H_20 \leftrightarrow X^- + H_30^+$

I				
C				
E				

Another Example

- A sample of a weak acid HX has a pH of 3.5. If the $K_a = 2.7 \times 10^{-5}$, calculate the initial concentration of HX.

Another Example

- $HX + H_20 \leftrightarrow X^- + H_30^+$

I				
C				
E				

More Examples

- What is the pH of a 25 ml sample of 0.25 M $HC_2H_3O_2$? $K_a = 1.8 \times 10^{-5}$
- pH = 2.676

Example

- What is the % dissociation of a 0.325 M solution of HCOOH? Ka = 1.8×10^{-4}

Weak Mixtures

- Calculate the pH of a solution that contains 1.00 M HCN & 5.00 M HNO_2. Also calculate the $[CN^-]$ at equilibrium. $K_{a\ HCN} = 6.2 \times 10^{-10}$ & $K_{a\ HNO2} = 4.0 \times 10^{-4}$

Weak Mixtures

- $HNO_2 \rightarrow H^+ + NO_2^-$

I			
C			
E			

Weak Mixtures

- Part 2 of question… Also calculate the $[CN^-]$ at equilibrium.
- $HCN \rightarrow H^+ + CN^-$

I			
C			
E			

Another example

- What is the pH when 25 ml of 0.25 M HNO_3 is mixed with 25 ml of 0.25 M HNO_2 (K_a HNO_2 = 4.0×10^{-4})

Example

- What is the pH of a 0.25 M solution of NH_3. $K_{b\ NH3} = 1.8 \times 10^{-5}$

One more example

- What is the pH of a mixture of 25 ml of a 0.25M KOH solution & 25 ml of 0.25 M CH_3NH_2?