

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 K_a , the weaker the acid**
- **The smaller the K_b , the weaker the base**
- $K_{eq} = \frac{[\text{products}]}{[\text{reactants}]}$
- $1 \times 10^{-14} = K_a \times K_b$

Acid & Base Ionization Constants

- Write the K_a expressions for the following reactions:
- $\text{HClO}_2 + \text{H}_2\text{O} \leftrightarrow \text{H}_3\text{O}^+ + \text{ClO}_2^-$

- $\text{HIO} + \text{H}_2\text{O} \leftrightarrow \text{H}_3\text{O}^+ + \text{IO}^-$

Acid & Base Ionization Constants

- Write the K_b 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}
$\text{HC}_2\text{H}_2\text{ClO}_2$	Monochloroacetic acid	1.35×10^{-3}
HF	Hydrofluoric acid	7.2×10^{-4}
HNO_2	Nitrous acid	4.0×10^{-4}
$\text{HC}_2\text{H}_3\text{O}_2$	Acetic acid	1.8×10^{-5}
$[\text{Al}(\text{H}_2\text{O})_6]^{3+}$	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}

*The units of K_a are customarily omitted.

Increasing acid strength

Using pH to Calculate K_a

- 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 K_a



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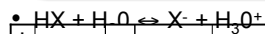
Using pH to Calculate K_a

- Calculate the K_a of a 0.220 M solution of H_3AsO_4 with a pH of 1.50. Calculate the $\text{p}K_a$

% Ionization

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

% Ionization

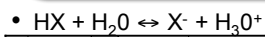


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Another Example

- 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



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More Examples

- What is the pH of a 25 ml sample of 0.25 M $\text{HC}_2\text{H}_3\text{O}_2$? $K_a = 1.8 \times 10^{-5}$
- pH = 2.676

Example

- What is the % dissociation of a 0.325 M solution of HCOOH ? $K_a = 1.8 \times 10^{-4}$

Weak Mixtures

- Calculate the pH of a solution that contains 1.00 M HCN & 5.00 M HNO_2 . Also calculate the $[\text{CN}^-]$ at equilibrium. $K_{a \text{ HCN}} = 6.2 \times 10^{-10}$ & $K_{a \text{ HNO}_2} = 4.0 \times 10^{-4}$

Weak Mixtures

- $\text{HNO}_2 \rightarrow \text{H}^+ + \text{NO}_2^-$

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Weak Mixtures

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

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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 ($K_a \text{HNO}_2 = 4.0 \times 10^{-4}$)

Example

- What is the pH of a 0.25 M solution of NH_3 .
 $K_b \text{NH}_3 = 1.8 \times 10^{-5}$

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 ?