

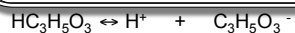
Acids & Bases

Calculating K_a from %
Dissociation
Polyprotic Acids
Properties of Salts

Example

- Lactic acid ($\text{HC}_3\text{H}_5\text{O}_3$) is a waste product that accumulates in the muscle during exertion, leading to pain & a feeling of fatigue. A 0.100 M solution is 3.7% dissociated. Calculate K_a .

Example



| | | | |
|---|--|--|--|
| I | | | |
| C | | | |
| E | | | |

Polyprotic Acids

- More than one ionizable H^+
- H^+ come off one at a time
- Each one has a specific K_a value
- $K_{a1} \gg \gg K_{a2} \gg K_{a3}$
- When calculating the pH of a polyprotic acid, you only use the 1st K_a because all of the others are so small

Complete Ionization

- Write the steps for the complete ionization of H₂Se

Complete Ionization

- Write the steps for the complete ionization of H₃AsO

Example

- Calculate the pH & the [] of all species of a 3.0 M solution of H₃PO₄.
- $K_{a1} = 7.5 \times 10^{-3}$, $K_{a2} = 6.2 \times 10^{-8}$, $K_{a3} = 4.8 \times 10^{-13}$

Example



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Example



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Example



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Example

- pH =
- $[\text{H}_3\text{PO}_4]$ =
- $[\text{H}_2\text{PO}_4^-]$ =
- $[\text{HPO}_4^{2-}]$ =
- $[\text{PO}_4^{3-}]$ =
- $[\text{H}^+]$ =

Acid Base Properties of Salts

- Salts of weak acids produce basic solutions
- $\text{NaC}_2\text{H}_3\text{O}_2$

Acid Base Properties of Salts

- Salts of weak bases produce acidic solutions
- NH_4Cl

Acid Base Properties of Salts

- Salts of strong acids & Bases produce neutral solutions
- NaCl

Calculations with salts

- $K_a \times K_b = K_w$
- Can find K_a or K_b with this equation
- On AP formula sheet

Example

- What is the pH if a 0.140M solution of $\text{NaC}_2\text{H}_3\text{O}_2$ ($K_a \text{ HC}_2\text{H}_3\text{O}_2 = 1.8 \times 10^{-5}$)

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Another example

- What is the pH of a 0.140M solution of diethylaminochloride $(C_2H_5)_2NH_3Cl$.
- $K_b (C_2H_5)_2NH_3^+ = 1.3 \times 10^{-3}$
- $(C_2H_5)_2NH_3Cl \rightarrow (C_2H_5)_2NH_3^+ + Cl^-$
- $(C_2H_5)_2NH_3^+ + H_2O \rightarrow (C_2H_5)_2NH_2 + H_3O^+$

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Qualitative Predictions of pH

- $K_a > K_b \rightarrow$ acidic
- $K_b > K_a \rightarrow$ basic
- $K_a = K_b \rightarrow$ neutral

pH Predictions

- Predict if an aqueous solution of the following are acidic, basic, or neutral
- $NH_4C_2H_3O_2$
- $K_b NH_4^+ = 1.8 \times 10^{-5}$
- $K_a HC_2H_3O_2 = 1.8 \times 10^{-5}$

pH Predictions

- Predict if an aqueous solution of the following are acidic, basic, or neutral
- NH_4CN
- $K_b NH_4^+ = 1.8 \times 10^{-5}$
- $K_a HCN = 6.2 \times 10^{-10}$

Effect of Structure of Acid Base Properties

TABLE 14.7 Bond Strengths and Acid Strengths for Hydrogen Halides

| H—X Bond | Bond Strength (kJ/mol) | Acid Strength in Water |
|----------|------------------------|------------------------|
| H—F | 565 | Weak |
| H—Cl | 427 | Strong |
| H—Br | 363 | Strong |
| H—I | 295 | Strong |

- Weak acid (HF)
 - Stays together
- Strong acids
 - Look at electronegativity

Effect of Structure of Acid Base Properties

TABLE 14.8 Several Series of Oxyacids and Their K_a Values

| Oxyacid | Structure | K_a Value |
|-------------------|---|-----------------------|
| HClO ₄ | $\begin{array}{c} \text{O} \\ \\ \text{H}-\text{O}-\text{Cl}-\text{O} \\ \\ \text{O} \end{array}$ | Large ($\sim 10^7$) |
| HClO ₃ | $\begin{array}{c} \text{O} \\ \\ \text{H}-\text{O}-\text{Cl} \\ \\ \text{O} \end{array}$ | ~ 1 |
| HClO ₂ | H—O—Cl—O | 1.2×10^{-2} |
| HClO | H—O—Cl | 3.5×10^{-8} |