

4.14 Ka Calculations

Weak acids : ionize in water , producing $[H_3O^+]$

near top of table

large $K_a = [H_3O^+]$ high

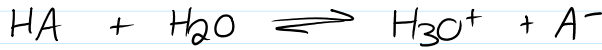
favours products : more acid } pH 3-4
↑
ionizes

near bottom

small $K_a = [H_3O^+]$ low

favour reactants : less acid
↓
ionizes

→ pH = 12-13

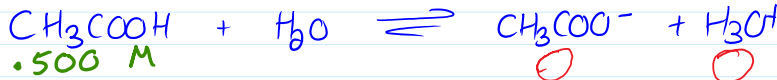


$$K_a = \frac{[H_3O^+][A^-]}{[HA]} = \frac{[products]}{[reactants]}$$

Given 2 ... Find 3rd

- $[HA]$ for weak acid
- K_a
- $[H_3O^+]$ or pH of solⁿ after it ionizes in water
↳ or both

Example #1 If $K_a = 1.85 \times 10^{-5}$ for CH_3COOH , what is the pH of a 0.500M solⁿ of CH_3COOH ?



I
A
Eg

* zero at start b/c CH_3COOH does not ionize until it mixes with water

If use this it requires a quadratic eqⁿ to solve

To simply : assume weak acid is sufficiently weak that the amount which ionizes (x) is insignificant compared to original 0.5M

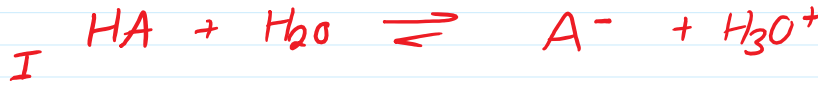
assume $.500 - x \approx .500\text{ M}$ "state" your assumption,

% Dissociation

- this is a way to check if assumption that $.500-x \cong .500$ was accurate
- accurate if % dissociation was $< 5\%$

$$= \frac{x}{\text{Initial}} \times 100\% = \frac{3.04 \times 10^{-3}}{.500} \times 100\% = .608\% \rightarrow \text{assumption ok!}$$

Example #2 If $\text{pH} = 1.70$ for a $.100\text{M}$ soln of HA , what is K_a ?



C

E

don't "assume"
you have
#s do the
math!

$$K_a = \frac{[\text{A}^-][\text{H}_3\text{O}^+]}{[\text{HA}]}$$

$K_a =$

Have pH
so know
[H_3O^+] at end)

$$\text{pH} = -\log [\text{H}_3\text{O}^+]$$

$$1.7 = -\log [\text{H}_3\text{O}^+]$$

=

Example #3 what mass of NH_4Cl will produce 1.5L of soln having a pH of 4.75 ?
 \rightarrow Do last after finding M

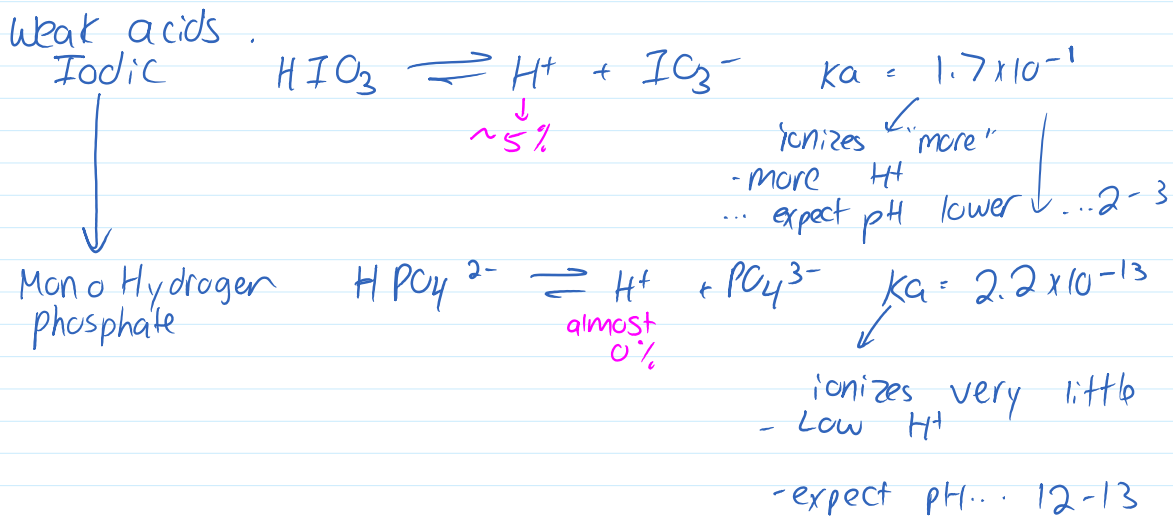
What is K_a ?

- a measure of how much a weak acid ionizes
- Strong acids ionize 100%, so K_a = very large



↳ high $[\text{H}^+]$ of H^+ = large K_a
also low pH (very acidic)

Weak acids .



All weak acids ionize less than 5-7%