

16.6 Weak Acids

Most acid substances are weak acids

↳ partially ionize



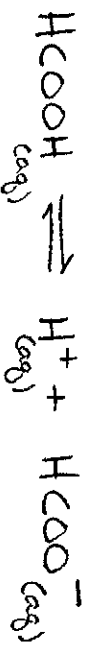
$$K_c = \frac{[\text{H}^+][\text{A}^-]}{[\text{HA}]} = K_a \leftarrow \begin{array}{l} \text{acid-dissociation} \\ \text{constant} \end{array}$$

The larger the value for $K_a \rightarrow$ the stronger the acid

Calculating K_a from pH

A student prepared a .10 M solution of HCOOH and found its pH @ 25°C to be 2.38

Calculate K_a

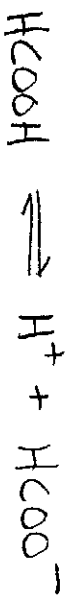


$$K_a = \frac{[\text{H}^+][\text{HCOO}^-]}{[\text{HCOOH}]}$$

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

$$2.38 = -\log [\text{H}^+]$$

$$[\text{H}^+] = 10^{-2.38} = 4.2 \times 10^{-3} \text{ M}$$



.10	0	0
-4.2×10^{-3}	$+4.2 \times 10^{-3}$	$+4.2 \times 10^{-3}$
.10 M	4.2×10^{-3}	4.2×10^{-3}

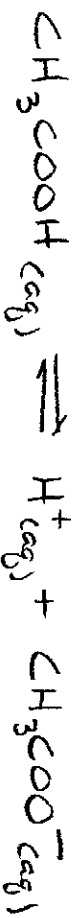
$$K_a = \frac{(4.2 \times 10^{-3})(4.2 \times 10^{-3})}{.10} = 1.8 \times 10^{-4}$$

Percent Ionization:

$$\begin{aligned} \% \text{ Ionization} &= \frac{\text{concentration ionized}}{\text{original ionized}} \times 100\% \\ &= \frac{[\text{H}^+]_{\text{equilibrium}}}{[\text{HA}]_{\text{initial}}} \times 100\% \end{aligned}$$

Using K_a to calculate pH

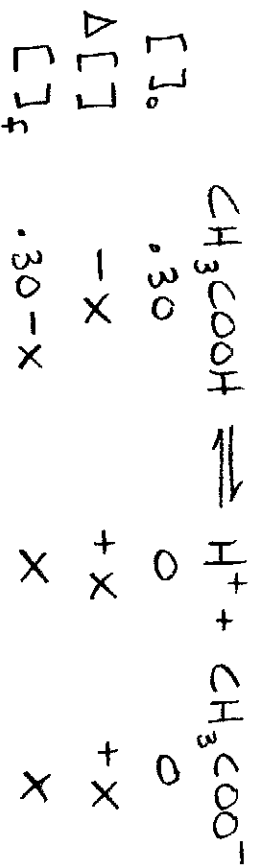
1. Write ionization equilibrium:



2. Write equil exp: find the value in a table

$$K_a = \frac{[\text{H}^+][\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]} = 1.8 \times 10^{-5}$$

3. Use I.C.E. table:



4. Substitute and solve for X:

$$1.8 \times 10^{-5} = \frac{X \cdot X}{.30 - X}$$

Assume X is small so $.30 - X \approx .30$

$$1.8 \times 10^{-5} = \frac{X^2}{.30}$$

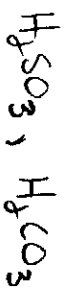
$$X = 2.3 \times 10^{-3} = [\text{H}^+]$$

$$\text{pH} = -\log 2.3 \times 10^{-3} = 2.64$$

✓ using % ionization = $\frac{.0023}{.030} \times 100\% = .77\%$
if % ionization > 5% use quadratic formula.

Polyprotic Acids

↳ acids with more than one ionizable H⁺



Note: Always easier to remove the first proton

16.7 Weak Bases



$$K_b = \frac{[\text{HB}^+][\text{OH}^-]}{[\text{B}]}$$

(base-dissociation constant)

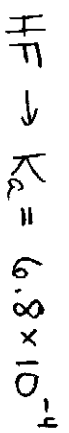
Types of Bases:

- 1 Neutral substance with a non-bonding pair of electrons that can accept a proton (Amines → nitrogen atom with non-bonding pair)
2. Anions of weak acids

16.8 Relationship between K_a & K_b

$$K_a \times K_b = K_w \quad pK_a + pK_b = pK_w = 14.00$$

Calculate K_b for F^-



$$\text{So } K_b = \frac{K_w}{K_a} = \frac{1.0 \times 10^{-14}}{6.8 \times 10^{-4}} = 1.5 \times 10^{-11}$$

Try Practice Exercise on 681