

#17.32, p 727

Find the pH and the degree of ionization for an 0.10 M solution of formic acid: HCHO_2

$$K_a = 1.7 \times 10^{-4}$$



$$K_a = 1.7 \times 10^{-4} = \frac{[\text{CHO}_2^-][\text{H}_3\text{O}^+]}{[\text{HCHO}_2]}$$

	Initial	Change	Equilibrium
$[\text{CHO}_2^-]$	0	+x	x
$[\text{H}_3\text{O}^+]$	0	+x	x
$[\text{HCHO}_2]$	0.10	-x	0.10 - x

After writing the equation for acid dissociation and the equilibrium expression, we write all concentrations in terms of one variable ... x

$$1.7 \times 10^{-4} = \frac{x^2}{0.10 - x}$$

$$1.7 \times 10^{-4} = \frac{x}{0.10 - x}$$

Assume x is much smaller than 0.10 ... so that
 $0.10 - x = 0.10$

$$\downarrow$$
$$1.7 \times 10^{-4} = \frac{x^2}{0.10}$$

$$[H_3O^+] = x = 0.004123 \quad x \text{ IS much smaller than } 0.10$$

$$pH = -\log(0.004123) = 2.38 = pH$$

Degree of ionization? DEGREE OF IONIZATION is the fraction of a weak electrolyte (acid or base) that dissociates in water.

$$\frac{[CHO_2^-]}{[HCHO_2]} = \frac{[H_3O^+]}{[HCHO_2]} = \frac{0.004123}{0.10} \approx 0.041 = DOI$$

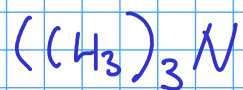
Sometimes, we express degree of ionization as a percent ... PERCENT IONIZATION

$$\% = DOI \times 100\% = 4.1\% \text{ dissociated}$$

... so about 96% of this acid is present as UNDISSOCIATED molecules!

#17, 46, p 728

An aqueous solution of 0.25 M trimethylamine has a pH of 11.63. What's the value of K_b ?



$$K_b = \frac{[(\text{CH}_3)_3\text{NH}^+][\text{OH}^-]}{[(\text{CH}_3)_3\text{N}]}$$

	Initial	Change	Equilibrium
$[(\text{CH}_3)_3\text{NH}^+]$	0	+ x	x
$[\text{OH}^-]$	0	+ x	x
$[(\text{CH}_3)_3\text{N}]$	0.25	- x	0.25 - x

$$\frac{x^2}{0.25 - x} = K_b$$

For this problem, we need to first solve for x in order to find K_b . Use pH to find pOH, then use pOH to find $[\text{OH}^-]$... which equals x.

$$\frac{x^2}{0.25-x} = K_b$$

$$\text{pH} = 11,63$$

$$\text{pOH} = 14,00 - 11,63 = 2,37$$

$$x = [\text{OH}^-] = 10^{-2,37} = 4,265795 \times 10^{-3}$$

$$K_b = \frac{(4,265795 \times 10^{-3})^2}{0,25 - (4,265795 \times 10^{-3})} = 7,4 \times 10^{-5}$$