Ka and % Ionization Problems

Example- A 0.50 mol/L solution of HCOOH has a K_a of 1.8×10^{-4}. Calculate % ionization.

$HCOOH + H_2O \rightleftharpoons H_3O^+ + HCOO^-$

	HCOOH		H_3O^+	$HCOO^-$
I	0.50		0	0
C	$-x$		$+x$	$+x$
E	$0.50-x$		x	$+x$

$K_a = \frac{[H_3O^+][HCOO^-]}{[HCOOH]}$

$1.8\times10^{-4} = \frac{x\cdot x}{0.50-x}$ (x is small)

$\sqrt{(1.8\times10^{-4})(0.50)} = \sqrt{x^2}$

$9.5\times10^{-3}\ mol/L = x = [H_3O^+]$

% ionization $= \frac{[H_3O^+]}{[HCOOH]} \times 100\%$

$= \frac{9.5\times10^{-3}}{0.500} \times 100\%$

$= 1.9\%$

Worksheet # 1,3,4,8

pH-Definition and Calculations

pH: 0 acid — 7 neutral — 14 base

Definition- "p" means $-\log(\ )$

pH means $-\log([H_3O^+])$

examples- $\log 100 = 2$ because $10^2 = 100$

$\log 10 = 1$ " $10^1 = 10$

$\log 1 = 0$ " $10^0 = 1$

$\log 0.1 = -1$ " $10^{-1} = 0.1$

2. Change $[H_3O^+] \rightarrow$ pH

a) $[H_3O^+] = 1.0\times10^{-7}$ $pH = -\log(1.0\times10^{-7}) = 7.0$

b) $[H_3O^+] = 3.3\times10^{-2}$ $pH = -(-1.5) = 1.5$

3. Change pH $\rightarrow [H_3O^+]$

a) $8.1 = -\log[H_3O^+]$

$10^{-8.1} = \log[H_3O^+]$

$7.9\times10^{-9} = [H_3O^+]$

pH and Ka Calculations

Example- Find the pH of 0.45 mol/L HF ($K_a = 6.6\times10^{-4}$)

$HF + H_2O \rightleftharpoons H_3O^+ + F^-$

	HF		H_3O^+	F^-
I	0.45		0	0
C	$-x$		$+x$	$+x$
E	$0.45-x$		x	x

$K_a = \frac{[H_3O^+][F^-]}{[HF]}$

$6.6\times10^{-4} = \frac{x\cdot x}{0.45-x}$ assume...

$(0.45)(6.6\times10^{-4}) = x^2$

$\sqrt{2.97\times10^{-4}} = \sqrt{x^2}$

$1.7\times10^{-2} = x = [H_3O^+]$

$pH = -\log(1.7\times10^{-2})$

$= 1.8$

Worksheet - #2,7,5

Text p.591 #5,7