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WEAK ACID + H_2O ⇒ HYDROLYSIS REACTION

$HA \rightleftharpoons H^+ + A^-$ $\quad HA + H_2O \rightleftharpoons H_3O^+ + A^-$

① given pH, $[HA]_i$ ⇒ Calculate Ka

② given Ka, $[HA]_i$ ⇒ Calculate $[H^+]$, $[A^-]$, pH

③ % ionization $= \frac{[H^+]}{[HA]_i} \times 100\%$

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① A 0.025M solution of lactic acid, $HC_3H_5O_3$, has a pH of 2.7. What is the Ka of lactic acid? What is the percent ionization?

$$HC_3H_5O_3 \rightleftharpoons H^+ + C_3H_5O_3^-$$

0.025	0	0
−0.002	+0.002	+0.002
0.023	0.002	0.002

$[H^+] = 10^{-pH}$
$= 10^{-2.7}$
$[H^+] = 0.002M$

$$Ka = \frac{(0.002)(0.002)}{0.023} = 1.7 \times 10^{-4}$$

$$\% \text{ ionization} = \frac{[H^+]}{[HC_3H_5O_3]_i} \times 100\%$$

$$= \frac{0.002}{0.025} \times 100\% = 8\% \text{ ionized}$$

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	$HC_3H_5O_3$	$\rightleftharpoons$	H^+	+	$C_3H_5O_3^-$
	0.025		0		0
	−0.002		+0.002		+0.002
	0.023		0.002		0.002

$[H^+] = 10^{-pH}$
$= 10^{-2.7}$
$[H^+] = 0.002M$

$$K_a = \frac{(0.002)(0.002)}{0.023} = 1.7 \times 10^{-4}$$

$$\%\text{ionization} = \frac{[H^+]}{[HC_3H_5O_3]_i} \times 100\%$$

$$= \frac{0.002}{0.025} \times 100\% = 8\% \text{ ionized}$$

The K_a of niacin, also known as nicotinic acid, $HC_6H_4NO_2$, is 1.4×10^{-5}. What is the pH of a 0.1M solution of niacin?

$HA \rightleftharpoons$	H^+	+ A^-
0.1M	0.0	0.0
$-x$	$+x$	$+x$
$0.1-x$	x	x
≈ 0.1		

$$K_a = \frac{x^2}{0.1} = 1.4\times10^{-5}$$

$$x = 0.0012\,M = [H^+] = [A^-]$$

$$pH = -\log[H^+]$$
$$= 2.92$$

Cyanic acid, HOCN, has a $K_a = 3.5\times10^{-4}$. If a solution of HOCN has a pH of 2.4, what is the initial molarity of the acid?

$HOCN \rightleftharpoons$	H^+	+ OCN^-
x	0.0	0.0
-0.004		
$x-0.004$	0.004	0.004

$$[H^+] = 10^{-pH}$$
$$= 10^{-2.4}$$
$$[H^+] = 0.004\,M$$

$$K_a = 3.5\times10^{-4} = \frac{(0.004)^2}{(x-0.004)}$$

$$x = 0.050\,M$$

A 0.03M solution of pyruvic acid, $HC_3H_3O_3$, is 6.6% ionized. What is the Ka of pyruvic acid?

$$\%\text{ionization} = \frac{[H^+]}{[HA]_i} \times 100\%$$

$$6.6 = \frac{[H^+]}{0.03} \times 100$$

$$[H^+] = 0.002M$$

	HA	$\rightleftharpoons$	H^+	$+$	A^-
	0.03		0		0
	-0.002				
	0.028		0.002		0.002

$$K_a = \frac{(0.002)^2}{0.028} = 1.4 \times 10^{-4}$$