$$\frac{x^2}{2.55-x} = 1.8\times10^{-5}$$

$$x^2 = 1.8\times10^{-5}(2.55-x)$$

$$x^2 = 4.59\times10^{-5} - 1.8\times10^{-5}x$$

$$x^2 + 1.8\times10^{-5}x - 4.59\times10^{-5} = 0$$

$$ax^2 + bx + c = 0$$

$$a = 1 \quad b = 1.8\times10^{-5}$$

$$c = -4.59\times10^{-5}$$

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

$$x = \frac{-1.8\times10^{-5} + \sqrt{(1.8\times10^{-5})^2 - 4(1)(-4.59\times10^{-5})}}{2(1)}$$

$$= 6.77\times10^{-3} = [H_3O^+]$$

$$\frac{x^2}{2.55 - x} = 1.8 \times 10^{-5}$$

$$HC_2H_3O_2(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + C_2H_3O_2^-(aq)$$

$x << 2.55$

$2.55 - x \approx 2.55$

$$\frac{x^2}{2.55} = 1.8 \times 10^{-5}$$

$$x^2 = 2.55(1.8 \times 10^{-5})$$

$$x^2 = 4.59 \times 10^{-5}$$

$$x = \sqrt{4.59 \times 10^{-5}}$$

$$x = 6.77 \times 10^{-3}$$

$$HA(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + A^-(aq)$$

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

	[HA]	$[H_3O^+]$	$[A^-]$
I	C	~0	0
C	$-X$	$+X$	$+X$
E	$C-X$	X	X

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

$$= \frac{(X)(X)}{C-X} = K_a$$

$$\frac{X^2}{C-X} = K_a$$

$$X^2 = K_a(C-X)$$

$$X^2 = K_aC - K_aX$$

$$X^2 + K_aX - K_aC = 0$$

$$X = \frac{-K_a + \sqrt{K_a^2 - 4(1)(-K_aC)}}{2(1)}$$

$$X = \frac{-K_a + \sqrt{K_a^2 + 4K_aC}}{2}$$

$$\frac{x^2}{c-x} = K_a$$

$$x << c$$

$$c - x \approx c$$

$$\frac{x^2}{c} = K_a$$

$$x^2 = c \cdot K_a$$

$$x = \sqrt{c \cdot K_a} = [H_3O^+]$$

$$[OH^-] = \frac{K_w}{[H_3O^+]} = \frac{1.0 \times 10^{-14}}{x}$$

$$B(aq) + H_2O(l) \rightleftharpoons BH^+(aq) + OH^-(aq)$$

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

	[B]	[BH^+]	[OH^-]
I	C	0	~0
C	$-x$	$+x$	$+x$
E	$C-x$	x	x

$$K_b = \frac{[BH^+][OH^-]}{[B]} \approx \frac{(x)(x)}{C-x} = \frac{x^2}{C-x}$$

$$\frac{x^2}{C-x} \approx K_b$$

$$x^2 \approx K_b C - K_b x$$

$$x^2 + K_b x - K_b C = 0$$

$$x \approx \frac{-K_b + \sqrt{K_b^2 + 4K_b C}}{2}$$

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

$$x << c$$

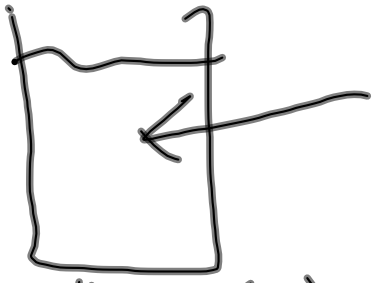
$$c - x \approx c$$

$$\frac{x^2}{c} \approx K_b$$

$$x^2 \approx c \cdot K_b$$

$$x \approx \sqrt{c \cdot K_b} \approx [OH^-]$$

HYDROLYSIS OF SALTS



$NH_4Cl(s) \xrightarrow{H_2O} NH_4^+(aq) + Cl^-(aq)$

$Cl^-(aq) + H_2O(l) \rightarrow N.R.$

$NH_4^+(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + NH_3(aq)$

$$K_a = \frac{[H_3O^+][NH_3]}{[NH_4^+]}$$

$NH_3(aq) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq) \quad K_b$

$2H_2O(l) \rightleftharpoons H_3O^+(aq) + OH^-(aq) \quad K_w$

$NH_4^+(aq) + OH^-(aq) \rightleftharpoons NH_3(aq) + H_2O(l) \quad \frac{1}{K_b}$

$NH_4^+(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + NH_3(aq) \quad K_w \cdot \frac{1}{K_b}$

$$K_a = \frac{K_w}{K_b} \rightarrow \boxed{K_a \cdot K_b = K_w}$$

For conjugates

$$K_a = \frac{K_w}{K_b}$$

$$NH_4^+(aq) + H_2O(\ell) \rightleftarrows H_3O^+(aq) + NH_3$$

I	C	—	~0	0
C	−x	—	+x	+x
E	C−x	—	x	x

$$[H_3O^+] = \sqrt{C \cdot K_a}$$