$$\frac{-1.8\times10^{-5}+\sqrt{(1.8\times10^{-5})^2-4(1)(-5.184\times10^{-5}}}{2(1)}$$

$$= 7.19\times10^{-3} = x = [H_3O^+]$$

$$[OH^-] = \frac{K_w}{[H_3O^+]} = \frac{1.0\times10^{-14}}{7.19\times10^{-3}} = 1.39\times10^{-12}\ M$$

$$pH = -\log[H_3O^+] = -\log(7.19\times10^{-3})$$

$$= 2.14$$

$$pOH = -\log[OH^-] = -\log(1.39\times10^{-12})$$

$$= 11.86$$

$$2.14 + 11.86 = 14.00$$

$$\frac{x^2}{2.88 - x} = 1.8 \times 10^{-5}$$

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

$$x << 2.88$$

$$2.88 - x \approx 2.88$$

$$\frac{x^2}{2.88} = 1.8 \times 10^{-5}$$

$$x^2 = 5.184 \times 10^{-5}$$

$$x = 7.2 \times 10^{-3}$$

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

$$K_a = \frac{[H_3O^+][A^-]}{[HA]} = \frac{x^2}{c-x} = K_a$$

	HA	H_3O^+	A^-
I	c	~0	0
C	−x	+x	+x
E	c−x	x	x

$$x << c \rightarrow c - x \approx c$$

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

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

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

$$NH_3(aq) + H_2O(l) \rightleftarrows NH_4^+(aq) + OH^-(aq)$$

$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]}$$

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

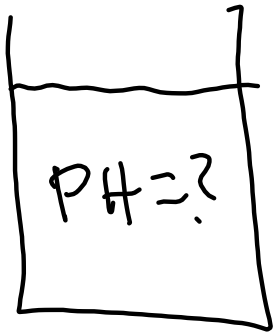
$$K_b = \frac{[BH^+][OH^-]}{[B]} = \frac{x^2}{c-x} = K_b$$

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

$$x \ll c \rightarrow c - x \simeq c$$

$$\frac{x^2}{c} = K_b \rightarrow x^2 = K_b \cdot c$$

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



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

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

0.50 M NH_4Cl

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

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

$[NH_4^+]$	$[H_3O^+]$	$[NH_3]$
0.50	~0	0
$-x$	$+x$	$+x$
$0.50-x$	x	x

$$\frac{x^2}{.50} = K_a \rightarrow x = \sqrt{K_a(0.50)}$$

For acid/base conjugate pairs

$$K_a \cdot K_b = K_w$$

$$K_a = \frac{K_w}{K_b} = \frac{1.0 \times 10^{-14}}{1.8 \times 10^{-5}}$$

$$= 5.6 \times 10^{-10}$$

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

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

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

$$\cancel{2}\,H_2O(l) \rightleftarrows H_3O^+(aq) + \cancel{OH^-(aq)} \quad K_w$$

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