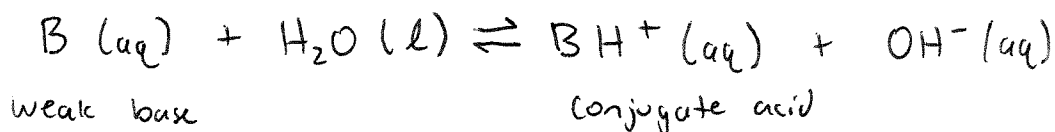


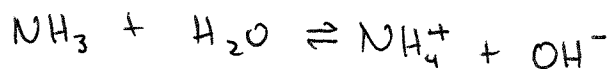
Weak Bases (WB)

- Like WA, WB have an equilibrium constant called the base dissociation constant, K_b
- Equilibrium calculations work the same as for acids, using the base dissociation constant instead



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

What is the pH of 0.15 M NH_3 @ 25°C?



$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]} = 1.8 \times 10^{-5}$$

	$NH_3(M)$	$NH_4^+(M)$	$OH^-(M)$
I	0.15	0	0
C	-x	+x	+x
E	0.15-x	x	x

$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]} = \frac{x^2}{0.15-x} = 1.8 \times 10^{-5}$$

If we assume that $x \ll 0.15$, then $0.15 - x = 0.15$

$$\text{Then: } 1.8 \times 10^{-5} = \frac{x^2}{0.15} \quad x = 1.6 \times 10^{-3}$$

(2)

Daily dose of quinine for malarial prevention is 2100mg. What is pH of a gin and tonic that contains one dose of quinine in 100 mL?

$$2.1 \text{ g} \times \frac{1 \text{ mol}}{324 \text{ g}} = 6.48 \times 10^{-3} \text{ mol}$$

$$= 6.48 \times 10^{-2} \text{ M}$$

$$pK_{b1} = 5.1 \quad pK_{b2} = 9.7$$

$$K_b = \frac{[BH^+][OH^-]}{[B]} = \frac{x^2}{0.0648 - x} = 7.9 \times 10^{-6}$$

Assume that $x \ll 0.0648$, then $0.0648 - x \approx 0.0648$

$$\text{so: } 7.9 \times 10^{-6} = \frac{x^2}{0.0648}, \quad x = 7.15 \times 10^{-4}$$

• x is $[OH^-]$, so $-\log(x)$ is pOH ($pOH = 3.15$)

$$\bullet \text{ pH} = 14 - pOH = 10.85$$

Solution of NH_3 has $pH = 11.30$. What is its concentration? $K_b = 1.8 \times 10^{-5}$



	NH_3	NH_4^+	OH^-
I	y	0	0
C	-2.0×10^{-3}	$+2.0 \times 10^{-3}$	$+2.0 \times 10^{-3}$
E	$y - 2.0 \times 10^{-3}$	2.0×10^{-3}	2.0×10^{-3}

$$K_b = 1.8 \times 10^{-5} = \frac{[NH_4^+][OH^-]}{[NH_3]}$$

$$= \frac{(2.0 \times 10^{-3})^2}{y - 2.0 \times 10^{-3}}$$

$$\text{Assume: } \frac{(2.0 \times 10^{-3})^2}{y} = 1.8 \times 10^{-5}$$

$$y = 4.5 \text{ M}$$

$$pH = 11.30$$

$$pOH = 2.7$$

$$[OH^-] = 2.0 \times 10^{-3}$$

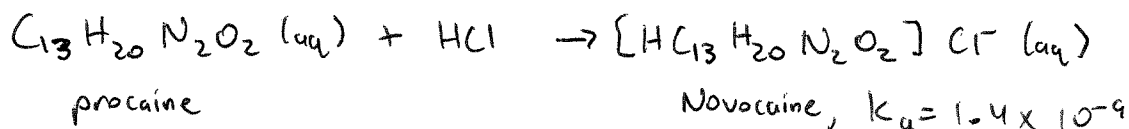
Relationship between K_b and K_a

- For conjugate acid-base pair,

$$K_a \times K_b = K_w$$

- Therefore, if you know one of them, you can calculate the other

Novocain is the hydrochloride salt of the base procaine.



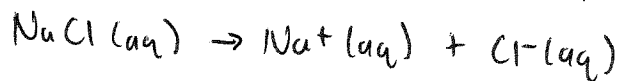
What is the pH of a 0.015M soln of procaine?

$$K_b = \frac{K_w}{K_a} = \frac{1.0 \times 10^{-14}}{1.4 \times 10^{-9}} = 7.14 \times 10^{-6}$$

Acid-Base Properties of Salt

- Most salts are strong electrolytes, producing ions in water
- Many ions react with H_2O to produce H^+ or OH^-
- A systematic analysis of a salt allows prediction of whether an aqueous solution will be acidic, basic, or neutral
 - The cation can be acidic or neutral
 - The anion can be acidic, basic, or neutral

In class question $\Rightarrow$ You dissolve NaCl in water. What is pH of the resulting soln?

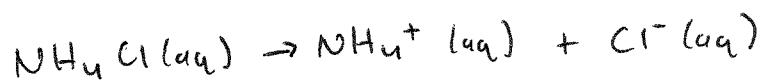


- Na^+ does not gain or accept H^+
- Cl^- does not gain or accept H^+

Neither ion has acid-base character; the pH = 7.0

In class question $\Rightarrow$ You dissolve NH_4Cl in water. What is pH of solution?

④



- NH_4^+ is the conjugate acid of NH_3 , a weak base
- Cl^- does not gain or accept H^+

NH_4^+ is a weak acid, so the $\text{pH} < 7.0$

Predicting Acid-Base Properties of Salt

- What ions are formed when the salt dissolves?
- Is the cation an acid?
 - Does it have H^+ to donate?
- Is the anion a base or an acid?
 - Can it accept H^+ ? (base)
 - Can it donate H^+ ? (acid)
- Compare K_a to K_b if necessary
 - Bigger equilibrium constant will dominate

- The anion from a monoprotic strong acid does not act as a base.

ie. Cl^- , Br^- , I^- , NO_3^- , ClO_3^- , ClO_4^-

- The cation from a strong base does not act as an acid

ie. Li^+ , Na^+ , K^+ , Ca^{2+} , Sr^{2+}

"Easy Cases"

<u>Cation</u>	<u>Anion</u>	<u>Type of solution</u>	<u>pH</u>
Weak Acid (NH_4^+ , Fe^{3+})	From a strong acid (Cl^- , NO_3^- , ClO_3^-)	Acidic	< 7.0
From a strong base (Na^+ , Ca^{2+})	Weak base (F^- , HCO_3^-)	Basic	> 7.0
From a strong base (Na^+ , Ca^{2+})	From a strong acid (Cl^- , NO_3^- , ClO_3^-)	Neutral	$= 7.0$