ex: CN^- (K_b) $K_b = ?$ 2.0×10^{-5}

HCN (K_a), $K_a = 4.9\times10^{-10}$ @25°C

$K_a \cdot K_b = K_w$ $\quad K_b = \frac{K_w}{K_a} = \frac{1.0\times10^{-14}}{4.9\times10^{-10}}$

$= 2.0\times10^{-5}$

NH_4^+, $K_a = ?$ 5.6×10^{-10}

NH_3, $K_b = 1.8\times10^{-5}$

$K_a \cdot K_b = K_w \Rightarrow K_a = \frac{K_w}{K_b} = \frac{1.0\times10^{-14}}{1.8\times10^{-5}}$

$= 5.6\times10^{-10}$

↑ constant

"weak" weak acid ~ "strong" weak base

↖ conjugate ↗

vice versa.

Acid-Base properties of salts

↳ ionic cpd.

weak acid	HA	A^- Anion
	ACIDIC	* BASIC *
weak base	B	BH^+ Cation
	BASIC	* ACIDIC *

anions ~ basic

Cations ~ acidic

easy way to remember

OH^- ~ BASIC

H^+/H_3O^+ ~ ACIDIC

But, consider STRONG acids + STRONG bases.

ex: $HCl \xrightarrow{100\%} H^+ + Cl^-$

acidic $\not\leftarrow$ ~~conj. base~~? neutral.

does not react w/ H^+!

⇒ Anions derived from STRONG acids are neutral.

⇒ Anions derived from weak acids are basic.

Strong Acids

6: $HCl \not\rightleftharpoons H^+ + Cl^-$ (neutral)

HBr — Br^-

HI — I^-

$HClO_4$ — ClO_4^-

HNO_3 — NO_3^-

H_2SO_4

neutral.

$H_2SO_4 \longrightarrow H^+ + HSO_4^-$

diprotic acid — ~~neutral~~

$HSO_4^- \overset{Ka}{\rightleftharpoons} H^+ + SO_4^{2-}$

⇒ weak acid

- anions from polyprotic acids that still have H^+ to donate are acidic!

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all cations are acidic, unless they come from a strong base, in which case they are neutral.

ex: $LiOH \xrightarrow{100\%} Li^+ + OH^-$ (neutral) ~~sbcd~~

$NaOH$ — Na^+

KOH — K^+

$RbOH$ — Rb^+

$CsOH$ — Cs^+

$Ba(OH)_2$ — Ba^{2+}

neutral.

CATIONS | ANIONS

acidic | basic

H^+ | OH^-

CATIONS from a strong base | ANIONS from a strong acid

neutral. | neutral

$Li^+, Na^+, K^+, Rb^+, Cs^+, Ba^{2+}$ | $Cl^-, Br^-, I^-, NO_3^-, ClO_4^-$

ex: $NH_4Cl(aq) \rightarrow NH_4^+(aq) + Cl^-(aq)$

ACIDIC — NH_4^+: acidic; Cl^-: neutral

ex: $LiF(aq) \rightarrow Li^+(aq) + F^-(aq)$

BASIC — Li^+: neutral; F^-: basic

ex: $Al(NO_2)_3(aq) \rightarrow Al^{3+}(aq) + 3NO_2^-(aq)$

Al^{3+}: acidic; NO_2^-: basic

??

ACIDIC if $K_a(Al^{3+}) > K_b(NO_2^-)$

BASIC if $K_b(NO_2^-) > K_a(Al^{3+})$

NEUTRAL if $K_a(Al^{3+}) = K_b(NO_2^-)$

What's the pH of 0.10M $NaNO_2(aq)$?

$NaNO_2(aq) \rightarrow Na^+(aq) + NO_2^-(aq)$

0.10M | 0.10M | 0.10M

neutral | basic

K_b ?

H^+

$NO_2^-(aq) + H_2O(l) \rightleftharpoons HNO_2(aq) + OH^-(aq)$

I	0.10M	—	0	≈0
C	−x	—	+x	+x
E	(0.10−x)	—	(x)	(x)

$K_b = \dfrac{[HNO_2][OH^-]}{[NO_2^-]_{eq}}$

~~$K_b(NO_2^-) = ?$~~

$K_a \cdot K_b = K_w$

HNO_2 ✓ NO_2^-

$2.2\times10^{-11} = \dfrac{(x)(x)}{0.10-x}$

$K_a(HNO_2) = 4.5 \times 10^{-4}$

$\Rightarrow K_b(NO_2^-) = \frac{K_w}{K_a} = 2.2 \times 10^{-11}$