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 $NaNO_2(aq)$?

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

0.10M → 0.10M (neutral) + 0.10M (basic)

H^+

K_b ?

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

	NO_2^-	H_2O	HNO_2	OH^-
I	0.10M	—	0	≈0
C	−x	—	+x	+x
E	(0.10−x)	—	(x)	(x)

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

$K_b(NO_2^-) = ?$

$K_a \cdot K_b = K_w$

HNO_2 NO_2^-

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

$K_a(HNO_2) = 4.5\times10^{-4}$

$\Rightarrow K_b(NO_2^-) = \frac{K_w}{K_a} = 2.2\times10^{-11}$

$$2.2\times10^{-11} = \frac{x^2}{0.10-x} \approx \frac{x^2}{0.10}$$

$\Rightarrow \sqrt{2.2\times10^{-11}\ 0.10} = \sqrt{x^2}$ if $x \ll 0.10$

$\Rightarrow x = 1.5\times10^{-6}$

$$\%\ \text{dissoc} = \frac{1.5\times10^{-6}}{0.10}\times 100$$

way < 5%.

$\Rightarrow x = 1.5\times10^{-6}$

$\Rightarrow [OH^-] = x = 1.5\times10^{-6}\,M$

pH? $pOH = -\log[OH^-] = 5.83$

@25°C $pH = 14.00 - pOH$

$= 8.17$

Comment: (I) E $[OH^-] \approx 0$ real: $1 \times 10^{-7} M$

prob: calculated $[OH^-] = 1.5 \times 10^{-6} M$

but ... if we actually include OH^- from H_2O self-ion ...

$[OH^-] = 1.0 \times 10^{-7} M + 1.5 \times 10^{-6} M$

$= 1.6 \times 10^{-6} M$

ACID vs BASE

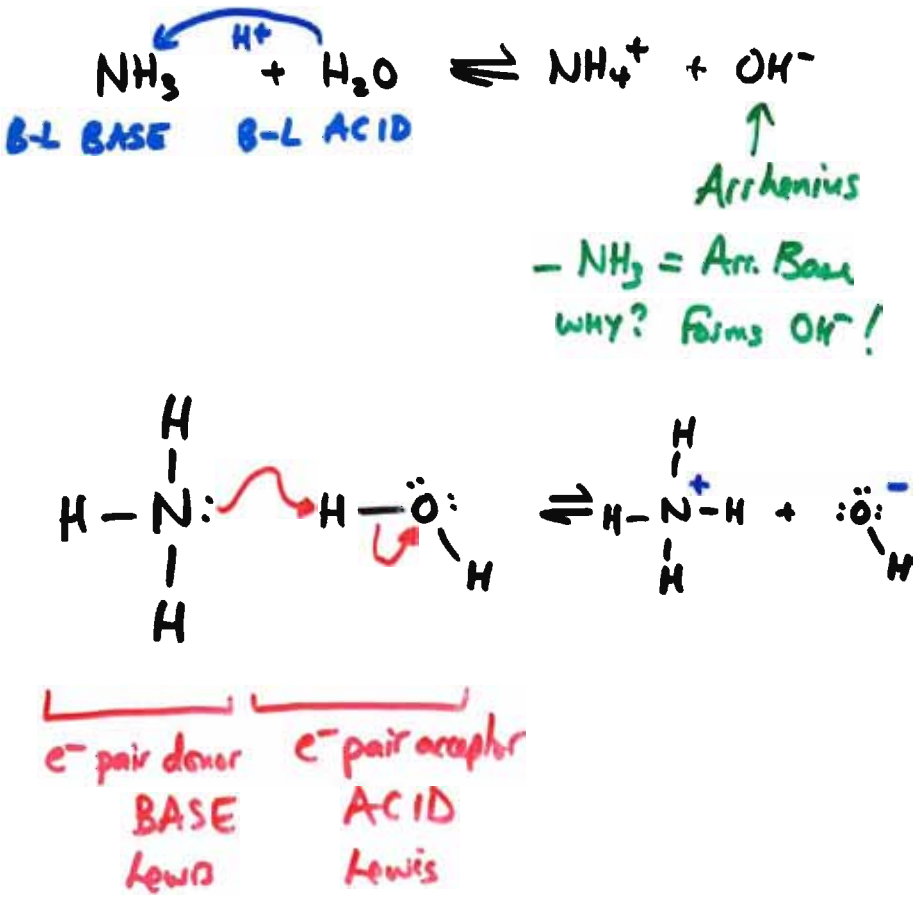
H^+ donor — H^+ acceptor

Brønsted-Löwry

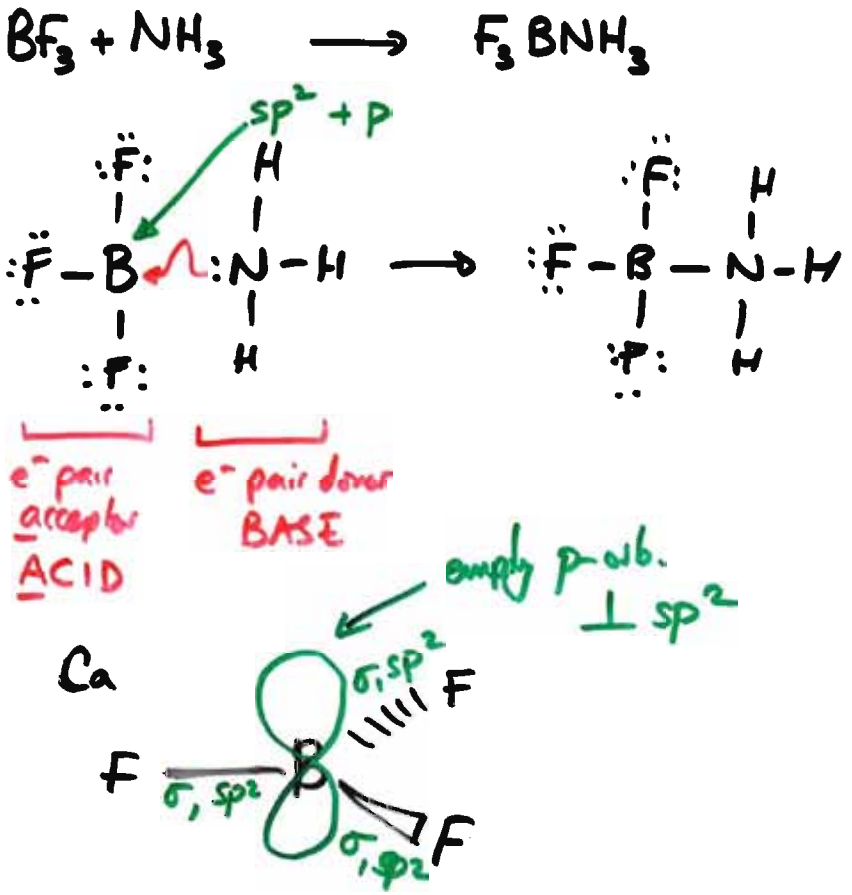
makes H^+/H_3O^+ in water — Arrhenius — makes OH^- in water

e^- pair acceptor — Lewis — e^- pair donor

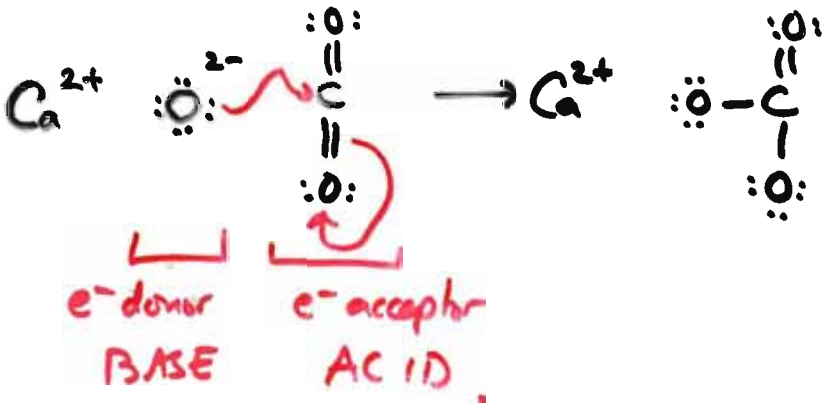
Acid — Base


H+
NH3 + H2O ⇌ NH4+ + OH-
B-L BASE
B-L ACID
Arrhenius
- NH3 = Arr. Base
WHY? Forms OH- !
e- pair donor
BASE
Lewis
e- pair acceptor
ACID
Lewis

what about...


BF3 + NH3 ⟶ F3BNH3
sp2 + p
e- pair acceptor
ACID
e- pair donor
BASE
empty p-orb. ⊥ sp2
Ca
F
σ, sp2
F
σ, sp2
F
σ, sp2

$$CaO(s) + CO_2(g) \longrightarrow CaCO_3(s)$$



Ch 17 – Acid-Base eqm + Solubility eqm

Buffer

... is a soln that can 'resist' changes in pH when small amts of acids/bases are added.

A drop of conc HCl + add to 1-L pure H_2O

pH: 7 → 3.22. drop of 3.78

A drop of conc HCl + add to 1-L of a buffer that's

1.0 M CH_3CO_2H / 1.0 M CH_3CO_2Na

pH: 4.74 → 4.73

drop of 0.01