Buffers resists change in pH

weak Acid and its salt

weak Base and its salt

$HOAc + NaOAc$ then if H_2O

$HOAc + H_2O \rightleftharpoons H_3O^+ + OAc^-$

$NaOAc \xrightarrow{H_2O} Na^+ + OAc^- \rightleftharpoons HOAc$

try adding HCl i.e. H^+ "ties it up"

try adding NaOH i.e. OH^-

$$HOAc + H_2O \rightleftharpoons H_3O^+ + OAc^-$$

$HClO$ (wk Acid) and $KClO$ (salt)

① H_2O ②

$HClO + H_2O \rightleftharpoons H_3O^+ + ClO^-$

$KClO \xrightarrow{H_2O} K^+ + ClO^- \rightleftharpoons HClO$

Add KOH i.e. OH^-

add HNO_3 i.e. H^+

Basic Buffer

wk Base and its salt

NH_3 (g) NH_4Cl H_2O

HCl

$NH_4^+Cl^-$

shift

$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

$NH_4Cl \xrightarrow{H_2O} NH_4^+ + Cl^-$

try Adding HCl i.e. H^+ $\rightleftharpoons$ $\underline{\underline{NH_4OH}}$

Try Adding NaOH i.e. OH^-

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

HNO_3

NH_4NO_3

$HClO_4$

NH_4ClO_4

Calculate the pH of a buffer solution that is 0.10 M HOAc and 0.090 M NaOAc ($OAc^- = CH_3COO^-$) $K_a = 1.8 \times 10^{-5}$

chemistry

$$HOAc + H_2O \rightleftharpoons H_3O^+ + OAc^-$$
$$NaOAc \rightarrow Na^+ + OAc^-$$

net chemistry

	$HOAc$ +	H_2O $\rightleftharpoons$	H_3O^+ +	OAc^-
I.	0.10	NA	0	0.090
C.	$-x$		$+x$	$+x$
E.	$0.10 - x$		x	$0.090 + x$

$$K_a = \frac{[H_3O^+][OAc^-]}{[HOAc]}$$

$$1.8 \times 10^{-5} = \frac{x(0.090 + x)}{0.10 - x}$$

Try dropping (if < 5%, okay)

$x = 2 \times 10^{-5} = [H_3O^+]$ pH = 4.70

2 sig figs

Calculate the pH of a (buffer) 0.10 M NH_3 and 0.090 NH_4Cl solution? $K_b = 1.8 \times 10^{-5}$

Chemistry:

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$
$$\cancel{NH_4}Cl \rightarrow NH_4^+ + \cancel{Cl^-}$$

	NH_3 +	H_2O $\rightleftharpoons$	NH_4^+ +	OH^-
I.	0.10	NA	0.090	0
C.	$-x$		$+x$	$+x$
E	$0.10 - x$		$0.090 + x$	x

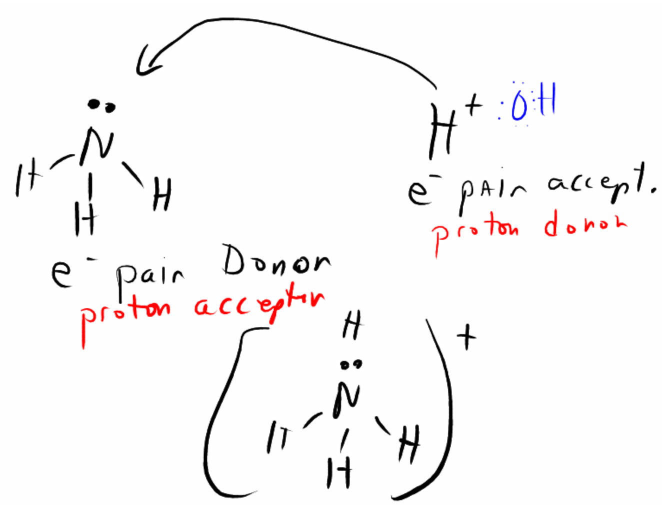
$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]}$$

$$1.8 \times 10^{-5} = \frac{(0.090 + x)\,x}{0.10 - x}$$

try dropping (If < 5%, okay)

$x = 2.0 \times 10^{-5} = [OH^-]$ → pOH = 4.70

pH = 9.30 Basic



Henderson Hasselbach Eq: for Acidic Buffers

$$K_a = \frac{[H_3O^+][A^-]}{[HA]} \qquad HA + H_2O \rightleftharpoons H_3O^+ + A^-$$

they solved for $[H_3O^+]$; then took $-\text{Log}$ of the Equation

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

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

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

$$pH = pK_a + \text{Log} \frac{[A^-]}{[HA]}$$

Note: the problem below is the same as the acidic buffer problem above.

Calculate the pH of a buffer solution that is 0.10 M HOAc and 0.090 M NaOAc ($OAc^- = CH_3COO^-$) $K_a = 1.8 \times 10^{-5}$

$$pH = pK_a + \text{Log} \frac{[A^-]}{[HA]}$$

$$pH = -\text{Log}\, 1.8 \times 10^{-5} + \text{Log} \frac{0.090}{0.10}$$

$$pH = 4.70$$