$pK_a = -\log K_a$ $\quad pK_b = -\log K_b$

H_3PO_4	$K_a = 7.5 \times 10^{-3}$	$pK_a = 2.12$
CH_3COOH	$K_a = 1.76 \times 10^{-5}$	$pK_a = 4.754$
NH_4^+	$K_a = 5.7 \times 10^{-10}$	$pK_a = 9.24$

The larger the pK_a, the weaker the acid

$K_a \cdot K_b = K_w \ (10^{-14})$

$pK_a + pK_b = 14$ for a conj. pair

BUFFER → a mixture of chemicals that causes a solution to resist a change in pH

2 compounds ⇒ weak acid HA + conj. base A^- } both present in similar concentrations

$HA + H_2O \rightleftharpoons H_3O^+ + A^-$ NOT A BUFFER not enough A^- present

typically... 0.1M HA
0.1M A^-

0.10M HF
0.05M ~~NaF~~ ✓

~~HCl~~
~~NaCl~~

~~H_3PO_4~~
~~Na_3PO_4~~

H_3PO_4
NaH_2PO_4

05.16.2012 1:12p 5/16/12, 9:55 AM, 44m 2s

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The <u>larger</u> the pKa, the <u>weaker</u> the acid

$K_a \cdot K_b = K_w \ (10^{-14})$

$pK_a + pK_b = 14$ for a conj. pair

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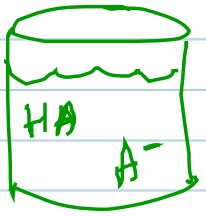
✗ ~~HCl~~ ~~NaCl~~

✗ ~~H_3PO_4~~ ~~Na_3PO_4~~

✓ H_3PO_4 NaH_2PO_4

How does a buffer work?



- I drip some H^+ into the buffered solution

A^- + H^+ ⟶ HA $\quad [A^-]\downarrow$ $\quad [HA]\uparrow$ $\quad pH \approx$ unchanged

(A^-: buffer base; H^+: added)

- I drip some OH^- into the buffered solution

HA + OH^- ⟶ H_2O + A^- $\quad [A^-]\uparrow$ $\quad [HA]\downarrow$ $\quad pH \approx$ unchanged

(HA: buffer acid; OH^-: added)

Henderson-Hasselbach equation

$$pH_{buffer} = pK_{a\ buffer\ acid} + \log\left(\frac{[A^-]}{[HA]}\right)$$

What is the pH of a buffer made to be 0.1M $NaHCO_3^-$ and 0.05M H_2CO_3?

$K_a\ H_2CO_3 = 4.3 \times 10^{-7} \Rightarrow pK_a = 6.37$

$$pH = 6.37 + \log\left(\frac{0.1}{0.05}\right) = 6.37 + \log 2$$

$$\boxed{pH = 6.67}$$

add H^+: $HCO_3^- + H^+ \longrightarrow H_2CO_3$

add OH^-: $H_2CO_3 + OH^- \longrightarrow H_2O + HCO_3^-$

Neutralizing ability

ex buffer pH = 4.5 [HA] = 0.1 M [A⁻] = 0.2 M → better at neutralizing added acid

→ has NOTHING to do w/ the buffer pH!

[buffer base] > [buffer acid] ⇒ better at neutralizing added acid

[buffer acid] > [buffer base] → better at neutralizing added base

buffer capacity ⇒ ↑[ ]'s, ↑ buffer capacity

acid w/ pKa = 5.2

buffer ① [HA] = 0.1 M, [A⁻] = 0.3 M → greater buffer capacity

buffer ② [HA] = 0.01 M, [A⁻] = 0.03 M → identical pH