

Challenge 4: Buffer

A buffer is constructed by dissolving in water at 25 °C 1.00 mol each of an acid, with $K_a = 1 \times 10^{-5}$, and its conjugate base in a total volume of 1.00 L.

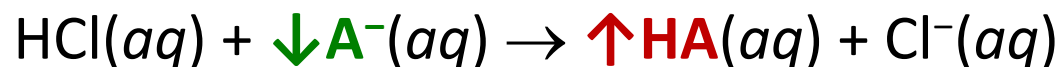
What is the pH after 500. mL of 0.100 M HCl has been added to the original buffer solution? **Answer:** pH = 4.96

What is the pH after 500. mL of 0.100 M NaOH has been added to the original buffer solution? **Answer:** pH = 5.04

Add **strong acid** to buffer

1 L buffer, $c_a = c_b = 1.00$ M, $K_a = 1 \times 10^{-5}$, **pH = 5.00**

Add 500. mL of 0.100 M HCl



HA \rightarrow 1.00 mol + 0.050 mol = **1.05 mol**

A⁻ \rightarrow 1.00 mol – 0.050 mol = **0.95 mol**

$c_a = 1.05$ mol/1.50 L, $c_b = 0.95$ mol/1.50 L

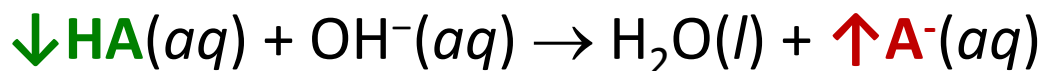
$c_a/c_b = 1.00 \rightarrow$ **1.05/0.95**, **pH \rightarrow 4.96 (tiny change!)**

Add **strong base** to buffer

1 L buffer, $c_a = c_b = 1.00$ M, $K_a = 1 \times 10^{-5}$, **pH = ...**

5.00

Add 500. mL of 0.100 M NaOH



HA \rightarrow 1.00 mol $-$ 0.050 mol = **0.95 mol**

A⁻ \rightarrow 1.00 mol + 0.050 mol = **1.05 mol**

$c_a = 0.95$ mol/1.50 L, $c_b = 1.05$ mol/1.50 L

$c_a/c_b = 1.00 \rightarrow$ **0.95/1.01**, **pH \rightarrow 5.04 (tiny change!)**