AP Chemistry
BUFFER REVIEW

A buffer is solution with a very stable pH. Acid or base can be added to a buffer without greatly changing the overall pH of the solution.

A buffer is created by placing a large amount of a weak acid or base into a solution along with its conjugate (in the form of a salt). AKA "COMMON ION EFFECT"

Don't forget the Henderson-Hasselbalch Equation can be used in place of ICE Tables

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

$$pOH = pK_b + log\frac{[HB^+]}{[B]}$$

Example:

A buffer system is created with 0.25*M* propanoic acid ($HC_3H_5O_2$) and 0.25*M* $NaC_3H_5O_2$.

$K_a = 1.3\times10^{-5}$

$HC_3H_5O_2 \rightleftharpoons H^+ + C_3H_5O_2^-$

a. Calculate the initial pH of this buffer system.
b. What would the pH of the system be if 0.030 mol of HCl is added to 1.0L of the initial buffer system?
c. What would the pH of the system be if 0.020 mol of NaOH is added to 1.0L of the initial buffer system?

a) $pH = [-\log(1.3\times10^{-5})] + \log\frac{(0.25)}{(0.25)}$

$pH = (4.886) + 0 = 4.89$

b) $C_3H_5O_2^- + HCl \longrightarrow HC_3H_5O_2 + Cl^-$

	$C_3H_5O_2^-$	HCl	$HC_3H_5O_2$
B	0.25	0.030	0.25
C	−0.030	−0.030	+0.030
A	0.22	∅	0.28

$pH = 4.886 + \log\left(\frac{0.22}{0.28}\right) = 4.78$

c) $HC_3H_5O_2 + NaOH \longrightarrow C_3H_5O_2^- + H_2O$

	$HC_3H_5O_2$	$NaOH$	$C_3H_5O_2^-$
B	0.25	0.020	0.25
C	−0.020	−0.020	+0.020
A	0.23	∅	0.27

$pH = 4.886 + \log\left(\frac{0.27}{0.23}\right) = 4.96$

You try it!

A buffer system is created with ~~0.15M~~ 0.20 M ascorbic acid ($HC_6H_7O_6$) and 0.15*M* sodium ascorbate, a common food preservative, $NaC_6H_7O_6$. $K_a = 7.9 \times 10^{-5}$

a. Calculate the initial pH of this buffer system. 0.009
b. What would the pH of the system be if ~~0.009~~ mol of HNO_3 is added to 1.0L of the initial buffer system? (volume is held constant)
c. What would the pH of the system be if ~~0.015 mol~~ of KOH is added to ~~1.0L~~ 500 mL of the initial buffer system? 0.06M, 25mL } 0.015 mol Volume is additive

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a) $pH = \cancel{4}.10 + \log \frac{0.15}{0.20} =$ ~~4.00~~ **3.98**

b) $C_6H_7O_6^- + H^+ \longrightarrow HC_6H_7O_6 + H_2O$

	$C_6H_7O_6^-$	H^+	$HC_6H_7O_6$
B	0.15	0.009	0.20
C	−0.009	−0.009	+0.009
A	~~0.006~~ 0.141	∅	~~0.202~~ 0.209

$pH = \cancel{4}.10 + \log \frac{0.141}{0.209} =$ ~~3.981~~ ~~3.98~~ **3.93**

c) $HC_6H_7O_6 + OH^- \longrightarrow C_6H_7O_6^- + H_2O$

$0.20M \times 0.5L = 0.1\ mol$

$0.15M \times 0.5L = 0.075\ mol$

	$HC_6H_7O_6$	OH^-	$C_6H_7O_6^-$
B	0.1	0.0015	0.075
C	−0.0015	−0.0015	+0.0015
A	0.085 mol	∅	0.09 mol
	0.525L = 0.162M		0.525L = 0.171M

$pH = \cancel{4}.10 + \log \frac{0.171}{0.162} =$ ~~4.127~~ ~~4.12~~ **4.12**