

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"

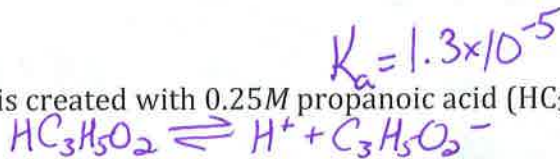
Don't forget the Henderson-Hasselbalch Equation can be used in place of ICE Tables

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

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

Example:

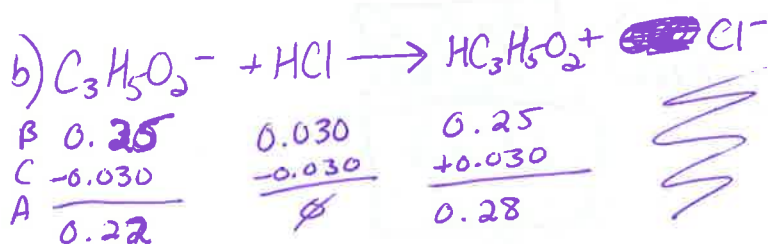
A buffer system is created with 0.25M propanoic acid ( $HC_3H_5O_2$ ) and 0.25M  $NaC_3H_5O_2$ .



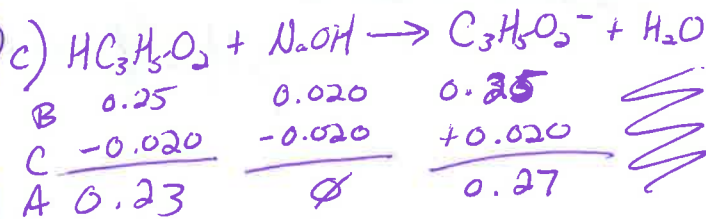
- Calculate the initial pH of this buffer system.
- What would the pH of the system be if 0.030 mol of HCl is added to 1.0L of the initial buffer system?
- What would the pH of the system be if 0.020 mol of NaOH is added to 1.0L of the initial buffer system?

a)  $pH = [-\log(1.3 \times 10^{-5})] + \log \frac{0.25}{0.25}$

$pH = (4.886) + 0 = 4.89$



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



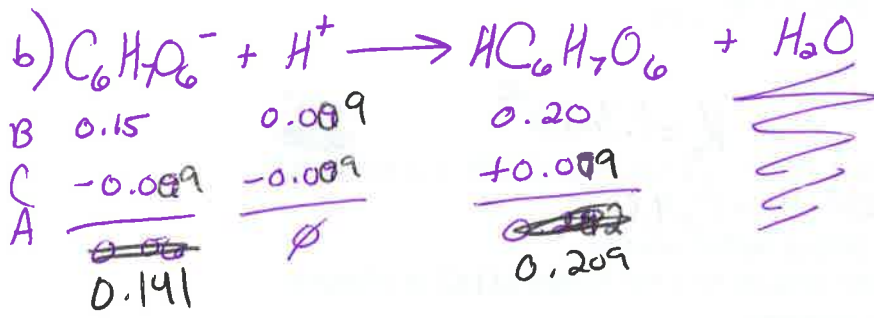
$pH = 4.886 + \log \left( \frac{0.27}{0.23} \right) = 4.96$

You try it!

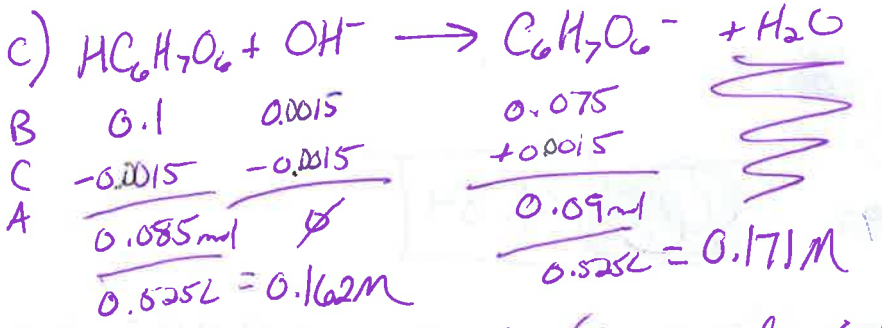
A buffer system is created with ~~0.15M~~ <sup>0.20M</sup> ascorbic acid ( $\text{HC}_6\text{H}_7\text{O}_6$ ) and 0.15M sodium ascorbate, a common food preservative,  $\text{NaC}_6\text{H}_7\text{O}_6$ .  $K_a = 7.9 \times 10^{-5}$

- Calculate the initial pH of this buffer system. <sup>0.009</sup>
- What would the pH of the system be if ~~0.009~~ <sup>0.009</sup> mol of  $\text{HNO}_3$  is added to 1.0L of the initial buffer system? (volume is held constant)
- What would the pH of the system be if ~~0.015~~ <sup>0.06M</sup> mol of  $\text{KOH}$  is added to ~~1.0L~~ <sup>25ml</sup> of the initial buffer system? <sup>0.015ml</sup> volume is additive

a)  $\text{pH} = 4.10 + \log \frac{0.15}{0.20} =$  ~~7.98~~ 3.98



$\text{pH} =$  ~~4.1~~ <sup>4.1</sup>  $+ \log \frac{0.141}{0.209} =$  ~~7.98~~ 3.93



$0.20\text{M} \times 0.5\text{L} = 0.1\text{mol}$   
 $0.15\text{M} \times 0.5\text{L} = 0.075\text{mol}$

$\text{pH} =$  ~~4.10~~  $+ \log \frac{0.171}{0.162} =$  ~~7.98~~ 4.12