Buffer Calculations

1.0 What is the pH of 50.00 mL buffer solution which is 2.00M in $HC_2H_3O_2$ and 2.00M in $NaC_2H_3O_2$?

$$pH = pKa + \log\left(\frac{base}{acid}\right) = -\log 1.8x10^{-5} + \log\left(\frac{2.00M}{2.00M}\right) = 4.74 + 0.00 = 4.74$$

2.0 What is the new pH after 2.00 mL of 6.00M HCl is added to this buffer ?

Initial moles of acid and base in buffer is (2.00mol/L)(0.500L) = 0.100

Initial moles of H^+ added is (6.00mol/L)(0.00200L) = 0.012

HCl is a strong acid and dissociates 100%. The H^+ ion reacts quantitatively with the conjugate base, $C_2H_3O_2^-$, form of the buffer, changing the base to acid ratio of the buffer and thus the pH.

			Base		**Acid**
	H^+	+	$C_2H_3O_2^-$	→	$HC_2H_3O_2$
Initial moles	0.012		0.100		0.100
Change in moles	-0.012		-0.012		+0.012
Final moles	0.000		0.088		0.112
New molarity	0.0		**1.69**		**2.15**

Remember that the final volume is 52.00 mL not 50.00 mL

The new pH is thus: $pH = -\log 1.8x10^{-5} + \log\left(\frac{1.69M}{2.15M}\right) = 4.74 + (-0.10) = 4.64$

3.0 What is the new pH after 2.00 mL of 6.00M NaOH is added to the **original** buffer?

NaOH is a strong base and dissociates 100%. The OH^- ion reacts quantitatively with the conjugate acid, $HC_2H_3O_2$ form of the buffer. Again the base to acid ratio of the buffer is changed and thus the pH. 0.012 moles of OH^- is added.

			Acid		**Base**		
	OH^-	+	$HC_2H_3O_2$	→	$C_2H_3O_2^-$	+	H_2O
Initial moles	0.012		0.100		0.100		
Change in moles	-0.012		-0.012		+0.012		
Final moles	0.000		0.088		0.112		
New Molarity	0.00		**1.69**		**2.15**		

The new pH is thus: $pH = -\log 1.8x10^{-5} + \log\left(\frac{2.15}{1.69}\right) = 4.74 = 0.10 = 4.84$