

WORKSHEET: SOLUTION EQUILIBRIUM (Weak acids and bases, buffers, Polyprotic acids, and Hydrolysis.)

SET A:

- 1) 40.00 ml of 0.350 M CH_3NH_2 is titrated with 0.280 M HCl until the end point is reached. Calculate the pH of the solution at the end point. (K_b for $\text{CH}_3\text{NH}_2 = 5.0 \times 10^{-4}$)

Setup:

	CH_3NH_2	+ HCl	\rightarrow	CH_3NH_3^+	+ HCl
<u>initial moles</u>	$0.0400 \text{ l} \times \frac{0.350 \text{ mole}}{\text{l}}$ = 0.0140 mole	$0.0500 \text{ l} \times \frac{0.280 \text{ mole}}{\text{l}}$ = 0.0140 mole		0	
<u>change in moles</u>	-0.0140	-0.0140		+0.0140	
<u>final mole</u>	0	0		0.0140	

$$[\text{CH}_3\text{NH}_3^+] = \frac{0.0140 \text{ mole}}{0.0900 \text{ l}} = 0.156 \text{ M}$$

Hydrolysis problem

	CH_3NH_3^+	+ H_2O	\rightleftharpoons	CH_3NH_2	+ H_3O^+
<u>Initial concs</u>	0.156			0	0
<u>Change in conc.</u>	-x			+x	+x
<u>Equi. concs</u>	0.156-x			x	x

$$K_a \text{CH}_3\text{NH}_3^+ = \frac{K_w}{K_b} = \frac{1.0 \times 10^{-14}}{5.0 \times 10^{-4}} = 2.0 \times 10^{-11}$$

$$K_a \text{CH}_3\text{NH}_3^+ = \frac{[\text{CH}_3\text{NH}_2][\text{H}_3\text{O}^+]}{[\text{CH}_3\text{NH}_3^+]}$$

$$2.0 \times 10^{-11} = \frac{(x)(x)}{(0.156-x)}$$

$$x = [\text{H}_3\text{O}^+] = 1.8 \times 10^{-6}$$

$$\text{pH} = 5.74$$

2) How many moles of HNO_2 must be added to a 1.00 liter of 0.370 M NaNO_2 to give a buffer of $\text{pH} = 4.20$? (Ignore any volume change due to the addition of HNO_2) (K_a for HNO_2 is 4.5×10^{-4}).
Setup:

	HNO_2	$+$	H_2O	\rightleftharpoons	H_3O^+	$+$	NO_2^-	
Initial conc.	C				0		0.370	
Change in conc.	-6.3×10^{-5}				$+6.3 \times 10^{-5}$		$+6.3 \times 10^{-5}$	
Equi conc.	$C - 6.3 \times 10^{-5}$		negligible		6.3×10^{-5}		$0.370 + 6.3 \times 10^{-5}$	negl.

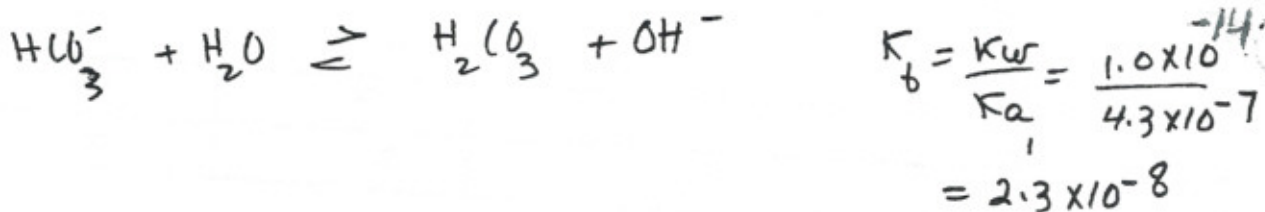
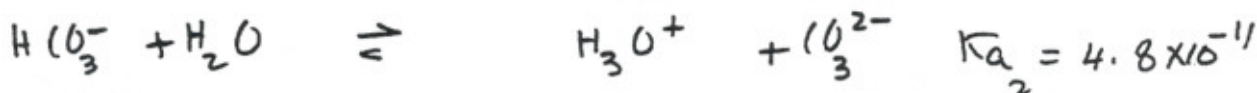
$$K_a = \frac{[\text{H}_3\text{O}^+][\text{NO}_2^-]}{[\text{HNO}_2]}$$

$$4.5 \times 10^{-4} = \frac{(6.3 \times 10^{-5})(0.370)}{(C - 6.3 \times 10^{-5}) \text{ negligible}}$$

$$C = 0.052$$

Answer: 0.052 moles

3) a) Is NaHCO_3 (aq) acidic, basic, or neutral? You must show your work to justify your answer.
(K_{a1} for $\text{H}_2\text{CO}_3 = 4.3 \times 10^{-7}$, K_{a2} for $\text{HCO}_3^- = 4.8 \times 10^{-11}$)
Setup:



Answer: K_b for HCO_3^- is larger than K_{a2} for HCO_3^- ; NaHCO_3 (aq) is basic.

b) Is NaHCO_3 (aq) a buffer? (You must show your work to prove that your answer is not a guess.)
Setup:



HCO_3^- ties up (reacts with) any H^+ or OH^- added.
A solution of HCO_3^- resists the change in pH when a small amount of H^+ or OH^- is added.
Answer: Yes

6) What is the $[H^+]$ concentration of a solution made by adding 35.00 ml of 0.660 M $C_6H_5NH_2$ to 40.00 ml of 0.420 M HCl? (K_b for $C_6H_5NH_2$ is 4.6×10^{-7})
Setup:

$C_6H_5NH_2$	+	HCl	\rightarrow	$C_6H_5NH_3^+$	+	Cl^-
<u>initial moles</u>						
$0.350 \text{ l} \times 0.660 \frac{\text{mole}}{\text{l}}$ $= 0.231 \text{ mole}$		$0.400 \text{ l} \times 0.420 \frac{\text{mole}}{\text{l}}$ $= 0.168 \text{ mole}$		0		
<u>change in moles</u>						
-0.168 mole		-0.168 mole				$+0.168 \text{ mole}$
<u>final moles</u>						
$0.231 \text{ mole} - 0.168 \text{ mole}$ $= 0.063 \text{ mole}$		0				0.168 mole

Buffer problem:

$C_6H_5NH_2$	+	H_2O	\rightleftharpoons	$C_6H_5NH_3^+$	+	OH^-
<u>Initial conc</u>						
$\frac{0.063 \text{ mole}}{0.0750 \text{ l}} = 0.84$				$\frac{0.168 \text{ mole}}{0.0750 \text{ l}} = 0.224$		0
<u>change in conc.</u>						
$-x$				$+x$		$+x$
<u>Equilibrium conc</u>						
$0.84 - x$				$0.224 + x$		x

$$K_b = \frac{[C_6H_5NH_3^+][OH^-]}{[C_6H_5NH_2]}$$

$$4.6 \times 10^{-7} = \frac{(0.224 + x)(x)}{(0.84 - x)}$$

$$x = [OH^-] = 1.7 \times 10^{-7} \text{ M}$$

$$[H^+] = \frac{1.0 \times 10^{-14}}{1.7 \times 10^{-7}} = 5.9 \times 10^{-8} \text{ M}$$

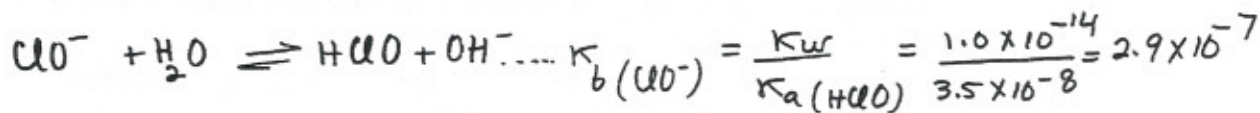
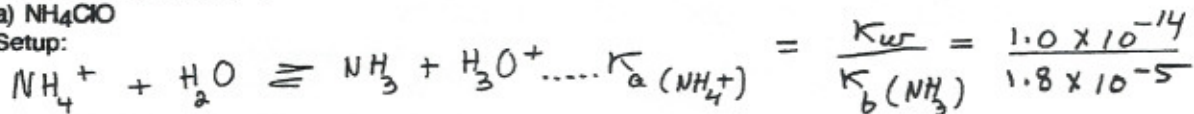
Answer: $5.9 \times 10^{-8} \text{ M}$

7) Predict whether the following solutions are acidic, basic, or neutral. Write the equilibrium equations, and all calculations if needed, to justify your answer. (K_b for NH_3 is 1.8×10^{-5} ,

K_a for HClO is 3.5×10^{-8})

a) NH_4ClO

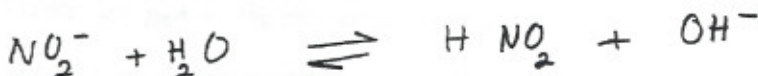
Setup:



Answer: K_b for $\text{ClO}^- > K_a$ for NH_4^+ . Basic

b) NaNO_2

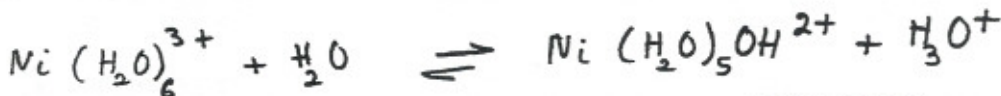
Setup:



Answer: Basic

c) $\text{Ni}(\text{NO}_3)_3$

Setup:



Answer: Acidic

SET B:

1) How many moles of HCHO_2 must be added to a 1.00 liter of 0.400 M NaCHO_2 to give a buffer of $\text{pH} = 3.60$? Ignore any volume change due to the addition of HCHO_2 . (K_a for $\text{HCHO}_2 = 1.8 \times 10^{-4}$)

Setup:



Initial	C added to 1.00 liter	0	0.400 mol/l
change	-2.5×10^{-4}	$+2.5 \times 10^{-4}$	$+2.5 \times 10^{-4}$
Equilibrium	$C - 2.5 \times 10^{-4}$	2.5×10^{-4}	$0.400 + 2.5 \times 10^{-4}$

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{CHO}_2^-]}{[\text{HCHO}_2]}$$

$$1.8 \times 10^{-4} = \frac{(2.5 \times 10^{-4})(0.400 + 2.5 \times 10^{-4})}{C - 2.5 \times 10^{-4}}$$

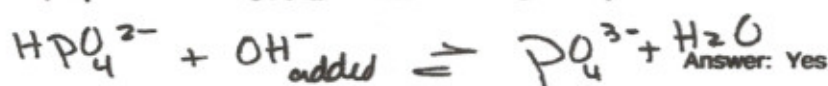
$$1.8 \times 10^{-4} = \frac{(2.5 \times 10^{-4})(.400)}{C}$$

$$C = 0.55 \text{ mole/l}$$

Answer: 0.55 mole

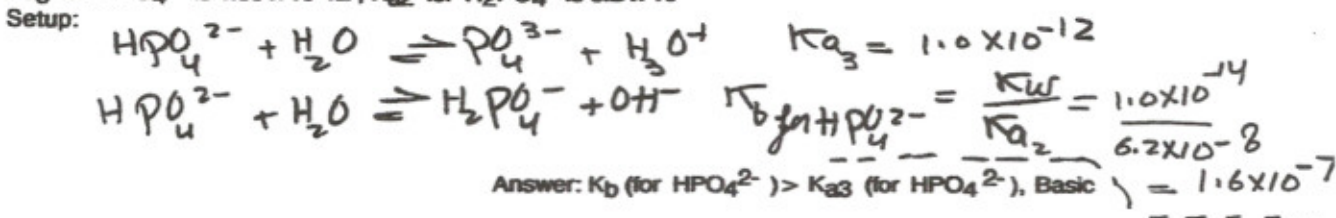
2) a) Is $\text{Na}_2\text{HPO}_4(\text{aq})$ a buffer? You must show your work to prove that your answer is not a guess.

Setup: Na_2HPO_4 is a buffer.



b) Is Na_2HPO_4 acidic, basic, or neutral? You must show your work to justify your answer.

K_{a3} for HPO_4^{2-} is 1.00×10^{-12} , K_{a2} for H_2PO_4^- is 6.2×10^{-8}



3) What is the $[\text{H}^+]$ concentration of a solution made by titrating 30.00 ml of 0.7200 M $\text{C}_6\text{H}_5\text{NH}_2$ with 0.2500 M HCl until the equivalence point is reached? K_b for $\text{C}_6\text{H}_5\text{NH}_2$ is 4.6×10^{-7} .

Setup:



① \rightarrow moles $\text{C}_6\text{H}_5\text{NH}_2 = M_{\text{C}_6\text{H}_5\text{NH}_2} V_{\text{C}_6\text{H}_5\text{NH}_2} = 0.7200 \text{ mole/l} \times 0.03000 \text{ l} = 0.02160 \text{ mole } \text{C}_6\text{H}_5\text{NH}_2$

② $0.02160 \text{ mole } \text{C}_6\text{H}_5\text{NH}_2 \left(\frac{1 \text{ mole HCl}}{1 \text{ mole } \text{C}_6\text{H}_5\text{NH}_2} \right) = 0.02160 \text{ mole HCl}$

③ $V_{\text{HCl}} = \frac{0.02160 \text{ mole HCl}}{0.2500 \text{ mole/liter}} = 0.08640 \text{ liter}_{\text{HCl}} = 86.40 \text{ ml}$

④ Total volume of solution = 30.00 ml + 86.40 ml = 116.40 ml solution

⑤ At the end point, all $\text{C}_6\text{H}_5\text{NH}_2$ has reacted completely. 0.02160 mole $\text{C}_6\text{H}_5\text{NH}_3^+$ is formed.

$$[\text{C}_6\text{H}_5\text{NH}_3^+] = \frac{0.02160 \text{ mole}}{0.1164 \text{ liter}} = 0.1856 \text{ M}$$

Hydrolysis problem:



Initial conc.	0.1856		0	0
Change in conc.	-x		+x	+x
Equ. conc.	0.1856-x		x	x

Answer: 6.4×10^{-5}

$$K_a = \frac{K_w}{K_b \text{ for } \text{C}_6\text{H}_5\text{NH}_2} = \frac{[\text{H}_3\text{O}^+][\text{C}_6\text{H}_5\text{NH}_2]}{[\text{C}_6\text{H}_5\text{NH}_3^+]} = \frac{(x)(x)}{(0.1856-x)}$$

$[\text{H}_3\text{O}^+] = 6.4 \times 10^{-5} \text{ M}$

- 6) How many moles of NaOH should be added to a 1.00 liter of 0.190 M HNO_2 to produce a solution of pH = 4.80? Assume there is no change in volume upon the addition of NaOH. K_a for HNO_2 is 4.5×10^{-4} .
Setup:

NaOH	+	HNO_2	\rightarrow	NaNO_2	+	H_2O
Initial moles						
C limiting		0.190		0		
change in moles						
$-C$		$-C$		$+C$		
Final moles						
0		$0.190 - C$		C		

Buffer problem:-

	HNO_2	+	H_2O	\rightleftharpoons	H_3O^+	+	NO_2^-
Initial conc							
$0.190 - C$					0		C
change in conc							
-1.6×10^{-5}					$+1.6 \times 10^{-5}$		$+1.6 \times 10^{-5}$
Equi. conc							
$0.190 - C - 1.6 \times 10^{-5}$					1.6×10^{-5}		$C + 1.6 \times 10^{-5}$

↑ negligible
↑ negligible

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{NO}_2^-]}{[\text{HNO}_2]}$$

$$4.5 \times 10^{-4} = \frac{(1.6 \times 10^{-5})(C + 1.6 \times 10^{-5})}{(0.190 - C - 1.6 \times 10^{-5})}$$

$$4.5 \times 10^{-4} = \frac{(1.6 \times 10^{-5})C}{(0.196 - C)}$$

$C = 0.18$ mole NaOH to be added to a 1.0 liter

7) What is the pH of a solution made by mixing 25.00 ml of 0.440 M $\text{CH}_3\text{NH}_3\text{Cl}$ and 37.00 ml of 0.200 M NaOH ? K_b for CH_3NH_2 is 5.0×10^{-4} .
Setup:



$$\textcircled{1} \Rightarrow \text{moles } \text{CH}_3\text{NH}_3^+ \text{ available} = M_{\text{CH}_3\text{NH}_3^+} V_{\text{CH}_3\text{NH}_3^+}$$

$$= 0.440 \frac{\text{mole}}{\ell} \times 0.02500 \ell$$

$$= 0.0110 \text{ mole } \text{CH}_3\text{NH}_3^+$$

$$\textcircled{2} \Rightarrow \text{moles } \text{OH}^- \text{ added} = M_{\text{NaOH}} V_{\text{NaOH}}$$

$$= 0.200 \frac{\text{mole}}{\ell} \times 0.03700 \ell$$

$$= 7.40 \times 10^{-3} \text{ mole NaOH}$$

CH_3NH_3^+ initial moles	OH^-	CH_3NH_2	H_2O
0.0110 mole	7.40×10^{-3} mole	0	
change in moles -7.40×10^{-3}	-7.40×10^{-3}	$+7.4 \times 10^{-3}$	
final moles $0.0110 - 7.40 \times 10^{-3}$	0	7.4×10^{-3}	

Buffer problem:

$$\text{CH}_3\text{NH}_2 + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{NH}_3^+ + \text{OH}^-$$

initial conc	CH_3NH_2	CH_3NH_3^+	OH^-
$7.40 \times 10^{-3} \text{ mole}$ 0.0620ℓ $= 0.119$	$3.60 \times 10^{-3} \text{ mole}$ 0.0620ℓ $= 0.0581$	0	
change in conc	$-x$	$+x$	$+x$
Equi. conc	$0.119 - x$	$0.0581 + x$	x

$$K_b = \frac{[\text{CH}_3\text{NH}_3^+][\text{OH}^-]}{[\text{CH}_3\text{NH}_2]}$$

$$5.0 \times 10^{-4} = \frac{(0.0581 + x)(x)}{(0.119 - x)}$$

$$x = [\text{OH}^-] = 1.0 \times 10^{-3} \text{ M}$$

$$\text{pOH} = 3.00$$

$$\text{pH} = 11.00$$

Answer: pH = 11.00

SET C:

1) The oxalate ion concentration, $C_2O_4^{2-}$, of 0.20 M $H_2C_2O_4$ is adjusted to a value of 3.00×10^{-3} M. What is the $[H^+]$ ion concentration in the solution? K_{a1} for $H_2C_2O_4$ is 5.6×10^{-2} and K_{a2} for $HC_2O_4^-$ is 5.1×10^{-5} .

Setup:



$$K_{overall} = K_{a1} K_{a2} = \frac{[H_3O^+]^2 [C_2O_4^{2-}]}{\Sigma H_2C_2O_4}$$

$$(5.6 \times 10^{-2})(5.1 \times 10^{-5}) = \frac{[H_3O^+]^2 (3.00 \times 10^{-3})}{(0.20)}$$

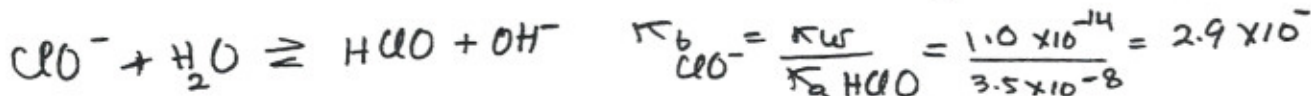
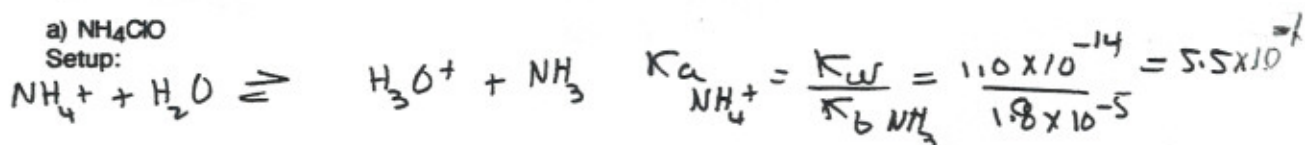
$$[H_3O^+] = 1.4 \times 10^{-2}$$

Answer: 1.4×10^{-2} M

2) Predict whether each of the following solutions is acidic, basic, or neutral. Write the equilibrium equations, and all calculations if needed, to justify your answer. K_b for NH_3 is 1.8×10^{-5} , K_a for $HClO$ is 3.5×10^{-8} .

a) NH_4ClO

Setup:



$$K_b \text{ for } ClO^- > K_a \text{ for } NH_4^+$$

Answer: K_b for $ClO^- > K_a$ for NH_4^+ . Basic

b) $KCNO$

Setup:



Answer: Basic

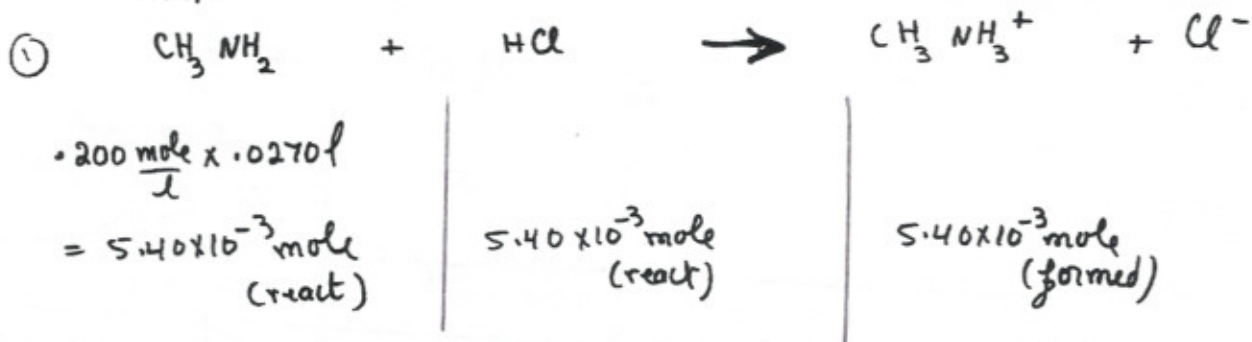
c) $Ni(ClO_4)_3$

Setup:



Answer: Acidic

3) What is the pH at the equivalence point when 27.0 ml of 0.200 M CH_3NH_2 are titrated with 0.350 M HCl? K_b for CH_3NH_2 is 4.4×10^{-4} .
Setup:



② Find vol of HCl added:

$$0.200 \frac{\text{mole}}{\text{l}} \text{CH}_3\text{NH}_2 \times 0.0270 \text{ l CH}_3\text{NH}_2 \left(\frac{1 \text{ mole HCl}}{1 \text{ mole CH}_3\text{NH}_2} \right) \left(\frac{1 \text{ l HCl}}{0.350 \text{ mole HCl}} \right)$$

$$= 0.0154 \text{ l HCl} = 15.4 \text{ ml HCl}$$

③ Find total volume after end point is reached:

$$27.0 \text{ ml CH}_3\text{NH}_2 + 15.4 \text{ ml HCl} = 42.4 \text{ ml}$$

$$= 0.0424 \text{ l}$$

④ Hydrolysis problem:



Initial conc.	$\frac{5.40 \times 10^{-3} \text{ mole}}{0.0424 \text{ l}} = 0.127 \text{ M}$	0	0
change in conc	-x	+x	+x
Equi. conc.	(0.127 - x)	x	x

$$K_a \text{CH}_3\text{NH}_3^+ = \frac{K_w}{K_b \text{CH}_3\text{NH}_2} = \frac{1.00 \times 10^{-14}}{4.4 \times 10^{-4}} = 2.3 \times 10^{-11}$$

$$K_a = \frac{[\text{CH}_3\text{NH}_2][\text{H}_3\text{O}^+]}{[\text{CH}_3\text{NH}_3^+]}$$

$$2.3 \times 10^{-11} = \frac{(x)(x)}{(0.127 - x)}$$

$$x = [\text{H}^+] = 1.7 \times 10^{-6}$$

$$\text{pH} = 5.76$$

Answer: 5.76

4) How many ml of 0.250 M HF (aq) must be added to 500.0 ml of 0.300 M NaF to give a buffer of pH = 3.50? K_a for HF is 6.8×10^{-4} .

Setup:

HF		+	H ₂ O		\rightleftharpoons	H ₃ O ⁺		+	F ⁻	
<u>Initial conc.</u>	$\frac{C_{\text{moles}}}{V_{\text{Total}}}$					0			$\frac{0.500 \text{ l} \times 0.300 \text{ mole/l}}{V_{\text{Total}}} = \frac{0.15}{V_{\text{Total}}}$	
change in con	-3.2×10^{-4}					$+3.2 \times 10^{-4}$			$+3.2 \times 10^{-4}$	
<u>Eq. conc.</u>	$\frac{C_{\text{moles}}}{V_{\text{Total}}}$		-3.2×10^{-4}			3.2×10^{-4}			$\frac{0.15}{V_{\text{Total}}} + 3.2 \times 10^{-4}$	

$$K_a = \frac{[H_3O^+][F^-]}{[HF]}$$

$$6.8 \times 10^{-4} = \frac{(3.2 \times 10^{-4}) \left(\frac{0.15}{V_{\text{Total}}} + 3.2 \times 10^{-4} \right)}{\left(\frac{C}{V_{\text{Total}}} - 3.2 \times 10^{-4} \right)}$$

negligible

$$6.8 \times 10^{-4} = \frac{(3.2 \times 10^{-4}) \left(\frac{0.15}{V_{\text{Total}}} + 3.2 \times 10^{-4} \right)}{\left(\frac{C}{V_{\text{Total}}} - 3.2 \times 10^{-4} \right)}$$

negligible

$$6.8 \times 10^{-4} = \frac{(3.2 \times 10^{-4}) \left(\frac{0.15}{V_{\text{Total}}} + 3.2 \times 10^{-4} \right)}{\left(\frac{C}{V_{\text{Total}}} - 3.2 \times 10^{-4} \right)}$$

$$6.8 \times 10^{-4} = \frac{(3.2 \times 10^{-4}) (0.15)}{C}$$

$$C_{\text{moles}} = 0.0706 \text{ moles}$$

$$V_{\text{HF}} = 0.0706 \text{ mole} \left(\frac{1 \text{ liter}}{0.250 \text{ mole}} \right) = 0.282 \text{ l} = 282 \text{ ml}$$

Answer: 282 ml

5) Find the pH of a solution made by mixing 25.0 ml of 0.0650 M benzylamine, $C_7H_7NH_2$, and 13.9 ml of 0.0500 M HCl. K_b for $C_7H_7NH_2$ is 4.7×10^{-10} .

Setup:

	$C_7H_7NH_2$	$+ HCl$	\rightarrow	$C_7H_7NH_3^+$
Initial moles	$0.0250 \text{ l} \times 0.0650 \frac{\text{mole}}{\text{l}}$ $= 1.63 \times 10^{-3} \text{ mole}$	$0.0139 \text{ l} \times 0.0500 \frac{\text{mole}}{\text{l}}$ $= 6.95 \times 10^{-4} \text{ mole}$		0
Change in moles	$-6.95 \times 10^{-4} \text{ mole}$	$-6.95 \times 10^{-4} \text{ mole}$		$+6.95 \times 10^{-4} \text{ mole}$
Final moles	$1.63 \times 10^{-3} - 6.95 \times 10^{-4}$ $= 0.94 \times 10^{-3} \text{ mole}$	0		$6.95 \times 10^{-4} \text{ mole}$

Buffer problem

	$C_7H_7NH_2$	$+ H_2O$	\rightleftharpoons	$C_7H_7NH_3^+$	$+ OH^-$
initial conc	$\frac{0.94 \times 10^{-3} \text{ mole}}{0.0389 \text{ l}}$ $= 2.39 \times 10^{-2}$			$\frac{6.95 \times 10^{-4} \text{ mole}}{0.0389 \text{ l}}$ $= 1.79 \times 10^{-2}$	0
Change in conc	$-x$			$+x$	$+x$
Equi conc	$2.4 \times 10^{-2} - x$			$1.79 \times 10^{-2} + x$	x

$$K_b = \frac{[C_7H_7NH_3^+][OH^-]}{[C_7H_7NH_2]}$$

$$4.7 \times 10^{-10} = \frac{\left(\frac{6.95 \times 10^{-4}}{0.0389} + x\right)(x)}{\left(\frac{0.94 \times 10^{-3}}{0.0389} - x\right)}$$

$$x = [OH^-] = 6.3 \times 10^{-10} \text{ M}$$

$$pOH = 9.20$$

$$pH = 4.80$$

6) A chemist wants to prepare a buffer of pH = 4.35. How many milliliters of 0.455 M acetic acid must be added to 465 ml of 0.0941 M NaOH solution to obtain such a buffer? K_a for $\text{HC}_2\text{H}_3\text{O}_2$ is 1.7×10^{-5} .

Setup:

	$\text{HC}_2\text{H}_3\text{O}_2$	NaOH	$\text{Na}^+\text{C}_2\text{H}_3\text{O}_2^-$	H_2O
Initial moles	C	$0.465 \text{ l} \times 0.0941 \text{ mole/l}$ $= 0.0438 \text{ mole}$ limiting	0	
change in # moles	-0.0438	-0.0438	+0.0438	
final moles	C - 0.0438	0	0.0438	

	$\text{HC}_2\text{H}_3\text{O}_2 + \text{H}_2\text{O}$	\rightleftharpoons	H_3O^+	$+\text{C}_2\text{H}_3\text{O}_2^-$
Initial conc	$\frac{C - 0.0438}{V_{\text{total}}}$		0	$\frac{0.0438 \text{ mole}}{V_{\text{total}}}$
Change in conc	-4.5×10^{-5}		$+4.5 \times 10^{-5}$	$+4.5 \times 10^{-5}$
Equi. conc	$\frac{C - 0.0438 - 4.5 \times 10^{-5}}{V_{\text{total}}}$		4.5×10^{-5}	$\frac{0.0438 + 4.5 \times 10^{-5}}{V_{\text{total}}}$

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{C}_2\text{H}_3\text{O}_2^-]}{[\text{HC}_2\text{H}_3\text{O}_2]}$$

$$1.7 \times 10^{-5} = \frac{(4.5 \times 10^{-5}) \left(\frac{0.0438}{V_{\text{total}}} \right)}{\left(\frac{C - 0.0438}{V_{\text{total}}} \right)}$$

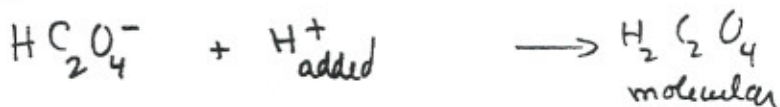
$$1.7 \times 10^{-5} = \frac{(4.5 \times 10^{-5})(0.0438)}{(C - 0.0438)}$$

$$C = 0.160 \text{ mole HC}_2\text{H}_3\text{O}_2$$

$$V_{\text{HC}_2\text{H}_3\text{O}_2} = \frac{0.160 \text{ mole}}{4.55 \text{ mole/l}} = 0.351 \text{ l}$$

Answer: 351 ml

7) a) Is NaHC_2O_4 (aq) a buffer? You must show your work to prove that your answer is not a guess.
Setup:

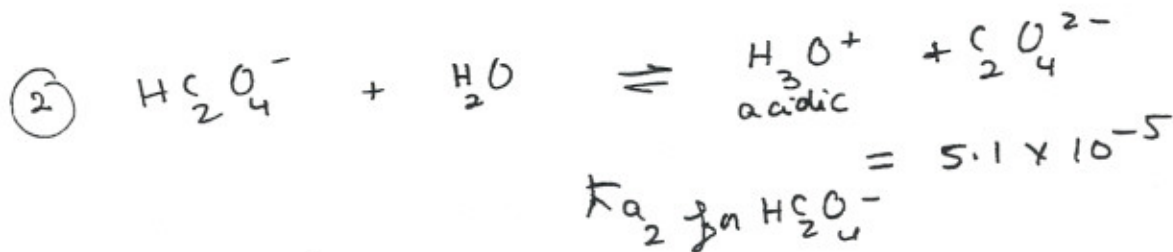


HC_2O_4^- ties up any H^+ or OH^- added to form molecular species. HC_2O_4^- (aq) resists the change in pH.

b) Is NaHC_2O_4 (aq) acidic, basic, or neutral? K_{a1} for $\text{H}_2\text{C}_2\text{O}_4$ is 5.6×10^{-2} , K_{a2} for HC_2O_4^- is 5.1×10^{-5} . You must show your work to justify your answer.
Setup:



$$K_b \text{ for } \text{HC}_2\text{O}_4^- = \frac{K_w}{K_{a1} \text{ for } \text{H}_2\text{C}_2\text{O}_4} = \frac{1.0 \times 10^{-14}}{5.6 \times 10^{-2}} = 1.8 \times 10^{-13}$$



K_{a2} for HC_2O_4^- is larger than K_b for HC_2O_4^- .
Solution is acidic.

Answer: K_{a2} for $\text{HC}_2\text{O}_4^- > K_b$ for HC_2O_4^- , Acidic