1.

$HCl \rightarrow H^+ + Cl^-$

$4.3 \times 10^{-4}\ M \quad 4.3 \times 10^{-4} \quad 4.3 \times 10^{-4}$

$[H^+] = 4.3 \times 10^{-4}$

$pH = 3.36$

$pOH = 10.64$

$[OH^-] = 2.29 \times 10^{-11}$

2.3×10^{-11}

2. $K_a = 1.8 \times 10^{-5}$

$$CH_3COOH \leftrightarrow H^+ + CH_3COO^-$$

4.3×10^{-4}	0	0
$4.3 \times 10^{-4} - x$	x	x

$$1.8 \times 10^{-5} = \frac{x^2}{4.3 \times 10^{-4}}$$

$$x = 8.79 \times 10^{-5}$$

$[H^+] = 8.8 \times 10^{-5}$ pH = 4.06

$[OH^-] = 1.1 \times 10^{-10}$ pOH = 9.94

$$pH = pK_a + \log \frac{[B]}{[A]}$$

pK_a: log of the K_a value.

$$pH = pK_a - \log \frac{[A]}{[B]}$$

1.

a) $HNO_2 \leftrightarrow NaNO_2 + H^+$

$.025 \quad .025 \quad 4.0 \times 10^{-4}$

$K_a \ 4.0 \times 10^{-4}$

$3.39 + \log\left(\frac{.025}{.025}\right)$

We can lower or increase the pH by no more than 1.

log of equal amounts of Acid to Base is Ø.

pH=3.39 $[H^+] = 4.0 \times 10^{-4}$

pOH=10.61 $[OH^-] = 2.5 \times 10^{-11}$

1b

$$pH = pK_a + \log \frac{[B]}{[A]}$$

4.0×10^{-4}

$$= 3.39 + \log \frac{[.01]}{[.025]}$$

$3.39 - .39$ $.3978$

$.40$

$pH = 3.00$ $[H^+]$ 1.0×10^{-3}

$pOH = 11.00$ $[OH^-]$ 1.0×10^{-11}

23. K_a

$$HA \longleftrightarrow H^+ + A^-$$

.25 $\quad 1.3489\times10^{-2} \quad 1.3489\times10^{-2}$

$pOH = 12.13$

$pH = 1.87$

$$= \frac{(1.3489\times10^{-2})^2}{.25}$$

$$7.278\times10^{-4}$$

$$K_a = 7.3\times10^{-4}$$

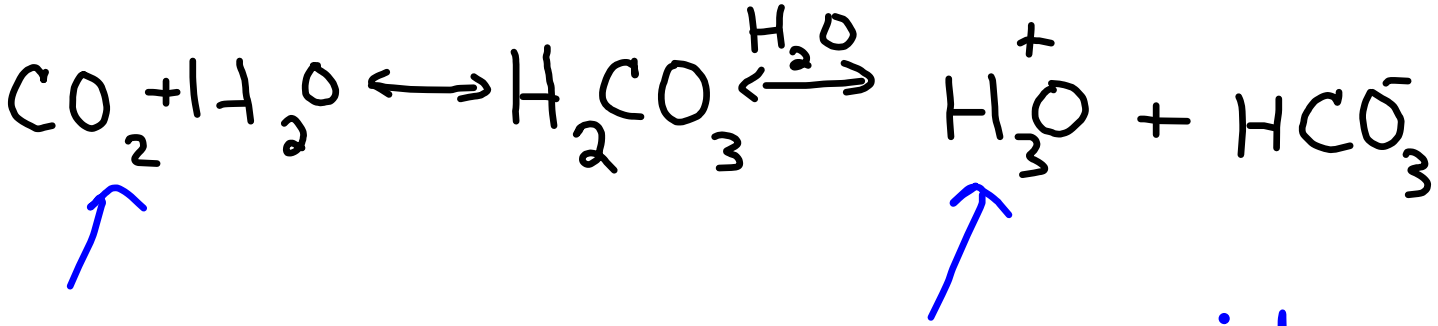
Example of sig figs.

pH = 4.738 pOH = 9.262

$[H^+] = 1.83 \times 10^{-5}$ $[OH^-] = 5.47 \times 10^{-10}$

Blood Buffer

pH = 7.35 to 7.45



produced as an end product of cellular metabolism

excess acid enters blood fluids and reacts w/ HCO_3^-

3c. buffer problem w/ weak acid and weak base

$$pH = 3.40 + \log\left(\frac{.057}{.132}\right)$$

$$= 3.40 + (-.3646)$$

$$= 3.035$$

$$= 3.04$$

4 a.

Without any NaOH yet

0 mL

$$HC_2H_3O_2 + NaOH \rightarrow NaC_2H_3O_2 + H_2O$$

$\varnothing$

$$HC_2H_3O_2 \leftrightarrow H^+ + C_2H_3O_2^-$$

.100 x x

$$1.8 \times 10^{-5} = \frac{x^2}{.100}$$

$$x = 1.342 \times 10^{-3}$$

$[H^+] = 1.342 \times 10^{-3}$ 1.3×10^{-3} taken from the K_a value

pH = 2.87

pOH = 11.13

4 b. $HC_2H_3O_2 + NaOH \rightarrow NaC_2H_3O_2 + H_2O$

5mL

$$.100 = \frac{x}{.03}$$

$$\frac{30mL \times 1L}{1000mL}$$

$x = .003 mol$

$$\frac{x}{.005} = .100$$

$$\frac{5mL \times 1L}{1000mL} =$$

$x = .0005 mol$

$$HC_2H_3O_2 + NaOH \rightarrow NaC_2H_3O_2 + H_2O$$

.003	.0005	0	0
− .0005			
.0025	0	.0005	.0005

$$pK_a = \log(1.8 \times 10^{-5})$$

$$pK_a = 4.745$$

$$pH = pK_a + \log\frac{[B]}{[A]}$$

$$pH = 4.745 + \log\left(\frac{.0005}{.0025}\right)$$

$$= 4.745 + (-.778)$$

$$pH = 4.046$$

$$pH = 4.05 \quad pOH = 9.95$$

$HC_2H_3O_2 \longleftrightarrow C_2H_3O_2^- + H^+$

acid base

4 c.

$$HC_2H_3O_2 + NaOH \rightarrow NaC_2H_3O_2 + H_2O$$

.003mol

$HC_2H_3O_2$ Stays as .003

$$\frac{x}{.015} = .100$$

$$x = .0015 \text{ mol}$$

$K_a = 1.8 \times 10^{-4}$

$HC_2H_3O_2 + NaOH \rightarrow NaC_2H_3O_2 + H_2O$

.003	.0015	0	0
−.0015	0	.0015	.0015
.0015			

$$pH = 4.745 + \log\left(\frac{.0015}{.0015}\right)$$

$$pH = pK_a = 4.75$$

$$pOH = 9.26$$

Half way to the equilvalence point !!

25 mL

$$HC_2H_3O_2 + NaOH \rightarrow NaC_2H_3O_2 + H_2O$$

.003

$$\frac{x}{.025} = .100$$

$$x = .0025 \text{ mol}$$

25mL

$$HC_2H_3O_2 + NaOH \rightarrow NaC_2H_3O_2 + H_2O$$

	.003	.0025	0	0
−	.0025			
	.0005	0	.0025	.0025

$pH = pK_a + \log\left(\frac{.0025}{.0005}\right)$ (4.745)

$pH = 5.444$

$pH = 5.44$ $pOH = 8.56$

1) pH = 4.814

2) pH = 8.75

$NaNO_2 + H_2O \leftrightarrow NaOH + HNO_2$

30 mL

$HC_2H_3O_2 + NaOH \rightarrow NaC_2H_3O_2 + H_2O$

.003	0	.003
.003		.060
x	0	

$\frac{x}{.03} = .100$

$x = .003$

equivalance pt.

The acid and base are in equal amounts

Need to switch to the reverse rxn

$HC_2H_3O_2 + NaOH \rightarrow NaC_2H_3O_2 + H_2O$

.003 ← has gone to the other side

$NaC_2H_3O_2 + H_2O_{(l)} \rightarrow HC_2H_3O_2 + NaOH$

total → .05 — x — x

strong base use K_b

$\frac{.003}{.060} = .05\,M$ — mL total

$K_b = \frac{1 \times 10^{-14}}{1.8 \times 10^{-5}}$

$K_b = 5.55\overline{5} \times 10^{-10}$

$\frac{x^2}{.05} = 5.556 \times 10^{-10}$

$x = 5.27 \times 10^{-6}$

$pOH = 5.28 \quad pH = 8.72$

Beyond the equivalance point

31 mL

$\frac{x}{.031} = .1 \quad x = .0031$

$HC_2H_3O_2 + NaOH \rightarrow NaC_2H_3O_2 + H_2O$

.003 mol .0031 mol

.0031 mol .0001 mol

- .0021 mol

moles left of NaOH $\rightarrow \frac{.0001 \text{ mol}}{.061 \text{ L}} = 1.6 \times 10^{-3} \text{ M}$

30 mL + 31 mL = total mL

pOH = 2.79 pH = 11.21

$NaC_2H_3O_2 + H_2O \rightarrow NaOH + HC_2H_3O_2$

.100

5

19mL

$HClO + NaOH \rightarrow NaClO + H_2O$

	.002	.0019	
−	.0019		
	.0001	∅	.0019

$pH = 7.456 + \log\left(\frac{.0019}{.0001}\right)$

$= 7.456 + (1.279)$

$= 8.735$

$= 8.74$ $\quad pOH = 5.27$

buffer 7.456 ± 1

buffer starts breaking down

20 mL

$\frac{x}{.02} = .1$

$HClO + NaOH \rightarrow NaClO + H_2O$

.002 .002

- .002

$\emptyset$ $\emptyset$ .002 H_2O (l)

← collect over here

$NaClO + H_2O_{(l)} \rightarrow HClO^- + OH^-$

.0333 − x x x

$(.1)(20) = x(60)$

$x = .0333$

$\frac{.002 mol}{.060 L} = .0333$

$K_b = \frac{1 \times 10^{-14}}{3.5 \times 10^{-8}} = 2.857 \times 10^{-7}$

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$

(s) (g) (g) (g)

$$\underset{.0333-x}{NaClO} + \underset{(\ell)}{H_2O} \rightarrow \underset{x}{HClO^-} + \underset{x}{OH^-}$$

$$\frac{x^2}{.0333} = 2.857 \times 10^{-7}$$

$$x = 9.754 \times 10^{-5}$$

$$x = 9.8 \times 10^{-5}$$

$$pH = 9.99 \qquad pOH = 4.01$$

21 mL

$\frac{x}{.021} = .1$

$HClO + NaOH \rightarrow NaClO + H_2O$

.002	.0021	.002
.002	.002	
0	.0001	

$Na^+ + OH^-$

Rules everything out b/c it is a strong base.

$\frac{.0001 \text{ mol}}{.061 \text{ L}} = [1.64 \times 10^{-3}] = [OH^-]$

pOH = 2.79 pH = 11.21

30 ml

$$\frac{x}{.03} = .1$$

$$HClO + NaOH \rightarrow NaClO + H_2O$$

	.002	.003	.002	
	.002	-.002		
	0	.001 mol		

Na^+ OH^-

$$[OH^-] = \frac{.001 mol}{.070L} = 1.43 \times 10^{-2} = [OH^-]$$

$$pOH = 1.84$$

$$pH = 12.16$$

Quiz Wed.

1. 0.00mL
2. Half way to the Equivalence pt
3. Over or at equivalence pt.

HClO

5.) **Without any NaOH yet**

The simple acid equation with no NaOH added

6) Half way to the equilvalence point !!

pH = pKa b/c the concentrations of the acid and base are the same.

7.) Need to switch to the reverse rxn

Must use reverse reaction b/c NaOH now becomes important.

Lab: .022 M at the end.

8) **Beyond the equivalance point**

Must use reverse reaction b/c NaOH now becomes important.

Must use total amount of mL for the salt (NaClO). Use the Kb