PROBLEM SET 5 KEY

Consider the following Titration Conditions

0.35 M ACID	0.45 M BASE	Equation/work	pH
No Acid	75 ml of Diethylmethyl amine pK_b=3.65	$pOH = \frac{1}{2}(3.65 - \log[.45]) = 2.00$ $pH = 14 - 2.00 = \boxed{12.00}$	
45 ml Formic Acid (pKa)=3.17 0.01575	35 ml of NaOH 0.01575	Endpoint $pH = 7 + \frac{1}{2}\left(3.17 + \log\left(\frac{.01575}{.08}\right)\right) = \boxed{8.23}$	
90 ml HCl .0315	70 ml NH_3 (pK_b = 4.75) .0315	Endpoint $pH = 7 - \frac{1}{2}\left(4.75 + \log\left(\frac{.0315}{.160}\right)\right) = \boxed{4.98}$	
100 ml Chloroacetic Acid (pKa=2.85) .0350	.0315 35 ml $Ca(OH)_2$	$pH = 2.85 - \log\left(\frac{0.035 - .0315}{.0315}\right) = \boxed{3.80}$	
100 ml of HCl .035	100 ml of Methylamine pK_b=3.34 .045	$pOH = 3.34 - \log\frac{(.045 - .035)}{(.035)} = 3.88$ $pH = 14 - 3.88 = \boxed{10.12}$	
45ml of Sulfuric Acid 0.01575 ×2	70 ml of NaOH .03150	Equivalence Pt $pH \sim \boxed{7.00}$ Assuming H_2SO_4 is Double(2) strong Acid	
90 ml of Cyanic Acid (HCNO) pKa = 3.46	17.5 ml of $Sr(OH)_2$	$pH = 3.46 - \log\frac{(.0315 - .01575)}{.01575} = \boxed{3.46}$	

.0315

.007875
×2
.01575

Buffers

Using the facts that Formic Acid (pK_a= 3.75), 2-Chlorobutanoic acid (pKa=2.86), and 4-Chlorobutanoic acid (pKa=4.52); show THREE ways to construct a BUFFER solution at pH=3.75 using the following: *(Hint be careful all of the concentrations are not equal)*

A	0.30M solution of Formic Acid
B	0.15M solution of Sodium Hydroxide
	0.30M solution of Potassium 4-Chlorobutanate
C	0.60M solution of Potassium Formate
D	0.10M solution of Nitric Acid
	0.30M solution of 4-Chlorobutanoic acid
	0.20M solution of Sodium Lactate
	0.20M solution of 2-Chlorobutanoic acid
	0.30M solution of Sodium 2-Chlorobutanate

Use closest pKa acid (Formic Acid pKa=3.75)

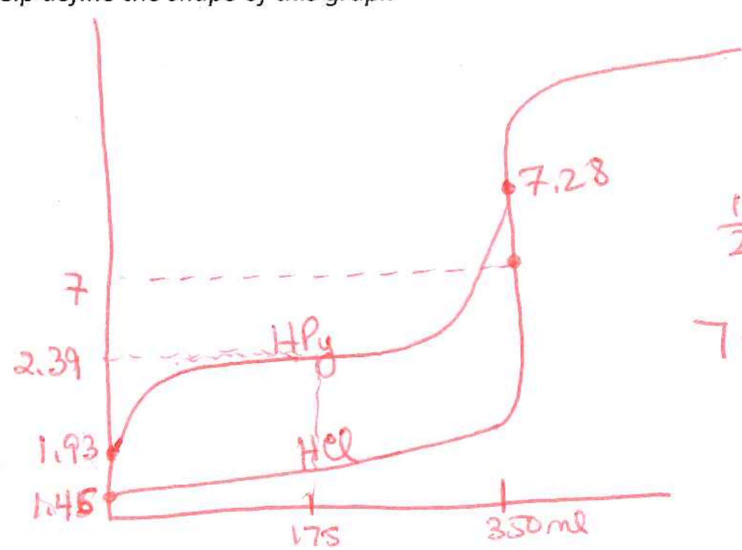
2part A + 1 part C $\quad HA + A^-$

1 part A + 1part B $\quad HA + \frac{1}{2} OH^-$

1 part C + 3 part D $\quad A^- + \frac{1}{2} HNO_3$

Titration

Draw a reasonable titration curve for the reaction of 250 ml 35mM Pyruvic acid (pK_a= 2.39) with 0.025M Potassium hydroxide. Contrast this with the titration curve for a 35 mM Hydrochloric acid *Remember* ***the THREE(3)*** *important pH's that help define the shape of this graph*



$(.250)(35) = (V)(25)$

$V = .350L = 350\,ml$

$\frac{1}{2}(2.39 - \log(.035)) = 1.93$

$7 + \frac{1}{2}\left(2.39 + \log\left(\frac{.00875}{.600}\right)\right) = 7.28$

A nitrous acid buffer is prepared by adding **150ml of 0.481** M nitrous acid (pKa = 3.35) to **100 ml of 0.314 M** sodium nitrite. **What is the pH of this buffer**?

$$pH = 3.35 - \log\frac{(.15)(.481)}{(.10)(.314)} = \boxed{2.99}$$

NOW 50 ml of 0.15M Calcium Hydroxide is added to 100ml of this buffer, what is the final pH?

$2(.05)(.15) = .015\,moles\,OH^-$

Careful here only 100 ml of 250 ml is used

moles of HA = 0.02886 = $\frac{2}{5}(.15)(.481)$

moles of A^- = 0.01256 = $\frac{2}{5}(.1)(.314)$

$$pH = 3.35 - \log\left(\frac{.02886 - .015}{.01256 + .015}\right) = \boxed{3.65}$$