BUFFER AND TITRATION KEY

1. Write the molecular, ionic and net ionic reactions for adding hypochlorous acid (HClO) with calcium hydroxide.

   molecular__ $2\ HClO(aq) + Ca(OH)_2\ (aq) \rightarrow 2\ H_2O(l) + Ca(ClO)_2(aq)$

   ionic_ $2\ HClO(aq) + Ca^{2+}(aq) + 2\ OH^-(aq) \rightarrow 2\ H_2O(l) + Ca^{2+}(aq) + 2\ ClO^-(aq)$

   net ionic_ $HClO(aq) + OH^-(aq) \rightarrow H_2O(l) + ClO^-(aq)$

2. Calculate the pH of a 2.00 L solution containing 0.885 moles of hypochlorous acid (HClO) and 0.905 moles of NaClO. Given K_a for HClO is 3.0×10^{-8}.

   This is a buffer. We can use the buffer equation. pKa = 7.5229

   $$pH = 7.5229 + \log\left[\frac{0.905 mol / 2.00 L}{0.885 mol / 2.00 L}\right] = \mathbf{7.53}$$

3. Calculate the pH if 50.0 mL of 0.125M nitric acid is added to a 2.00L buffer system composed of 0.250M acetic acid and 0.250M lithium acetate.

   Acetic acid moles = acetate ion moles = 2.00L (0.250 mol / L) = 0.500 moles
   Nitric acid moles = 0.0500L (0.125 mol / L) = 0.00625 mol

   Ka from text = 1.8×10^{-5} so pKa = 4.7447

   Rxn is the H^+ from nitric acid with the c. base of the buffer or acetate ion

	$H^+(aq) + CH_3COO^-(aq) \rightarrow HCH_3COO^-(aq)$		
I	0.00625 mol	0.500mol	0.500 mol
C	- 0.00625	- 0.00625	+ 0.00625
Final	0	0.49375 mol	0.50625 mol

   All the nitric acid is used up and reacted, and we still have buffer left, use buffer equation

   $$pH = 4.7447 + \log\left[\frac{0.49375 mol / 2.05 L}{0.50625 mol / 2.05 L}\right] = \mathbf{4.73}$$

4. How many milliliters of 0.95M NaOH must be added to 35.0 mL of 0.85M CH_3COOH to reach the equivalence point? What is the pH at the equivalence point? Given: K_a for acetic acid is 1.8×10^{-5}

   Finding the volume of NaOH is stoichiometry.

   35.0 mL (L / 1000 mL)(.85 mol / L)(1 NaOH / 1 acid)(L / 0.95 mol)(1000mL / L) = **31 mL**

   To find the pH we need the reaction with IF table in moles. So calc all the moles and put in table:

Rxn	$CH_3COOH(aq)$ +	$NaOH(aq)$ →	$NaCH_3COO\ (aq)$ +	$H_2O\ (l)$
I	0.02975 mol	.02975 mol	0	----
C	- 0.02975	- 0.02975	+ 0.02975	-----
F	0	0	0.02975 mol	----

   This makes sense because at the equivalence point all the acid and base are used up and only salt remains. This salt, sodium acetate, is a basic salt. The sodium ion is neutral, but the acetate ion is basic. This is an ICE table so we need molarity in it, not moles. Basically now we find the pH of a salt solution.

Rxn	$CH_3COO^-\ (aq)$ +	$H_2O\ (l)$ ⇆	$CH_3COOH\ (aq)$ +	$OH^-\ (aq)$
I	.4508 M	--	0	0
C	-x	--	x	x
E	.4508 – x	--	x	x

   $K_b = K_w / K_a = 5.5556 \times 10^{-10} = x^2 / .4508$
   $X = 1.58 \times 10^{-5}$ approximation checks
   pH = 9.20

5. Calculate the pH when 25.0 mL of 0.100M HBr is added to 15.0 mL of 0.100M LiOH.

Rxn	$HBr(aq)$ +	$LiOH\ (aq)$ →	$LiBr(aq)$ +	$H_2O(l)$
I	.00250 mol	.00150 mol	0	--
C	-.00150	-.00150	+.00150	--
F	.00100 mol	0	.00150 mol	--

   $[H^+]$ = .00100 mol / .0400 L = .0250 M so **pH = 1.602**