This is ACA # 24. It is OK to use your textbook, but if you can answers the questions without it that is OK too.

I recommend you print out this page and bring it to class. Click here to show a set of five ACA24 student responses, randomly selected from all of the student responses thus far, in a new window.

John , here are your responses to the ACA and the Expert's response.

Our discussion of acids and bases has prepared you to calculate the pH of the following solutions,

strong acids
weak acids
strong bases
weak bases
the salt of a strong acid and a strong base
the salt of a strong acid and a weak base
the salt of aweak acid and a strong base
common ion - weak acid and its conjugate base
common ion - weak base and its conjugate acid

A secret for calculating the pH of neutralization reactions/titration curves is recognizing which of the above solution is formed after mixing an acid and a base.

Here is an example of what I mean;

Predict the type of solution formed when 30.0 mL of 0.450 M NaOH is added to 15.0 mL of 0.800 M HCl.

To answer this question we write the neutralization equation and set up an ICF table. In an ICF table we have to work in moles of each component. So we must determine the moles of NaOH and HCl we have initially before any reaction occurs. Below is the completed ICF table.

	NaOH	+	HCl	$\rightleftarrows$	NaCl	+	H_2O
Initial	0.0135 mol		0.012 mol		0		-

Change	**-.012**	**-.012**	**.012**	**-**
Final	**0.0013**	**0**	**.012**	**-**

Looking at the the Final row we can make the following observations....

The final condition after the reaction occurs shows moles NaOH and the salt NaCl are present. Since the salt NaCl does not effect the pH of the solution only strong base is important in determining the pH of the solution. So mixing 30.0 mL of 0.450 M NaOH is added to 15.0 mL of 0.800 M HCl yields a solution of a strong base. We can calculate the pH of a strong base by taking the moles of the NaOH in the Final row and dividing by the total volume of the mixture and then doing the -log thing.

So now you try it....

1. Indicate what substances are present in the solution (Final row) when, (NOTE: you must follow the procedure described above)

a) 30.0 mL of 0.100 M NaOH are mixed with 25.0 mL of 0.100 M HBr **a strong base and a salt of a strong acid and a strong base** 57%

The solution contains moles of NaOH and moles of NaBr after mixing. This is a solution of a strong base.
Below is how the expert arrived at this answer....

	NaOH(aq) +	HBr(aq)	⇄	NaBr(aq) +	$H_2O(l)$
I	0.00300 mol	0.00250 mol		0	-
C	-0.00250 mol	-0.00250 mol		+0.00250 mol	-
E	0.00050 mol	0		+0.00250 mol	-

The solution contains moles of NaOH and moles of NaBr after mixing.

b) 20.0 mL of 0.0372 M NaOH are mixed with 34.0 mL 0.0520 M $HC_2H_3O_2$ common ion of a weak acid and its conjugate base (salt) 57%

The solution contains moles of $HC_2H_3O_2$ and moles of $NaC_2H_3O_2$ after mixing. This is a solution of a weak acid and its salt.
Below is how the expert arrived at this answer....

	NaOH(aq) +	$HC_2H_3O_2$(aq)	⇄	$NaC_2H_3O_2$(aq) +	H_2O(l)
I	0.000744 mol	0.00177 mol		0	-
C	-0.000744 mol	-0.000744 mol		+0.000744 mol	-
E	0	0.00103 mol		+0.000744 mol	-

The solution contains moles of $HC_2H_3O_2$ and moles of $NaC_2H_3O_2$ after mixing.

c) 40.0 mL of 0.234 M NH_3 are mixed with 34.0 mL 0.135 M HCl common ion solution, of a weak base and its conjugate acid (salt) 57%

The solution contains moles of NH_3 and moles of NH_4Cl after mixing. This is a solution of a weak base and its salt.
Below is how the expert arrived at this answer....

	NH_3(aq) +	HCl(aq)	⇄	NH_4Cl(aq)
I	0.00936 mol	0.00459 mol		0
C	-0.00459 mol	-0.00459 mol		+0.00459 mol
E	0.00477 mol	0		+0.00459 mol

The solution contains moles of NH_3 and moles of NH_4Cl after mixing.

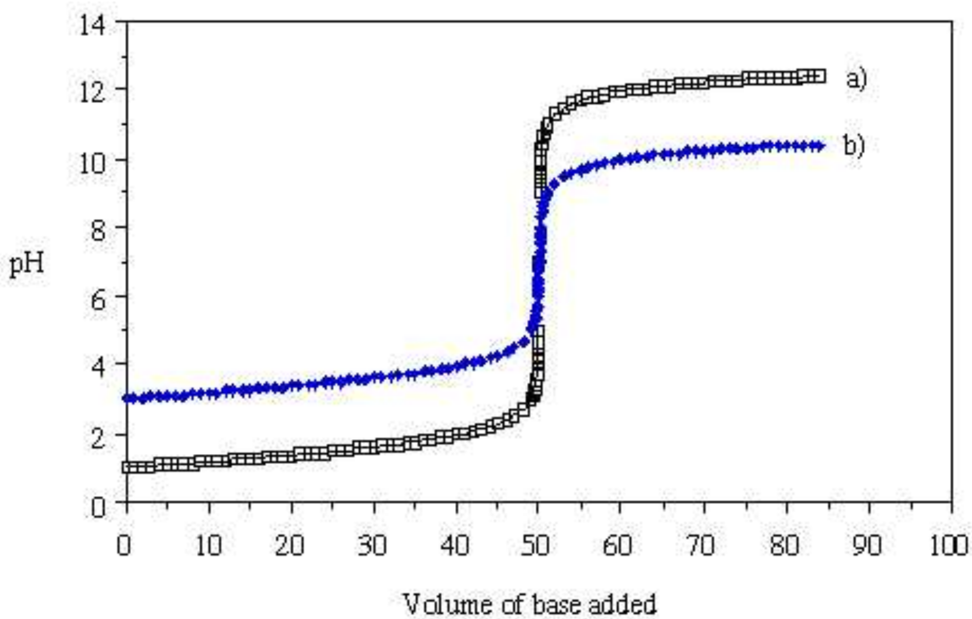
2. For each case in Q1 after the mixtures have been prepared, indicate whether the solution is acidic, basic or neutral.

a) basic The solution in 1a is basic. 57%

b) acidic The solution in 1b is acidic. (Note: K_a for $HC_2H_3O_2$ is greater than K_b for $C_2H_3O_2^-$.) 62%

c) basic The solution in 1b is basic. (Note: K_b for NH_3 is greater than K_a for NH_4^+.) 67%

3. Below is a figure showing two titration curves,



List some similarities and some differences in the solutions used to generate these titration curves. Use a) and b) to differentiate between the two systems.

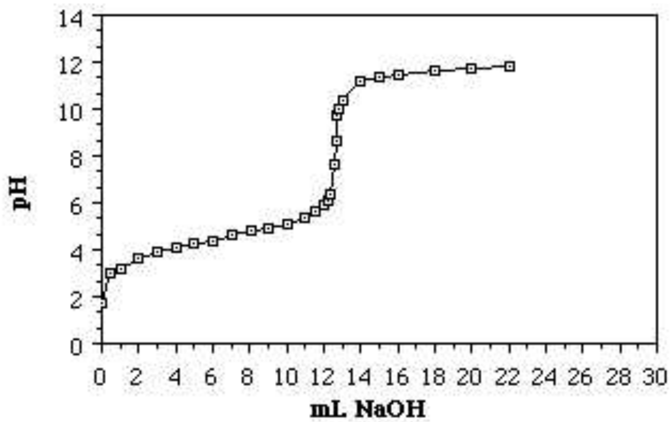
Similarities : equivalence point requires the same volume of base; the same equivalence point pH; both titrations involve a strong acid and a strong base

In both titrations a strong base is added to a strong acid. The equivalence point pH is the same for both acids (7). The same volume of base is required for each titration.

Differences : initial concentration of the strong acids are different; the concentration of the strong bases are different

The initial concentration of the acid is different, and the initial concentration of the base in each titration is different. Solution a) is a higher concentration of the strong acid compared to Solution b)

4. Below is a titration curve. What can you tell me about the solutions used to produce this titration curve?



the acid is most likely weak, while the base is most likely strong

This a titration of a weak acid and a strong base. The end point/equivalence point is NOT 7, but is basic. This is characteristic of a weak acid/strong base titration. Notice the pH of the solution in the early part of the titration is very different compared to the the pH of the solution in the early part of the titration in the curves of the SA/SB titration. Looks like the concentration of the base in this titration is the same as the concentration in curve a) in Q3.

4. Is there anything about the questions that you feel you do not understand? List your concerns/questions.

nothing

5. If there is one question you would like to have answered in lecture, what would that question be?

nothing