This is ACA # 23. 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 ACA23 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.

1. The following three substances are salts. For each identify the ions found in an aqueous solution.

$NaC_2H_3O_2$	$C_2H_5NH_3Cl$	KC_6H_5O
cation Na^+ 78%	cation C2H5NH3^+ 61%	cation Cl^-
Na^+ 22% no charge	17% Cl $C_2H_5NH_3^+$ 11% no charge	K^+ 72%
anion C2H3O2^- 73%	anion Cl^- 67%	27% no charge anion K^+
$C_2H_3O_2^-$ 27% no charge	Cl^-	$C_6H_5O^-$ 61% 33% no charge

These three substances are all soluble salts. In fact almost ALL salts formed in neutralization reactions are soluble. So for our purposes we will assume these salts are soluble. Since the salts are soluble, and all salts are ionic we can separate the salts into their component ions. One of the more difficult things for students to do is to correct identify the cation and anion in salts of strong/weak acids and strong/weak bases.

2. Predict whether the pH of 0.1 M solutions of each of the salts is greater, less or equal to 7.

Salt (0.1M)	pH (greater, equal or less than 7)
	greater than 7 pH >7 94%

$NaC_2H_3O_2$	Na^+ comes from a strong base so it will not effect the pH of the solution $C_2H_3O_2^-$ is the congugate base of a weak acid so it will act as a base in solution and the pH is greater than 7
$C_2H_5NH_3Cl$	less than 7 pH < 7 94% less lower X $C_2H_5NH_3^+$ is the congugate acid of a weak base so it will act as a acid in solution and the pH is less than 7 Cl^- is the conjugate base of a strong acid so it will not effect the pH of the solution
KC_6H_5O	greater than 7 pH > 7 77% K^+ comes from a strong base so it will not effect the pH of the solution $C_6H_5O^-$ is the congugate base of a weak acid so it will act as a base in solution and the pH is greater than 7

3. In a 0.10 M $NaC_2H_3O_2$ solution which ion effects the pH of the solution?

C2H3O2^- 72%

$NaC_2H_3O_2$ is a salt of a strong base and a weak acid. Salts (Na^+) of strong bases do not effect the pH of water. Salts of weak acids do. So $C_2H_3O_2^-$, the conjugate base of the weak acid $HC_2H_3O_2$, effects the pH of the solution.

4. Write a Bronsted-Lowry equation which describes the acid/base character of the ion

in Q3. (Hint: if you have indicated the salt has the properties of a base write a BL equation which supports that behavior.)

C2H3O2^-(aq) + H2O(l) ---> HC2H3O2(aq) + OH^-(aq) 83%

When we write the chemical equation describing how $NaC_2H_3O_2$ behaves as a base we neglect the Na^+ and only use $C_2H_3O_2^-$ in the equation. The reaction is

$$C_2H_3O_2^- + H_2O \rightleftharpoons HC_2H_3O_2 + OH^-$$

5. Calculate the pH of 0.10 M $NaC_2H_3O_2$ solution.

pH = 8.88 72%

pH = 8.88

	$C_2H_3O_2^-(aq)$ +	$H_2O(l)$	$\rightleftharpoons$	$HC_2H_3O_2(aq)$ +	$OH^-(aq)$
I	0.1	-		0	~0
C	-x	-		+x	+x
E	0.1 - x	-		+x	+x

$K_b = [HC_2H_3O_2][OH^-]/[C_2H_3O_2^-]$

$K_b = K_w/ K_a(HC_2H_3O_2) =(1.00 \times 10^{-14})/(1.75 \times 10^{-5}) = 5.7 \times 10^{-10}$

$K_b= 5.7 \times 10^{-10} = [x][x]/[.1 - x]$

we can assume 0.1 - x = 0.1

$5.7 \times 10^{-10}*(.1) = x^2$

7.6×10^{-6} M $= x = [OH^-]$

So the pOH = 5.12 and the pH = 8.88

6. Calculate the pH of a solution that is 0.10 M $HC_2H_3O_2$ and 0.10 M $NaC_2H_3O_2$. Hint: Write the chemical reaction for the weak acid dissociation for the ICE table. Just be careful when you enter the initial concentration of each species in the chemical equation.)

pH = 4.75 77%

pH = 4.76

	$C_2H_3O_2^-(aq)$ +	$H_2O(l)$	$\rightleftharpoons$	$HC_2H_3O_2(aq)$ +	$OH^-(aq)$
I	0.1	-		0.1	~0
C	-x	-		+x	+x
E	0.1 - x	-		0.1 + x	+x

$K_b = [HC_2H_3O_2][OH^-]/[C_2H_3O_2^-]$

$K_b = K_w/ K_a(HC_2H_3O_2) =(100 \times 10^{-14})/(1.75 \times 10^{-5}) = 5.7 \times 10^{-10}$

$K_b= 5.7 \times 10^{-10} = [0.1 + x][x]/[.1 - x]$

we can assume x <<< 0.1

$K_b= 5.7 \times 10^{-10} = [0.1][x]/[.1]$

5.7×10^{-10} M= x = $[OH^-]$

So the pOH = 9.24 and the pH = 4.76

Something interesting in this problem...when we have a solution containing a weak acid and its conjugate base, whether the solution is acidic or basic depends on which component has the larger equilibrium constant, the acid or the base. If the acid (as in

this case) has the larger K the solution is acidic.

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

nothing

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

nothing

Do we need more than one ICE table to find pH with multiple salts?