This is ACA # 22. 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 ACA22 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. Write the formula of the salt formed when the following acid and base react. Indicate the acid/base properties of a solution of the salt as either neutral, greater than 7, or less than 7.

Acid	Base	Formula of the salt	Acid base properties
HNO_3	KOH	KNO3 90% KNO_3	neutral 76% neutral
HCl	NH_3	NH4Cl 76% NH_4Cl	acidic 87% acidic pH < 7
$HC_3H_5O_2$	NaOH	NaC3H5O2 90% $NaC_3H_5O_2$	basic 90% basic pH > 7
HBr	$C_6H_5NH_2$	C6H5NH3Br 57% $C_6H_5NH_3Br$	acidic 81% acidic pH < 7

NH_3Cl 10%

2. For each of the following salts indicate the formula of the anion and the cation in the salt, the formula of the acid and base that had to react to form the salt. Indicate the acid/base properties of a solution of the salt as either neutral, greater than 7, or less than 7. For example:

KCN is a salt: the cation is K^+ : the anion is CN^-. The acid and base that reacted to form the salt are HCN (a weak acid) and KOH (a strong base). Since K^+ comes from a strong base, K^+ will not effect the pH of the solution. The anion CN^- come from a weak acid, and therefore can effect the pH of the solution. Since CN^- is the conjugate base of HCN, it is basic and the pH of the solution will be greater than 7.

Formula of the salt	Cation	Anion	Acid	Base	Acid base properties
KCN	K^+	CN^-	HCN	KOH	pH is greater than 7

Complete the following table for the two salts.

Formula of the salt	Cation	Anion	Acid	Base	Acid base properties of the salt
KClO	K^+ 90% K^+	ClO^- 90% ClO^-	HClO 90% HClO	KOH 95% KOH	basic 76% basic pH > 7
$CH_3NH_3NO_3$	CH3NH3^+ 67% $CH_3NH_3^+$	NO3^- 87% NO_3^-	HNO3 87% HNO_3	CH3NH2 50% CH_3NH_2	acidic 82% acidic pH < 7

3. Based on the acid base properties you assigned to KClO and $CH_3NH_3NO_3$ write the balanced chemical equation that describes the acid base character of the ion that controls the pH of the solution. For the example in Q2 we had concluded that CN^- controls the pH of the solution, so we can write a chemical equation that describes how CN^- behaves as a base.

$$CN^- + H_2O \rightleftarrows HCN + OH^-$$

Write the chemical equation for each salt from Q2:

KClO

ClO^-(aq) + H2O(l) -->HClO(aq) + OH^-(aq)

$ClO^- + H_2O \rightleftarrows HOCl + OH^-$ 62%

Because K^+ comes from a strong base it will not effect the pH of the solution so we can neglect it.

$CH_3NH_3NO_3$

CH3NH3^+(aq) + H2O(l) --> CH3NH2(aq) + H3O^+(aq)

$CH_3NH_3^+ + H_2O \rightleftarrows CH_3NH_2 + H_3O^+$ 52%

Because NO_3^- comes from a strong acid it will not effect the pH of the solution so we can neglect it.

4. Calculate the pH of a 0.100 M KClO solution. (NOTE: K_a (HClO) = 3.0 x 10^{-8})

Here is a table of equilibrium constants to help answer this question.)

pH == 10.26 38%

We need to setup the ICE table for this dissociation:

	ClO^-	$+ H_2O$	$\rightleftharpoons$	HOCl	$+ OH^-$
Initial	0.100 M	-------		~0	0
Change	- x	-------		+ x	+ x
Equilibrium	0.100 - x	-------		0 + x	0 + x

$K_b = K_w/K_a(HClO) = 1.0 \times 10^{-14}/3.0 \times 10^{-8} = [HOCl][OH^-]/[ClO^-]$

$3.3 \times 10^{-7} = (x)(x)/(0.100 - x)$

Assume x <<<< 0.100 M because K_b is very small compared to the initial concentration of the weak acid. So 0.100 - x reduces to 0.100 because x is so small compared to 0.100 .

$3.3 \times 10^{-7} = (x)(x)/(0.100)$

$3.3 \times 10^{-8} = x^2$

$x = 1.8 \times 10^{-4}$ M = $[OH^-]$

pOH = -log $[OH^-]$

pOH = -log (1.8×10^{-3}) = 3.74

pH = 14 - pOH = 14 - 3.74 = 10.26

5. Calculate the pH of a 0.100 M $CH_3NH_3NO_3$ solution. (NOTE: Here is a table of equilibrium constants to help answer this question.)

pH = 5.82 38%

We need to setup the ICE table for this dissociation:+ $H_2O \rightleftarrows CH_3NH_2 + H_3O^+$

	$CH_3NH_3^+$	$+ H_2O$	$\rightleftharpoons$	CH_3NH_2	$+ H_3O^+$
Initial	0.100 M	-------		~0	0
Change	- x	-------		+ x	+ x
Equilibrium	0.100 - x	-------		0 + x	0 + x

$K_a = K_w/K_b(CH_3NH_2) = 1.0 \times 10^{-14}/4.4 \times 10^{-4} = [CH_3NH_2][H_3O^+]/[CH_3NH_3^+]$

$2.3 \times 10^{-11} = (x)(x)/(0.100 - x)$

Assume x <<<< 0.100 M because K_a is very small compared to the initial concentration of the weak acid. So 0.100 - x reduces to 0.100 because x is so small compared to 0.100 .

$2.3 \times 10^{-11} = (x)(x)/(0.100)$

$2.3 \times 10^{-12} = x^2$

$x = 1.5 \times 10^{-6}$ M = $[H_3O^+]$

pH = -log $[H_3O^+]$

pH = -log (1.5×10^{-6}) = 5.82

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

nothing

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

nothing