

Name: \_\_\_\_\_

Period: \_\_\_\_\_

Seat#: \_\_\_\_\_

**Purpose:** Experimentally verify the predicted and calculated pH of different salts.

**Background:**

A salt is the product formed when a \_\_\_\_\_ reacts with a \_\_\_\_\_. When you put a salt into water the salt can make the solution acidic, basic, or neutral. It is possible to predict whether a salt is acidic, basic, or neutral. In order to do this you must first look to see which compound the salt ions originally came from. If the ion came from a:

Strong Acid then the salt ion will make the solution \_\_\_\_\_

Strong Base then the salt ion will make the solution \_\_\_\_\_

Weak Acid then the salt ion will make the solution \_\_\_\_\_

Weak Base then the salt ion will make the solution \_\_\_\_\_

Once you have identified the property of each salt ion, you must see how they will contribute to the pH when they are both present in the same solution

Acidic ion + Neutral ion will make the solution \_\_\_\_\_

Basic ion + Neutral ion will make the solution \_\_\_\_\_

Neutral ion + Neutral ion will make the solution \_\_\_\_\_

Acidic ion + Basic ion will require that you compare \_\_\_\_\_  
in order to predict if solution is acidic/basic/neutral

When you have a combination of an acidic ion and a basic ion you will need to know how “strong” each one is by comparing their K values. Below is a chart that summarizes how you can predict if the salt is acidic/basic/neutral by comparing the K values.

$K_{\text{acid}} < K_{\text{base}}$  then the salt is acidic

$K_{\text{acid}} > K_{\text{base}}$  then the salt is basic

$K_{\text{acid}} = K_{\text{base}}$  then the salt is neutral

It is one thing to theoretically predict if a salt is acidic/basic/neutral, but if you know the concentrations and K values you can calculate the actual pH of the solution. In this activity you will predict if the salt is acidic/basic/neutral but then you will also do the math and calculate the theoretical pH of the salt solution. Then you will use pH paper to verify whether or not your calculated pH matches your experimental findings.

**Remember:**

You may need to use  $K_w = K_a \times K_b$  to do your calculations. Also remember that  $K_w$  will vary depending on the temperature of the water!  $K_w$  is only  $1 \times 10^{-14}$  if the water is 25 °C. Below is a general range of  $K_w$  values based on temperature in case your water is not actually at 25 °C. Pick the  $K_w$  value that is closest to the temperature of the water you are using in the lab activity. (Yes, I know it is a big range, best chart we have right now ☺)

Temp. °C	0	10	20	25	30	40	50	100
K <sub>w</sub>	$0.114 \times 10^{-14}$	$0.293 \times 10^{-14}$	$0.681 \times 10^{-14}$	$1.008 \times 10^{-14}$	$1.471 \times 10^{-14}$	$2.916 \times 10^{-14}$	$5.476 \times 10^{-14}$	$51.3 \times 10^{-14}$

**Salt #1 – 0.10 M sodium acetate,  $K_a$  for acetic acid =  $1.78 \times 10^{-5}$**

1) Write the equation for the dissociation of the sodium acetate.

2) Using your dissociation reaction above, predict if the salt is acidic/basic/neutral. Justify your prediction!

3) Write the hydrolysis reaction for anything that hydrolyzes.

4) Based on your hydrolysis reaction, what is the K value that you need to use? Remember – they don't always give you the K for the actual ion that is reacting with water! You need to always check if you have  $K_{(ion)}$

5) Solve for all the various items below. Remember – the order in which you solve for them may change depending on if you have an acidic, basic, or neutral salt and also your personal preferences!

*Theoretical  $[H_3O^+]$*

*Theoretical  $[OH^-]$*

*Theoretical pOH*

*Theoretical pH*

6) Using pH paper, test the pH of the 0.10 M sodium acetate solution. Record your observations below.

7) Discuss the difference between the theoretical pH calculation and the experimentally determined pH from the lab. If the numerical results are different are they at least in the correct range? (Acidic vs. Basic vs. Neutral)

**Salt #2 – 0.10 M sodium bicarbonate,  $K_a$  for carbonic acid =  $4.30 \times 10^{-7}$**

**8)** Write the equation for the dissociation of the sodium bicarbonate.

**9)** Using your dissociation reaction above, predict if the salt is acidic/basic/neutral. Justify your prediction!

**10)** Write the hydrolysis reaction for anything that hydrolyzes.

**11)** Based on your hydrolysis reaction, what is the K value that you need to use? Remember – they don't always give you the K for the actual ion that is reacting with water! You need to always check if you have  $K_{(ion)}$

**12)** Solve for all the various items below. Remember – the order in which you solve for them may change depending on if you have an acidic, basic, or neutral salt and also your personal preferences!

*Theoretical  $[H_3O^+]$*

*Theoretical  $[OH^-]$*

*Theoretical pOH*

*Theoretical pH*

**13)** Using pH paper, test the pH of the 0.10 M sodium bicarbonate solution. Record your observations below.

**14)** Discuss the difference between the theoretical pH calculation and the experimentally determined pH from the lab. If the numerical results are different are they at least in the correct range? (Acidic vs. Basic vs. Neutral)

**Salt #3 – 0.10 M ammonium chloride,  $K_b$  for ammonia =  $1.8 \times 10^{-5}$**

**15)** Write the equation for the dissociation of the ammonium chloride.

**16)** Using your dissociation reaction above, predict if the salt is acidic/basic/neutral. Justify your prediction!

**17)** Write the hydrolysis reaction for anything that hydrolyzes.

**18)** Based on your hydrolysis reaction, what is the K value that you need to use? Remember – they don't always give you the K for the actual ion that is reacting with water! You need to always check if you have  $K_{(ion)}$

**19)** Solve for all the various items below. Remember – the order in which you solve for them may change depending on if you have an acidic, basic, or neutral salt and also your personal preferences!

*Theoretical  $[H_3O^+]$*

*Theoretical  $[OH^-]$*

*Theoretical pOH*

*Theoretical pH*

**20)** Using pH paper, test the pH of the 0.10 M ammonium chloride solution. Record your observations below.

**21)** Discuss the difference between the theoretical pH calculation and the experimentally determined pH from the lab. If the numerical results are different are they at least in the correct range? (Acidic vs. Basic vs. Neutral)