FLINN SCIENTIFIC

Name_____

Data Tables

Table 1. Formation of a Salt

	pH Paper Color	pH Value
0.1 M Hydrochloric Acid, HCl		
0.1 M Sodium hydroxide, NaOH		
0.1 M HCl + 0.1 M NaOH		

Figure 1. Sketch and describe the solid residue on the slide.

Table 2. An Antacid in Action

	Observations
Initial color of solution (upset stomach)	
Color changes (antacid introduced)	
Additional stomach secretion	

Table 3. The Rainbow Reaction

	Observations
Colors observed top to bottom	

Table 4. Strength and Indicators

Solution	Concentration	pH paper color	pH	Effect on phenolphthalein	Label Strong or Weak? Acid or Base?
HCl	0.1 M				
H_2SO_4	0.1 M				
$HC_2H_3O_2$	0.1 M				
NaOH	0.1 M				

Table 5. Titration Data

Trial #	Concentration	Acid	Volume of acid (# drops)	Volume of 0.1 M NaOH (# drops)	Average Volume 0.1 M NaOH (# drops)
I	0.1 M	HCl			
II	0.1 M	HCl			
I	0.1 M	H_2SO_4			
II	0.1 M	H_2SO_4			
I	0.1 M	$HC_2H_3O_2$			
II	0.1 M	$HC_2H_3O_2$			
I	Unknown A	HCl			
II	Unknown A	HCl			
I	Unknown B	H_2SO_4			
II	Unknown B	H_2SO_4			

Questions and Analysis of Data

Refer to the data in your tables to answer the following questions

Part A. Neutralization — Formation of a Salt

1. a. What is the pH of 0.1 *M* HCl? of 0.1 *M* NaOH?

   b. What is the pH of an equal mixture of the two?

2. Write a balanced chemical equation for the neutralization reaction. (Remember: acid + base → salt + water)

3. What is the solid residue that is left on the depression slide after evaporating the solution? Give the name and the formula for this compound.

Part B. Neutralization of Acid Using an Antacid Tablet

4. What was the purpose of using the universal indicator solution?

5. Explain what caused the color change in the beaker of dilute HCl as the antacid tablet dissolved.

6. Write balanced chemical equations for the neutralization reactions that occur between the antacid tablet (which consists of calcium carbonate and magnesium hydroxide) and the acid. *Note:* Write a separate reaction for each of the two active ingredients in the antacid tablet. Include any side reactions that may occur.

Part C. Neutralization Forming a Rainbow Reaction

7. Clearly describe the colors that you observed in the test tube after performing the rainbow reaction.

8. Explain what the color order indicates. *Hint:* Why do you think the solution at the bottom of the tube is more basic than that at the top?

9. Write the balanced net ionic chemical equation(s) for the neutralization reaction(s) between the sodium carbonate and the acid.

Part D. Neutralization — Microtitration of Monoprotic and Diprotic Acids

10. Write a balanced chemical equation for each of the following neutralization reactions

    a. Reaction between HCl and NaOH

b. Reaction between H_2SO_4 and NaOH

c. Reaction between $HC_2H_3O_2$ and NaOH

11. Look at the balanced equations in #10

a. How many moles of NaOH combine with 1 mole of HCl?

b. How many moles of NaOH combine with 1 mole of H_2SO_4?

c. How many moles of NaOH combine with 1 mole of $HC_2H_3O_2$?

12. Now analyze your data in Table 5.

a. What is the ratio of drops of 0.1 M NaOH to 0.1 M HCl?

b. What is the ratio of drops of 0.1 M NaOH to 0.1 M H_2SO_4?

c. What is the ratio of drops of 0.1 M NaOH to 0.1 M $HC_2H_3O_2$?

d. Do your observed results fit with the results you would expect, based on your answer to question 11? Explain whether or not you think your experimental results are valid and why.

13. Both HCl and $HC_2H_3O_2$ are monoprotic acids, meaning they each have only one ionizable proton to lose to a base. H_2SO_4 is a diprotic acid which means it has 2 ionizable protons to lose to a base. Relate this to your experimental results.

14. a. While the 0.1 M HCl and the 0.1 M $HC_2H_3O_2$ have the same molar concentration of 0.1 M, the strengths of these two acids differ. From your results in Table 4, which is a stronger acid? How do you know?

b. Which acid, HCl or $HC_2H_3O_2$, required more NaOH to reach neutralization? Does acid strength have an effect on the amount of base needed for neutralization?

Part E. Determine the Concentration of an Acid via Titration with NaOH

15. Calculate the concentration of the Unknown A HCl solution. Use the average data from your trials and show all of your work.

16. Calculate the concentration of the Unknown B H2SO4 solution. Use the average data from your trials and show all of your work.

Part F. Extension — Design a Neutralization Titration Procedure

17. Attach your original experimental procedure, data table, and results to this question page.