EXPERIMENT 8 Chemistry 100

ACIDS, BASES, AND ELECTROLYTES

PART I. INTRODUCTION

Acids were first recognized as substances that taste sour (The sour taste of lemons and limes is due to *citric acid*), will dissolve certain metals, and will dissolve some types of rocks.

Bases were characterized by their bitter taste and slippery feel (Hand soaps and toothpastes, for example)

A **neutral** solution is neither basic nor acidic. Acids and bases will react together to form neutral solutions. One can say that an acid will neutralize a base and vice-versa.

Indicators are substances that change color depending on whether they are in an acidic or basic solution.

Electrolytes are compounds whose aqueous solutions will conduct electricity. Electrical conductivity depends upon charged particles that carry electrical current. In an aqueous solution, the charged particles are ions. The more ions present in the solution, the greater its conductivity.
In today's lab, your instructor will test solutions of non, weak and strong electrolytes.

Buffers are solutions that resist the change in pH. Our blood and the ocean contain buffers that help maintain a consistent pH which is not necessarily 7. A buffer is a weak acid and its salt or weak base and its salt

In today's lab you will observe some characteristic chemical and physical properties of acids and bases. You will also perform some calculations with concentration.

PART II. PROCEDURE

Safety goggles **must** be worn at all times
Hydrochloric acid, HCl, and acetic acid, $HC_2H_3O_2$ can harm eyes, skin, and clothing. Handle with care. Any acid spilled on the skin or splashed into your eye should be rinsed with a large volume of water.

NaOH and NH_3(aq) solutions are corrosive to the skin and can harm your eyes. Any base spilled on the skin or splashed into your eyes should be rinsed with a large volume of water.

A ELECTROLYTES: DEMONSTRATION:

Your instructor will submerge electrodes into the following solutions. Record each solutions conductivity below. The conductivity will either be strong, weak, or none:

Solution	Formula	Conductivity
1 M hydrochloric acid		
1 M acetic acid		
1 M sodium hydroxide		
1 M aqueous ammonia		
1 M sodium chloride		
1 M ammonium acetate		
2% sucrose (table sugar)	$C_{12}H_{22}O_{11}$ (polar)	
2% ethanol solution	C_2H_60 (polar)	
Deionized water		
Tap water		

Draw a diagram that shows how a solution of sodium chloride conducts electricity. Make sure to show a sample of ions, water molecules and some electrodes

B ACIDS AND BASES:

In your spot plate add 5 drops of each of the solutions in the table below to 3 different wells. Make sure you write on a paper towel a diagram that shows what is in each well.

Put 3 pieces of red litmus paper, 3 pieces of blue litmus paper and 3 pieces of universal indicator paper on a paper towel. Using a stirring rod transfer a drop of the each solution acid to the end of both litmus papers. Clean your stirring rod between each sample. Record the color of each solution on the litmus papers in the table below.

From the top of your lab bench find the dropper bottle of Phenolphthalein. Add 1 or 2 drops to each of the solutions in the table and record the color. Repeat the process in the last set of wells using universal indicator from a dropper bottle.

Solution	Color of indicator				
	Red litmus	Blue litmus	Phenolphthalein	Universal indicator	pH
1 M acetic acid					
1 M hydrochloric acid					
1M sodium chloride					
1 M ammonia					
1 M Sodium Hydroxide					

Dispose of all solutions into the sink.

What color of litmus paper can be used to test a solution to see if it is acidic?

_____litmus
(red, blue)

What color of litmus paper could you use to test a solution to see if it is basic?

_____litmus
(red, blue)

Reaction of acids with metals:

Drop a small piece of "mossy zinc" into one well with hydrochloric acid and into another well with Acetic acid. Record your observations

Observation_____

C. Buffers

You will test the pH of solutions of acid and base in which a buffer has been added and in which a buffer has not been added.

In six clean and relatively dry test tubes set up the following solutions. For the HCl solution use the HCl solution in bottle #2 at your lab bench. For the NaOH solution use the NaOH solution in bottle #7 at your lab bench.

Prepare the tubes as they are described in the table below. Make sure the tubes are well mixed. You can use a clean stirring rod. Rinse it between dipping it in each tube.

Now test the pH of each of the six test tubes with a piece of universal indicator paper. Place six pieces of the indicator paper on a paper towel and dip your clean stirring rod into tube one and then touch the paper. Clean the stirring rod and repeat for each paper. Record the color of the paper immediately, the colors fade, and record the pH of the solution. Do not throw the papers away until your instructor has initialed your results.

Tube #	Solution	Color of pH paper	pH
1	9 ml Distilled water and 1 ml buffer and 1 drop HCl		
2	9 ml Distilled water and 1 ml buffer and 1 drop NaOH		
3	9 ml Distilled water and 1 ml buffer		
4	10ml distilled water and one drop HCl and no buffer		
5	10ml distilled water and one drop NaOH and no buffer		
6	10 ml Distilled water and no buffer		

Instructor's initials_____

Dispose of all solutions into the sink.

D. Serial Dilutions

You will be diluting solutions of HCl and NaOH and testing their pH.

1. At the reagent bench obtain about 10 ml 0.1 M HCl and 10 ml 0.1 M NaOH.

2. In your clean and dry 10 ml graduated cylinder measure exactly 1.00 ml of the 0.10 M HCl and put the rest of the .1 M HCl in test tube #1.

3. To the graduated cylinder with the 1 ml of acid add exactly 9.00 ml of water or exactly to the 10.00 ml mark. Mix it well by pouring it into a clean test tube and back into the graduated cylinder two times. The new solution should be .01 M HCl.

4. Pour 9 ml of the new .01 M HCl solution from step 3 into test tube #2. Leave exactly 1.00 ml in the graduated cylinder.

5. To the graduated cylinder with the 1 ml of acid add exactly 9.00 ml of water or exactly to the 10.00 ml mark. Mix it well by pouring it into a clean test tube and back into the graduated cylinder two times. The new solution should be .001 M HCl. Pour this solution into test tube #3.

6. Repeat all of the steps above for the NaOH solution using clean and dry test tubes and graduated cylinder.

7. On a paper towel lay out 6 pieces of universal indicator paper. Number them 1-6. Dip your clean stirring rod into each solution and then onto the corresponding paper. Clean the stirring rod between tubes.

8. Write down the color of the paper without delay as it will fade. Match the color of the paper to the color on the paper tube. If the paper color seems to be in between two colors on the tube then record the number that best fits the color of the paper.

Save these solutions for part E. below.

Tube #	Solution	pH predicted (theoretical)	Color of Universal Indicator paper	pH (measured)
1	.1 M HCl			
2	.01MHCl			
3	.001MHCl			
4	.1 M NaOH			
5	.01 M NaOH			
6	.001 M NaOH			

Instructor's initials_____

E. Measuring pH with pH (Universal indicator) paper

In your spot plate obtain a sample (half-fill the wells) of each of the solutions shown in the table below. Dip a small (1cm) piece of Universal Indicator paper into each well. Record the color of the paper and match the color to the pH scale on the tube of paper.

Measuring pH with cabbage juice

Make sure there is no Universal Indicator paper in the solution wells. Obtain a piece of purple cabbage (one leaf) from the reagent bench. Break it up into small pieces and boil it in about 150- ml of de-ionized water in a 250 ml beaker. Add 15 drops of the cabbage juice extract to each of the wells of your spot plate. Make sure you add the same amount of extract to each well. Record the color of each solution.

Complete the table that compares the colors of each pH indicator at each pH

Table 1: Chemicals and their pH

Solution	Color of cabbage juice	Color of pH paper	pH
.1 M HCL			
.01 M HCl (from part D)			
.001 M HCl (from part D)			
.1 M NaOH			
.01 M NaOH (from part D)			
.001 M NaOH (from part D)			
Windex			
Milk			
Orange Juice			
Distilled water			
Honey			
Vinegar			
NaCl			
Tap water			
Lemon juice			

Dispose of all solutions into the sink.

Complete the table showing the color of cabbage juice at each pH. 1-14.

Cabbage juice color	pH
	1
	2
	3
	4
	5
	6
	7
	8
	9
	10
	11
	12
	13
	14

Questions and Answers:

1. Which substances had different pHs than you expected

2. Why are acids and bases important?

3. Were the household cleaners basic or acidic or both?

4. What does pH mean to you now?