GENERAL CHEMISTRY I
GUIDED INQUIRY EXPERIMENTS
LAB COMPONENT CHE101L CONTENT: LAB 1
SPRING 2023
ACID AND BASE CLASSIFICATIONS

NAME …… **NAME OF THE INSTRUCTOR** ……

SECTION …….. **SIGNATURE & DATE** ……..

STUDENT ID…….. **REPORT SUBMISSION DATE** ……

DATE…… **TIME**……..

Experiment 1 (session1)
Acid and Base Classifications

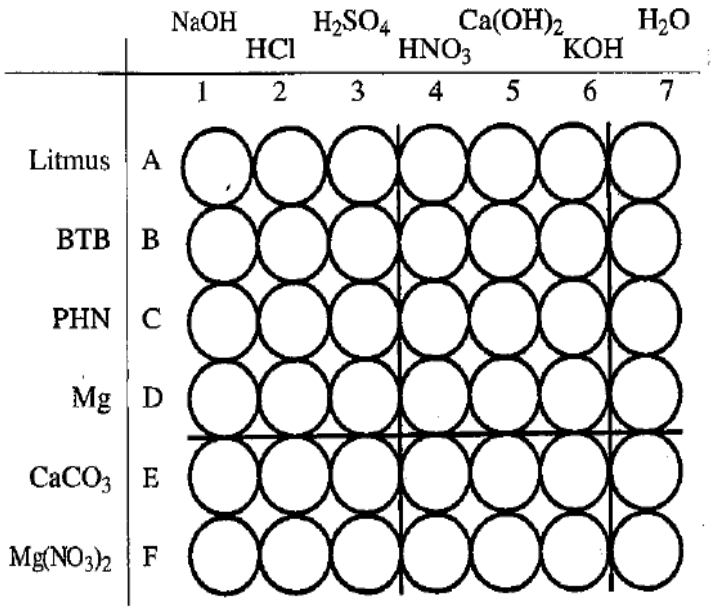
Acids and bases are classes of chemical compounds. There are weak and strong acids and bases based on their ability to dissociate in aqueous solution. They can interact with each other. Be careful when you handle acid or base in any situation. Please read the lab safety section carefully and consult with your instructor if necessary.

Problem Statement: What are the characteristics of acid and base solutions?

Part I

Data Collection: ***Properties of acids and bases***

A. Set up a 96 well micro-plate on the lab bench. Label rows and columns which can be seen in figure below. With a medicinal dropper or dropper bottle carefully ½ fill each well of column 1(***rows A-F***) with 1.00 M NaOH solution.



B. Do the same with columns 2-7 with 1.00 M HCl, 1.00 M H_2SO_4, 1.00 M HNO_3, saturated Ca $(OH)_2$, 1M KOH and distilled water respectively. Rinse the dropper when changing solutions.

C. Dip small pieces of red and blue litmus paper in each of the solutions in row **A** (see diagram) and record your observations in the table on the next below.

D. Add one micro drop bromothymol blue (BTB) to each of the solutions in row **B** and one micro drop of phenolphthalein (PHN) to each of the solutions in row **C**. Record your observation in the table.

E. Place a small piece of magnesium (Mg) metal in each of the solutions in row **D**. Record your observation in the table.

F. Place a small amount of $CaCO_3$ in each of the solutions in row **E**. Record your observation in the table.

G. Add one micro drop of Mg $(NO_3)_2$ solution to each of the solutions in row **F**. Record your observation in the table.

Record your Observation.

	NaOH	HCl	H_2SO_4	HNO_3	Ca $(OH)_2$	KOH	Distilled Water
Litmus							
Bromothymol blue							
Phenolphthalein							
Mg							
$CaCO_3$							
Mg $(NO_3)_2$							

Data Analysis

a. Group the seven solutions according to similar properties. What are the least number of groups needed? What substances are in each group?

b. Write an equation for any one of the reactions you observed when you added the $Mg(NO_3)_2$ solutions?

Part II

Data Collection: *Reactions of acids and bases*

Obtain 20.00 mL of 1.00 M HCl and divide it equally into two 50.00 mL beakers. Mark them as beaker 1 and beaker 2.

Beaker 1

Put several pieces of Mg metal into beaker 1 and cover it with a watch glass. Wait few minutes, don't remove the watch glass. Hold a lighted match to the pouring spout of the beaker. Write down your observations. Write a chemical equation which represents the reaction.

Beaker 2

Put several chips of $CaCO_3$ into the second beaker of 1.00 M HCl solution and test with a lighted match. Record your observation and write a chemical equation which represents the reaction.

Data Interpretation for part I and part II

a. Suppose HCl is one of a class of compounds call “acid” and NaOH is one of class of compounds called “base”. What did you learn about them in this experiment so far?

b. From there chemical formula given, identify the similarities and differences among each of the groups you identified in the data analysis section of **Part I**.

Part III (Session2)

Data Collection: *Preparation of various* concentrations of acids and bases

Following serial dilution method prepare 0.1, 0.01, 0.001, 0.0001 & 0.00001 M HCl and NaOH from 1M 10 ml stock solution. All in 10ml container.

To prepare 0.1M HCl, you need to dilute the 1M stock solution by a factor of 10. To do this, you need to mix 1 part of the 1M stock solution with 9 parts of distilled water.

1. Take 1ml of 1M HCl stock solution in a 10ml container.
2. Add 9ml of distilled water to the container.
3. Mix well and the final concentration of the solution will be .1M HCl.

To prepare .01M HCl, you need to dilute the .1M solution by a factor of 10. To do this, you need to mix 1 part of the .1M solution with 9 parts of distilled water.

1. Take 1ml of .1M HCl solution in a 10ml container.
2. Add 9ml of distilled water to the container.
3. Mix well and the final concentration of the solution will be .01M HCl.

To prepare 0.001M HCl, you need to dilute the .01M solution by a factor of 10. To do this, you need to mix 1 part of the .01M solution with 9 parts of distilled water.

1. Take 1ml of .01M HCl solution in a 10ml container.
2. Add 9ml of distilled water to the container.
3. Mix well and the final concentration of the solution will be 0.001M HCl.

To prepare 0.0001M HCl, you need to dilute the 0.001M solution by a factor of 10. To do this, you need to mix 1 part of the 0.001M solution with 9 parts of distilled water.

1. Take 1ml of 0.001M HCl solution in a 10ml container.
2. Add 9ml of distilled water to the container.
3. Mix well and the final concentration of the solution will be 0.0001M HCl.

To prepare 0.00001M HCl, you need to dilute the 0.0001M solution by a factor of 10. To do this, you need to mix 1 part of the 0.0001M solution with 9 parts of distilled water.

1. Take 1ml of 0.0001M HCl solution in a 10ml container.
2. Add 9ml of distilled water to the container.
3. Mix well and the final concentration of the solution will be 0.00001M HCl.

The same steps can be followed to prepare 0.1, 0.01, 0.001, 0.0001, and 0.00001M NaOH solutions from the 1M stock solution.

Part IV

Data Collection: Concentrations of acids and bases

a. Obtain 10.00 mL of a 0.10 M HCl solution in a clean test tube and label it "10^{-1} M H^+". Transfer 1.00 mL of 10^{-1} M HCl solution to a test tube and add 9.00 mL of distilled water in it. Mix it thoroughly and label the test tube as "10^{-2} M H^+". Rinse and shake dry the transferring glass wires. Repeat the procedure to prepare solutions 10^{-3} M H^+", 10^{-4} M H^+" and "10^{-5} M H^+".

b. Again obtain 10.00 mL of 0.10 M NaOH in a test tube and label it as "10^{-1} M OH^-". Repeat above serial dilution procedure to prepare up to "10^{-5} M OH^-" solution.

c. Obtain a centimeter long strip of a broad range pH paper. Dip a glass rod into distilled water and touch that to a small section of a pH paper. Compare the color of the paper with the color code provided with the paper and record the value in the table below. Using the same procedure, test the 10 solutions you made in sections a and b above.

Distilled water pH = _____

Acid		**Base**	
Dilution	**pH**	**Dilution**	**pH**
10^{-1}		10^{-1}	
10^{-2}		10^{-2}	
10^{-3}		10^{-3}	
10^{-4}		10^{-4}	
10^{-5}		10^{-5}	

Data Analysis and Interpretation

a. What conclusions can be drawn from these data?

b. **Mental Model:** Draw a series of pictures that contrasts four of your dilutions (two acids and two bases) with each other and represents the atomic and molecular species involved. Explain how your picture illustrates your observations.