GENERAL CHEMISTRY

LAB COMPONENT CHE101L

GUIDED INQUIRY EXPERIMENTS

CONTENT: LAB 1

ACID AND BASE CLASSIFICATIONS

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REPORT SUBMISSION DATE (ASSIGNED BY INSTRUCTOR) .....

Experiment 1
Acid and Base Classifications

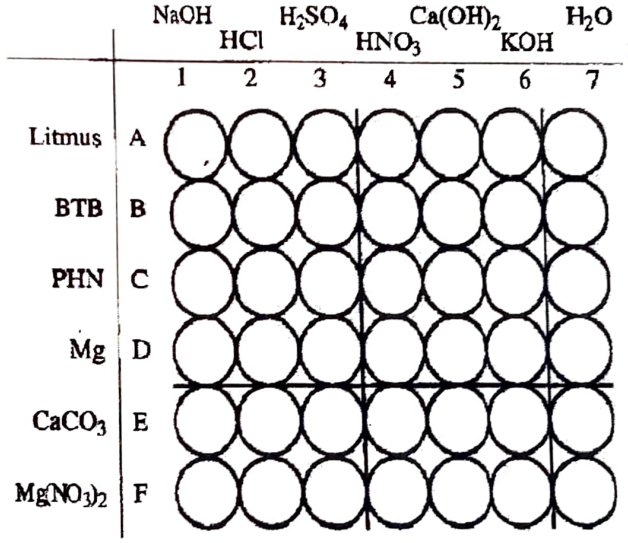
Acids and bases are classes of chemical compounds. There are weak and strong acids and bases based on their ability to dissociate in aqueous solution. They can interact with each other. Be careful when you handle acid or base in any situation. Please read the lab safety section carefully and consult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

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

Part II

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 microdrop bromothymol blue (BTB) to each of the solutions in row **B** and one microdrop 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 microdrop of $Mg(NO_3)_2$ solution to each of the solutions in row **F**. Record your observation in the table.

Record your observations

	NaOH	HCl	H_2SO_4	HNO_3	$Ca(OH)_2$	KOH	Distilled Water
Litmus B	Blue	Red	Red	Red	Blue	Blue	Blue
Litmus R	Blue	Red	Red	Red	Blue	Blue	Red
Bromothymol blue	Blue	Yellow	Yellow	Yellow	Blue	Blue	No change
Phenolphthalein	Purple	No change	No change	No change	Purple	Purple	No change
Mg	No change	Bubble	Bubble	Bubble	No change	No change	No change
$CaCO_3$	PPT	PPT + Bubble	PPT	PPT	PPT + Cloudy	PPT	PPT
$Mg(NO_3)_2$							

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?

We can group the seven solutions according to similar properties into three group. They are:

I. Acid : HCl, H_2SO_4, HNO_3

II. Base : $NaOH$, $Ca(OH)_2$, KOH

III. Neutral : Distilled water

We have recorded the colours by mixing various indicators. and we can conclude that they belong to different groups.

b. Write an equation for any one of the reaction you observed when you added the ~~$Mg(NO_3)_2$~~ $CaCO_3$ solutions?

$CaCO_3 + 2NaOH \longrightarrow Ca(OH)_2(aq) + Na_2CO_3(aq)$

Here, when $CaCO_3$ reacts with $NaOH$, it will produce $Ca(OH)_2$.

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.

Here. $Mg_{(s)} + 2HCl_{(l)} \longrightarrow MgCl_{2(aq)} + H_{2(g)}$

In beaker 1, Mg reacts with acid HCl and create H_2 gas. H_2 gas is highly flameable. so, holding a lighted match to the pouring spout, we observed that an explosion occur with a 'pop' sound and the flame of the match stick went off.

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.

$CaCO_{3(s)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + CO_{2(g)} + H_2O$

Here, $CaCO_3$ reacts with HCl acid and produce $CaCl_2$, water and CO_2 gas. When we took a burning matchstick close to the beaker 2, we observed that, the flame of match stick was extinguished silently, As we know that CO_2 is fire extinguisher, it helps to went of the flame of the match stick.

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?

HCl is acid and completely ionized in aquas solution. Acid turn blue litmus paper into red, bromothymol blue to yellow, phenolphthalein stays colourless. Acid solution produce H_2 gas with metal ~~Mg and~~ Mg and $CaCO_3$ it produce CO_2 gas. NaOH is base that dissolves in water produces OH^- ions. It turn red litmus paper to Blue, Bromothymol goes blue, phenolphthalein turns purple in base. with Mg it produce $Mg(OH)_2$.

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**.

Acid	Base	Neutral (Water)
1. Makes litmus red.	1. Makes litmus blue.	1. No change.
2. Makes BTB Yellow.	2. Makes BTB blue.	2. Makes BTB blue.
3. pH value lower than 7	3. pH > 7	3. pH = 7
4. Makes PHN colourless	4. Makes PHN purple	4. No change
5. Acid are electrolytes	5. Base are electrolytes	5. One kind of electrolyte.

Part III

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 and b above.

Distilled water pH = 7

Acid		Base	
Dilution	**pH**	**Dilution**	**pH**
10^{-1}	0.5	10^{-1}	13
10^{-2}	1	10^{-2}	11.5
10^{-3}	2.5	10^{-3}	10.5
10^{-4}	6	10^{-4}	9
10^{-5}	6.5	10^{-5}	8.5

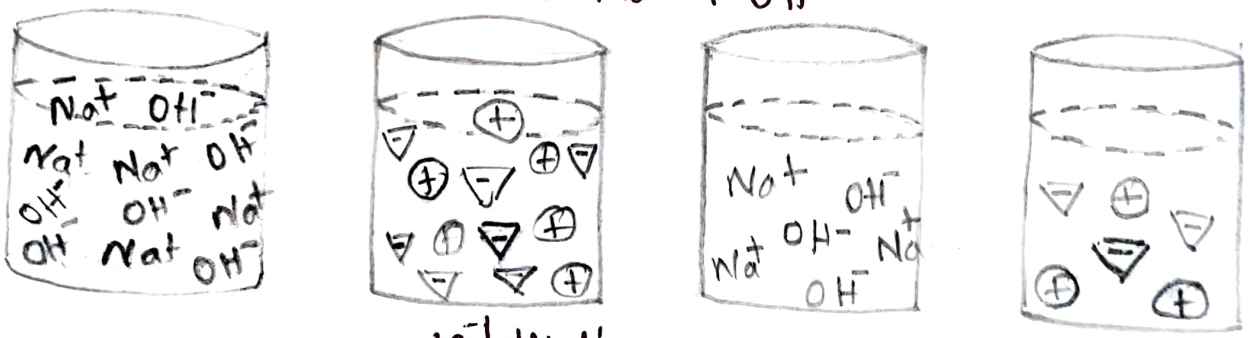
Data Analysis and Interpretation

a. What conclusions can be drawn from these data?

Here, the '10^{-1} M H^+' dilution, 10.0 ml of 0.1M HCl solution shows a pH of 1. Because it is a strong acid. The pH gradually increases and the solution becomes neutral as more distilled water added to it. Again, 10^{-1}M OH^- with 10 ml of 0.1M NaOH is very strong base that shows pH of 13. With the addition of more distilled water, the solution becomes less basic and also becomes neutral.

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.

For bases: $NaOH \xrightarrow{H_2O} Na^+ + OH^-$



10^{-1} dilution 10^{-3} dilution

The concentration of OH^- ions per unit volume decreases while base diluted with water. Then the pH value will be decreased

For Acid: $HCl + H_2O \longrightarrow H_3O^+ + Cl^-$

10^{-1} dilution 10^{-3} dilution

The concentration of H^+ ions per unit volume decreases while Acid diluted with water. As a result, the pH will be increased. As H^+ is inversely related to its pH.