CHE 101L

General Chemistry Lab

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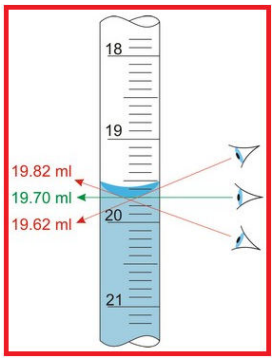
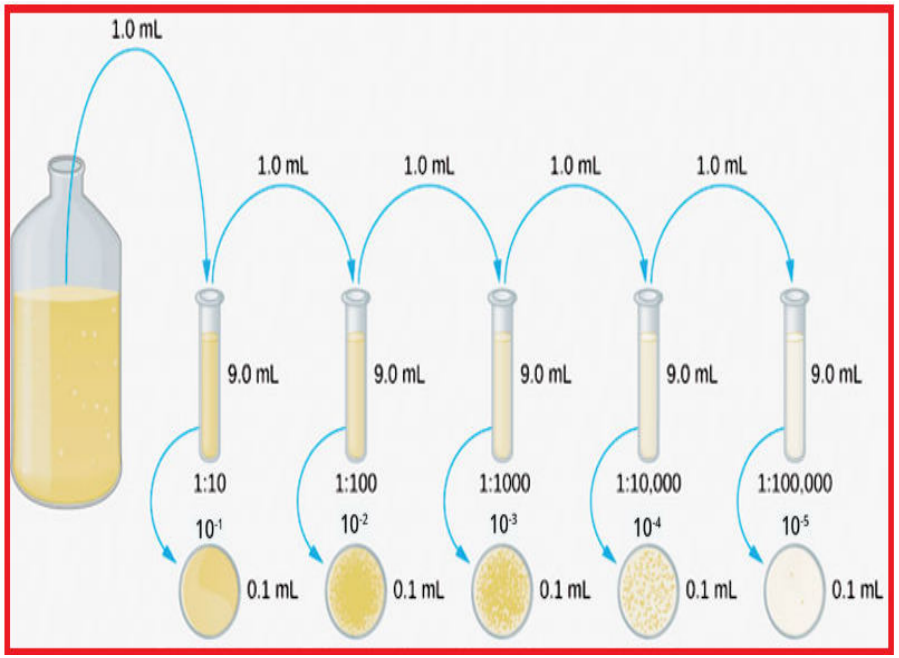
Part I

Expt 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 in any situation.
- Please read the lab safety carefully and consult with you instructor if necessary.



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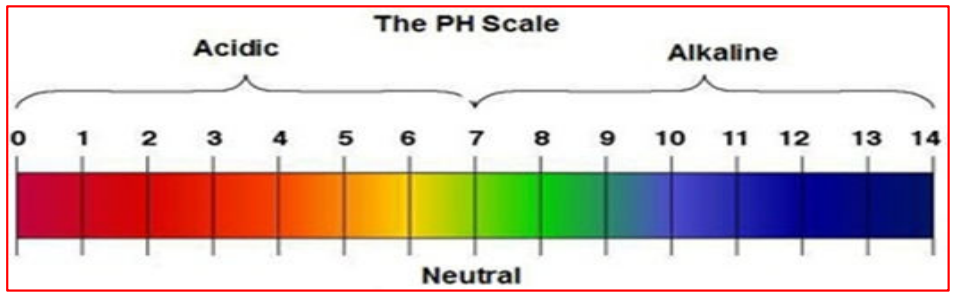
Problem Statement: What are the characteristics of acid and base solutions?

Properties of Acids

- Sour/tart taste
- Conduct electricity
- Litmus turns red
- Release H^+ in to water
- pH <7
- Neutralize a base
- Most food items

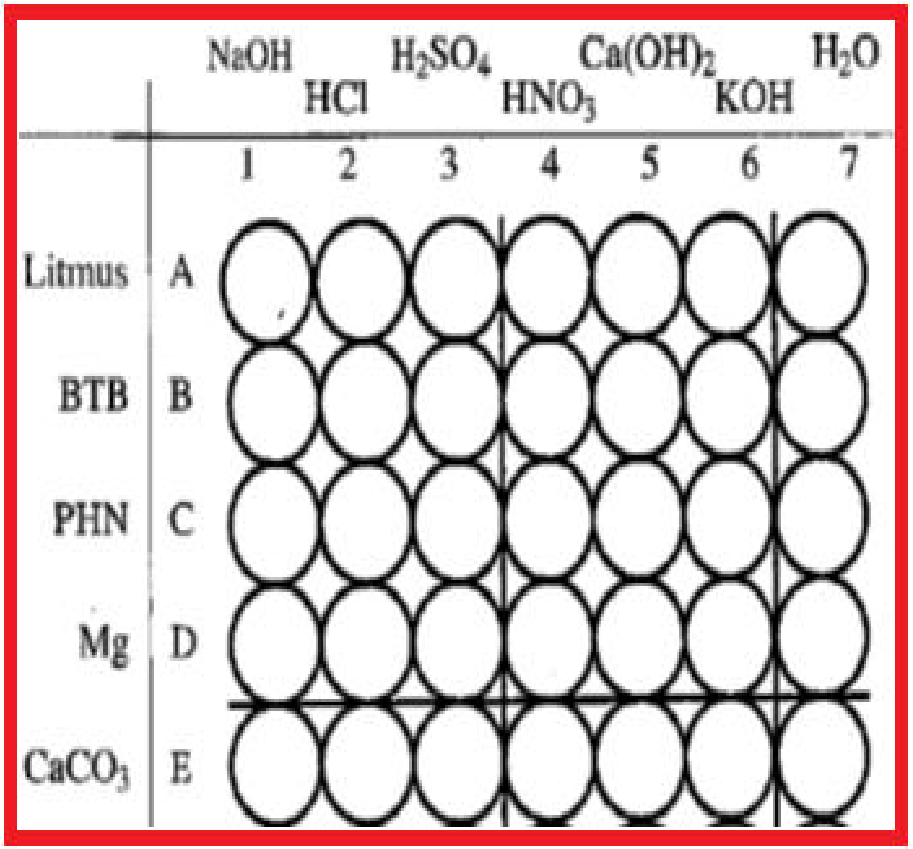
Properties of Bases

- Slippery to the touch
- Bitter taste
- Conduct electricity
- Litmus turns blue
- Release OH^- in to water
- pH >7
- Neutralize an acid
- Most cleaning items



Procedure:

1. Set up a 96 well micro-plate on the lab bench. Label rows and columns which can be seen in Figure. With a medicinal/plastic dropper or dropper bottle carefully ½ fill each well of column 1 (rows A-E) with 1.00 M NaOH solution.
2. 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 (H_2O), respectively. Rinse the dropper when changing solutions.



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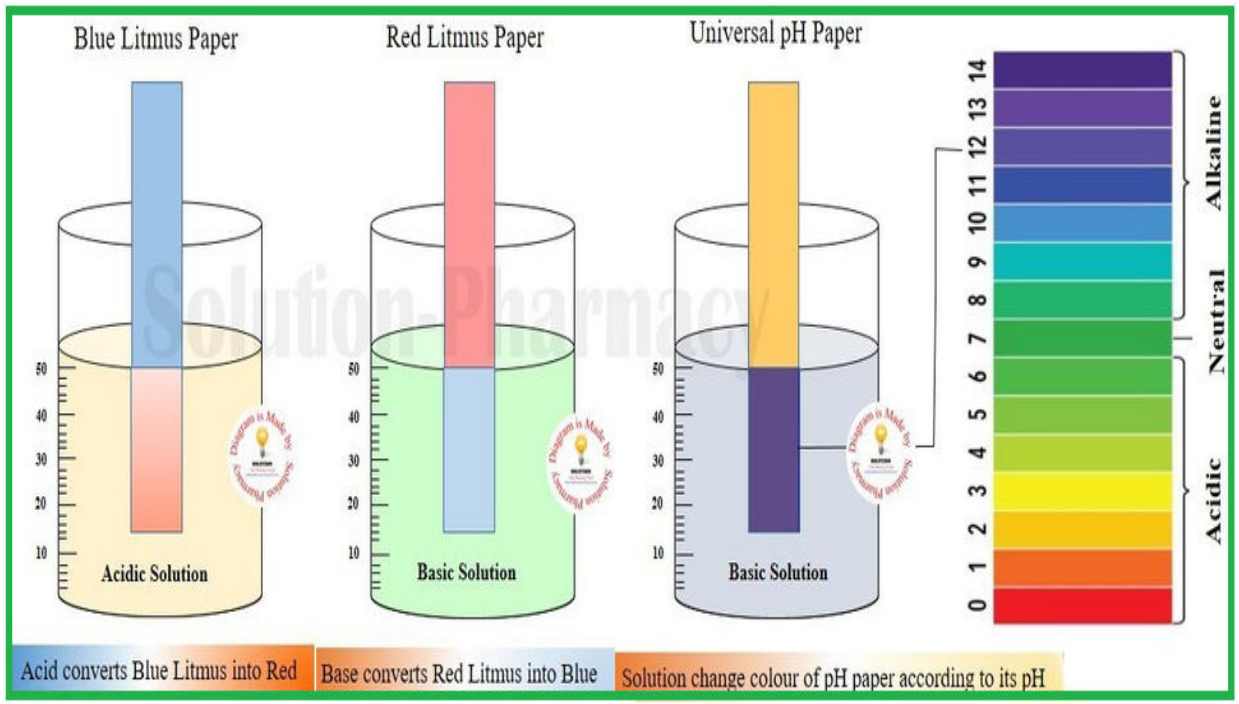
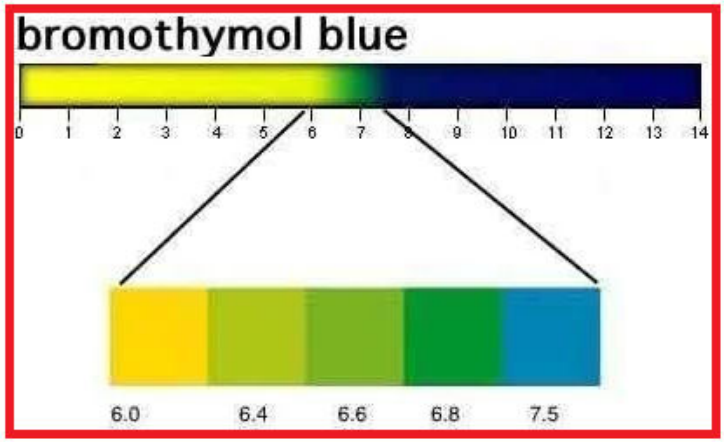
3. Dip small pieces of red and blue litmus paper in each of the solutions in row A (see diagram) and record your observations in the Table 1.

4. Then 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 1.





•**Phenolphthalein** – common indicator, **colorless** in an acid; pink in a base.


colorless in an acid


pink in a base.

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5. Place a small piece of magnesium (Mg) metal in each of the solutions in row D. Record your observation in the Table 1.

6. Place a small amount of $CaCO_3$ in each of the solutions in row E. Record your observation in the Table 1.

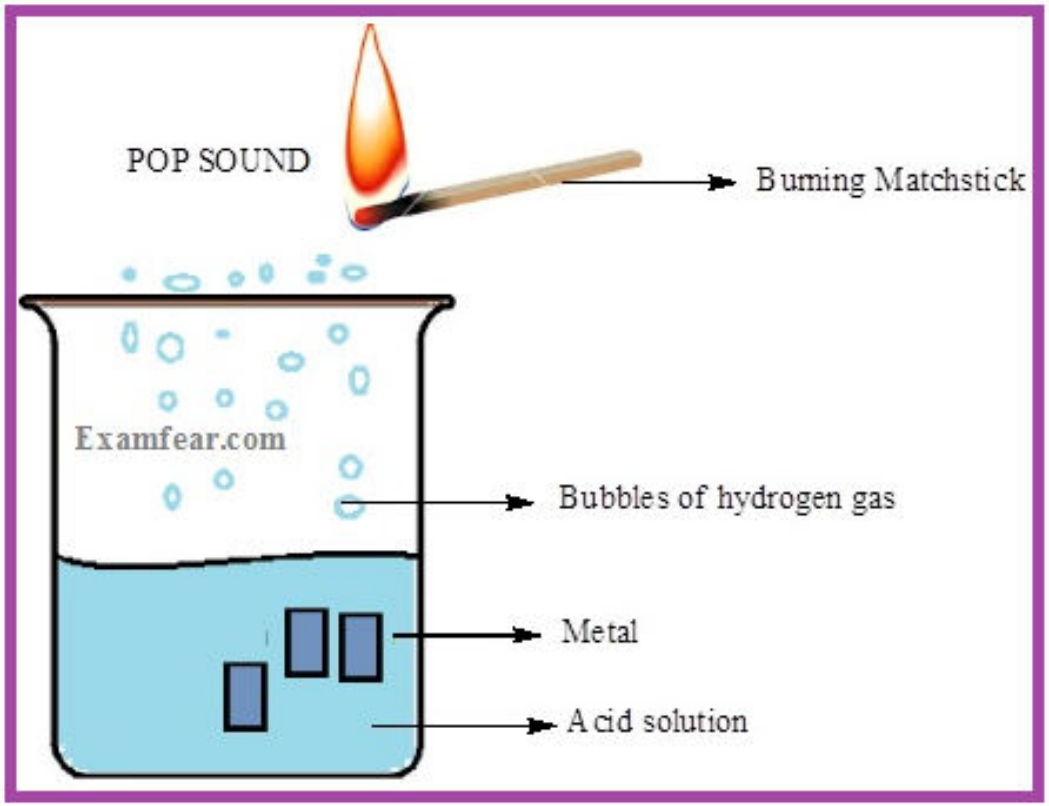

Table 1. Record your observations

	NaOH	HCl	H_2SO_4	HNO_3	$Ca(OH)_2$	KOH	H_2O
Litmus (red)	Turns blue						No change
Litmus (blue)		Turns red					No change
Bromothymol blue	Turns blue		Turns yellow				
Phenolphthalein	Pink		Colorless				
Mg	No change		occurs in H_2 gas				
$CaCO_3$	No change		occurs in CO_2 gas				

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?

According to similar properties at least 3 groups are needed:

Acid: HCl, H_2SO_4, HNO_3

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

Neutral: Distilled Water (H_2O)

- There are 3 compounds in both acid and base group each. Distilled water forms neutral group alone as it behaves differently than both acid and base group.

b. Write an equation for any one reaction you observed when you added the Mg ribbon?

- Mg ribbon reaction with HCl to produce $MgCl_2$ and H_2 gas:

$$Mg_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_2\,(aq) + H_2\,(g)$$

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.

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Beaker 1

Put several pieces of Mg metal into the beaker 1 of 1.00 M HCl solution 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.

- Record your observations and write a chemical equation which represents the reaction.

- The reaction makes bubble in H_2 gas and the lighted match makes a pop sound and stops burning after being exposed to gas flamed:

$$Mg_{(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2\,(aq)} + H_{2\,(g)}$$

Beaker 2

Put several chips of $CaCO_3$ into the beaker 2 of 1.00 M HCl solution and test with a lighted match.

- Record your observation and write a chemical equation which represents the reaction.

- The reaction makes bubbles or effervescences in CO_2 gas and the lighted match makes turned off:

$$CaCO_{3(s)} + HCl_{(aq)} \rightarrow CaCl_{2\,(aq)} + CO_{2\,(g)} + H_2O_{(l)}$$

Data Interpretation for part I and part II

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

- Acid turns blue litmus in to red but red litmus remains red.
  - All acidic solutions like HCl, H_2SO_4 and HNO_3 produces hydrogen gas (H_2) with Mg metal and calcium carbonate with acidic solutions.
  - Bromothymol blue (BTB) shows change in color from orange to yellow and phenolphthalein stays colorless.

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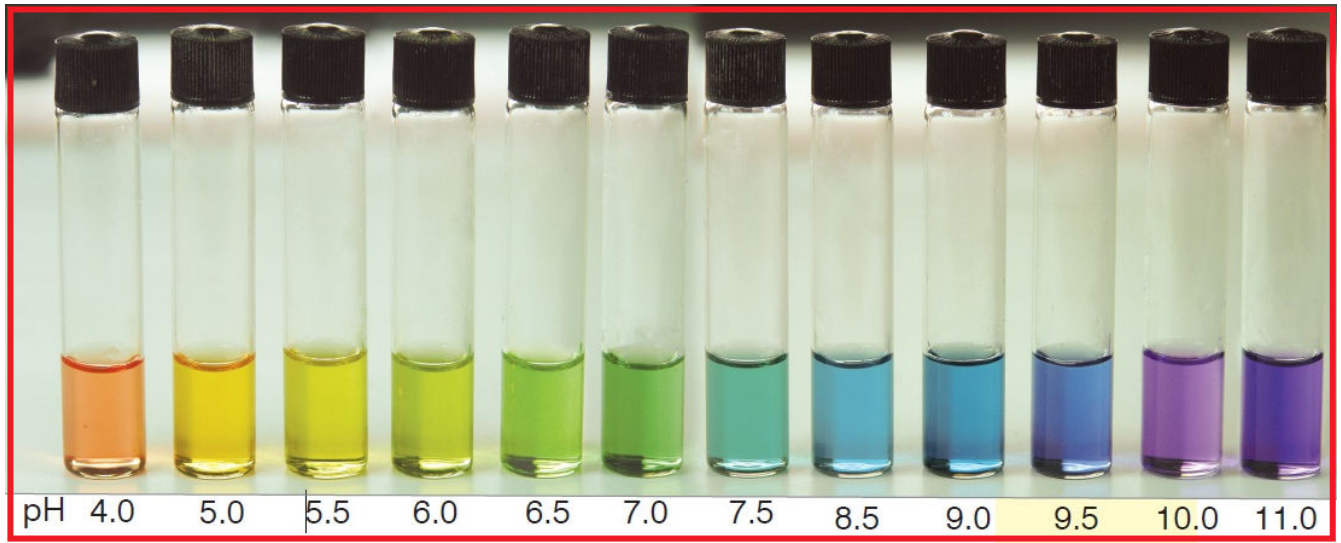

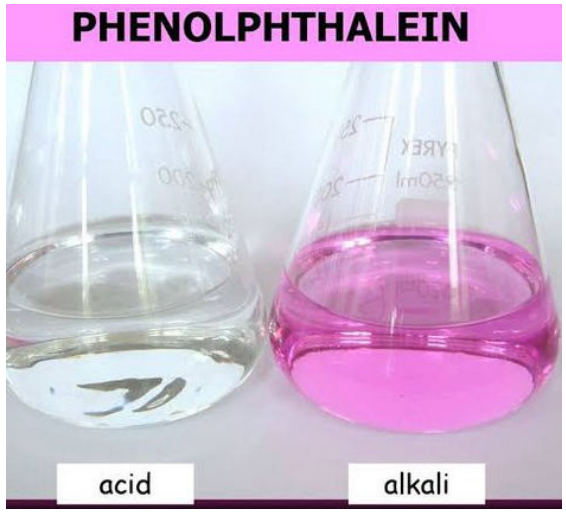

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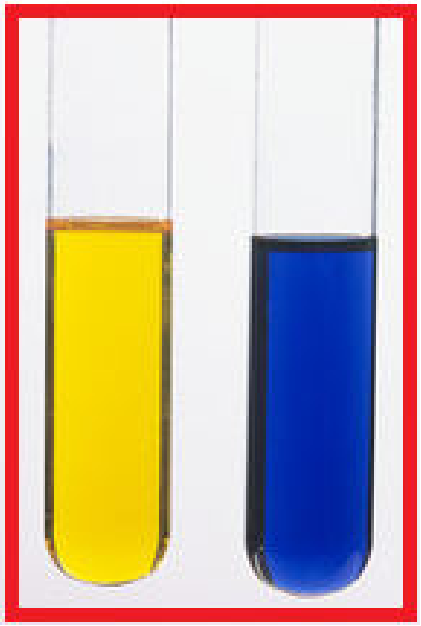
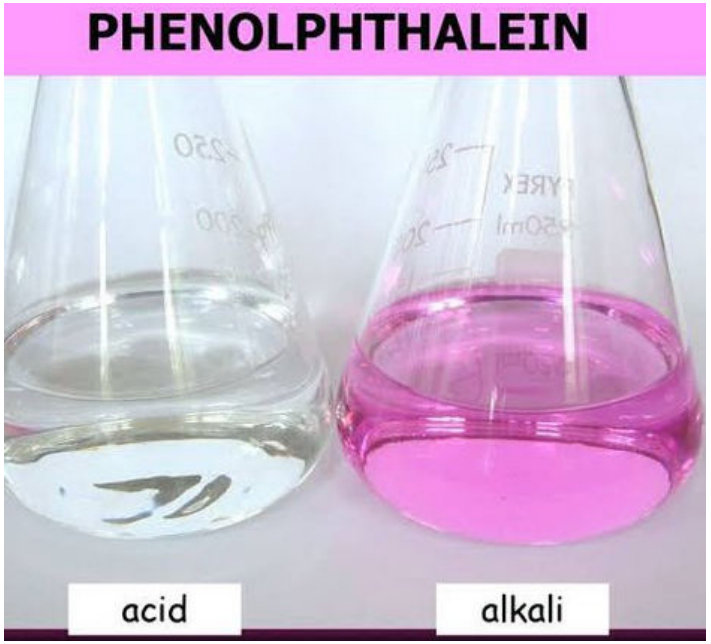
- Acid turns red litmus in to blue but blue litmus remains blue.
  - All basic solutions like NaOH, $Ca(OH)_2$ and KOH produces no reaction occur with Mg metal and calcium carbonate.
  - Bromothymol blue (BTB) shows change in color from orange to blue and phenolphthalein in color from colorless to pink.





Data Interpretation for part I and part II

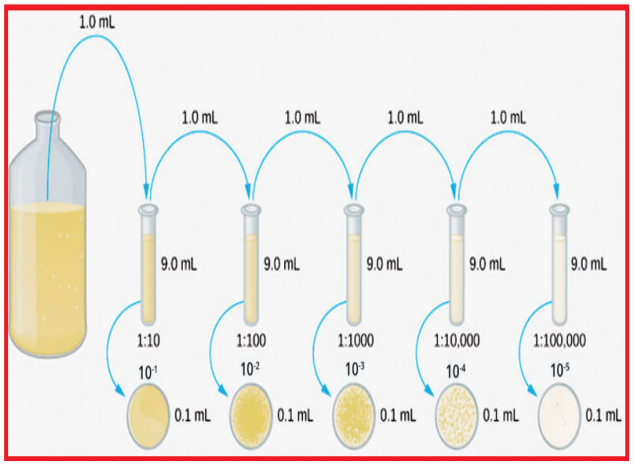
b. From there chemical formula given, identify the similarities and differences among each of the groups you identified in the data analysis section of Part I.

- Both acids and bases change the colour of litmus paper. Acid turns blue in to red and base turns red in to blue litmus paper.
- Distilled water makes no change of color to litmus paper.
- Acid reacting with carbonates to produces salt, water and CO_2.
- Acid reaction with Mg ribbon to produces salt and H_2.

Part III

Data Collection: Concentrations of acids and bases

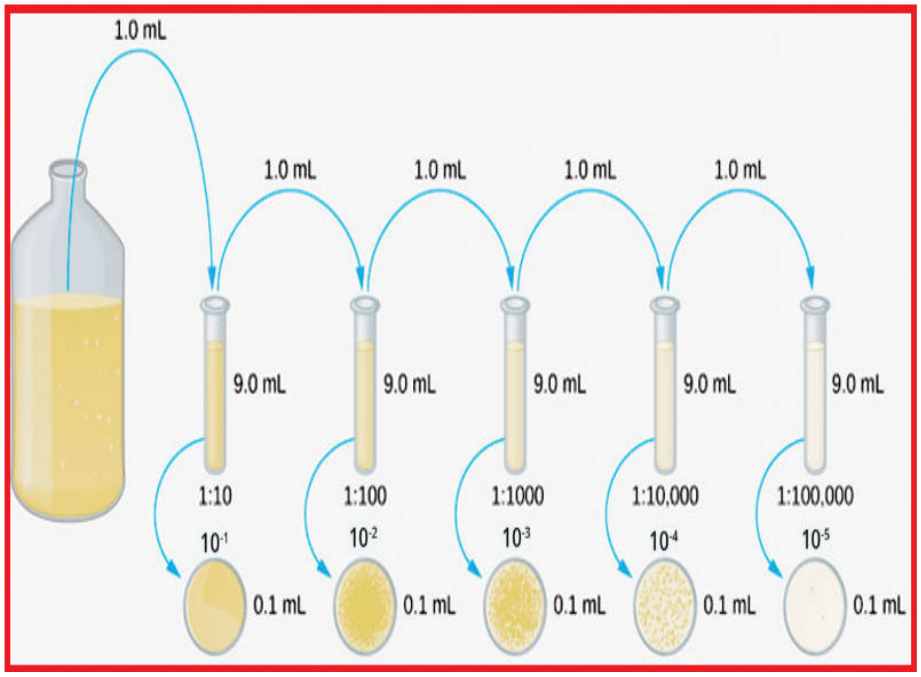
a. Obtain 10.00 mL of a 0.10 M HCl solution in a clean test tube and label it "10^{-1} M H^+". Transfer 1.00 mL of 10^{-1} M HCl solution to a test tube and add 9.00 mL of distilled water in it. Mix it thoroughly and label the test tube as "10^{-2} M H^+". Rinse and shake dry the transferring glass wires.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



Data Collection:

Concentrations of acids and bases

a. 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

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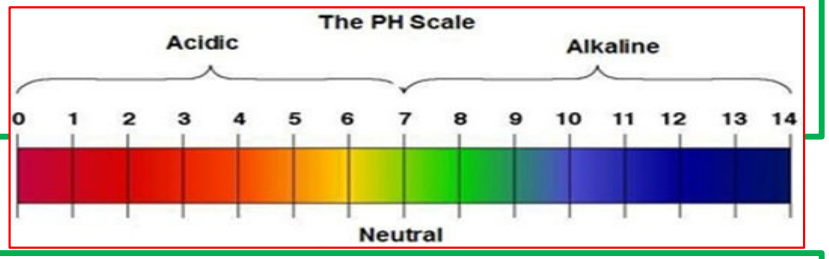
Acid		Base	
Dilution	pH	Dilution	pH
10^{-1}	0	10^{-1}	13
10^{-2}	2	10^{-2}	10
10^{-3}	6	10^{-3}	8
10^{-4}	6.5	10^{-4}	7.5
10^{-5}	7	10^{-5}	7

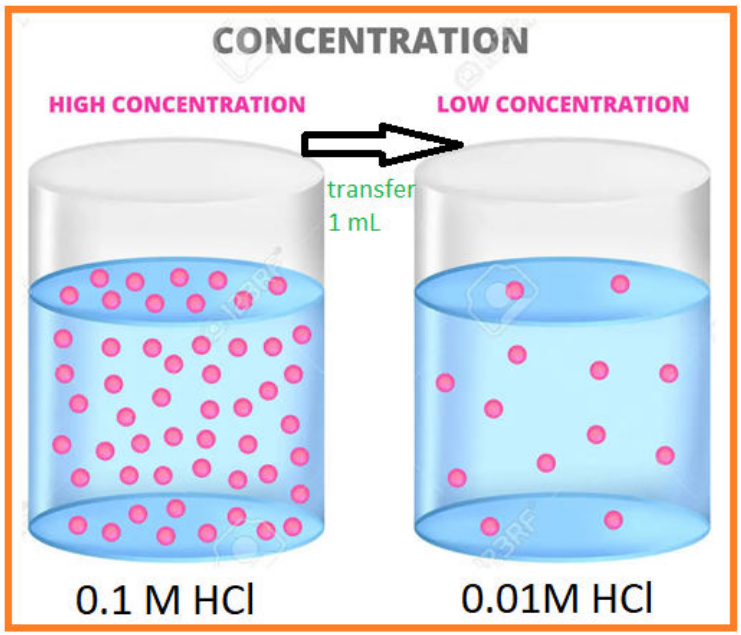
Data Analysis and Interpretation

a. What conclusions can be drawn from these data?

- As acid undergoes serial dilution, the pH increases because the concentration of H^+ ion decreases.
- As base undergoes serial dilution, the pH decreases because the concentration of OH^- ion decreases.

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.





- In 0.1 M HCl solution has more concentration of H^+ ion. So the pH is less. When the serial dilution occurs there is less amount of H^+ ions. So, the pH increases.

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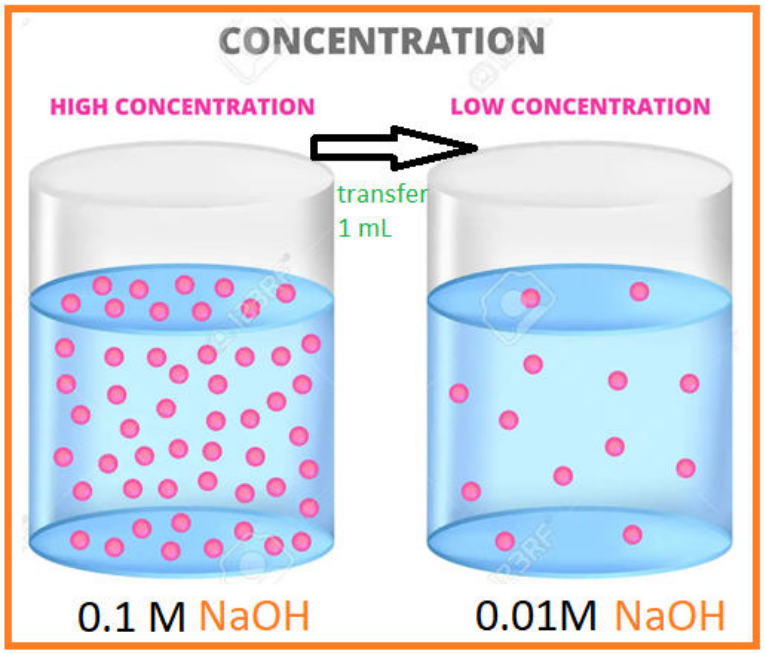
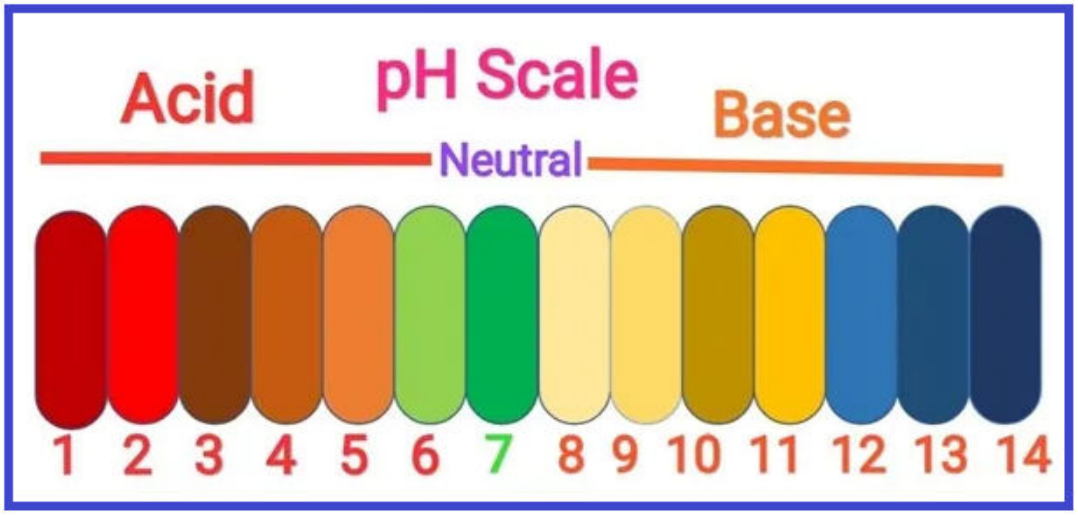
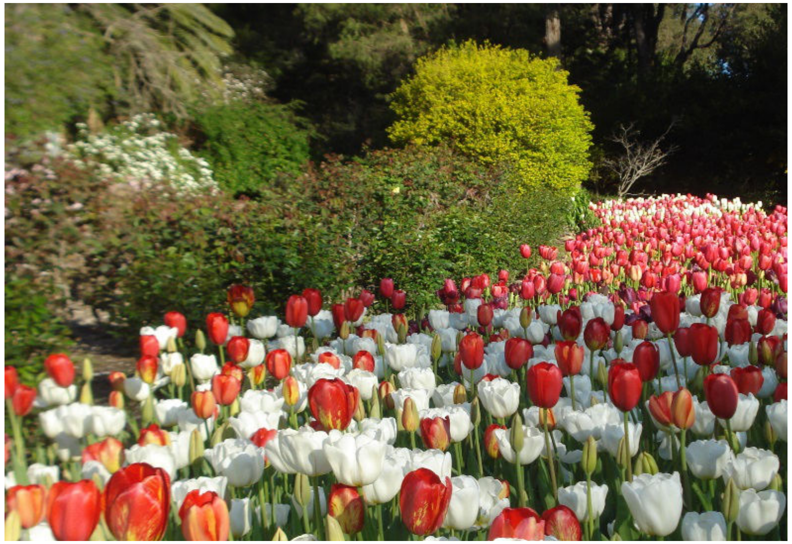


- In 0.1 M NaOH solution has more concentration of OH^- ion. So the pH is more. When the serial dilution occurs there is less amount of OH^- ions. So, the pH decreases.



Thank You for Listening



Any Questio