Name _____

Determining the pH of an Unknown

Introduction:
The pH scale uses numbers from 1-14 to describe how acidic or basic a solution is. A pH value of 7 is neutral (neither acidic or basic), a pH value below 7 is acidic and a pH value above 7 is basic. The lower the pH the more acidic a solution is. The higher the pH, the more basic a solution.

Indicators are often used to measure pH. An indicator is a weak acid (or base) that changes its color in a known pH range when it gains or loses a hydrogen ion. In this range, the acid (or base) is a different color than its conjugate acid (or base). Phenolphthalein is a common indicator that is colorless when it is protonated (contains a hydrogen atom). When a base is added it reacts with the hydrogen atom of the indicator. As the phenolphthalein loses its hydrogen, it turns pink. This color change is why phenolphthalein is an indicator.

In this investigation we are going to use several different indicators: congo red (3.0-5.0), bromcresol green (3.8-5.4), Phenolphthalein (8.2-10), bromthymol blue (6.0-7.6), thymol blue (8.0-9.6), and litmus (5.5-8.2). You will pick three indicators to work with (at least one acid indicator and one base indicator) and observe the color changes that take place when each indicator is put into eleven solutions that have known pH values ranging from pH 2 to pH 12. You will then use your data as the basis for determining the pH of an unknown solution provided by your teacher.

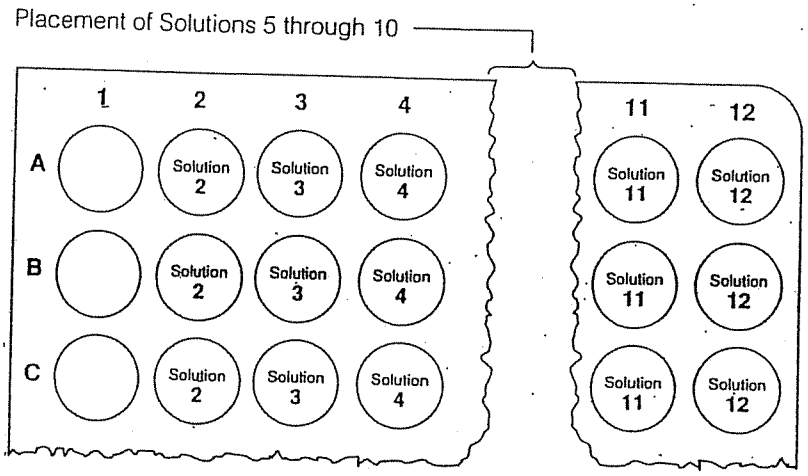
Problem:
How can the pH of an unknown solution be determined using acid-base indicators?

Materials:
Goggles
12 pipets for each pH solution
Well Plates
Indicator Solutions (transition pH range)
- congo red (3.0-5.0)
- bromcresol green (3.8-5.4)
- PHTH (8.2-10)
- bromthymol blue (6.0-7.6)
- thymol blue (8.0-9.6)
- litmus (5.5-8.2)

Unknown pH solution
Solutions ranging from
pH 2 to pH 12

Procedure:

1. Put your goggles on. Add just enough pH 2 solution to cover the bottom of each well in column 2 of your well plate (wells A2, B2 and C2). For columns 3-12 of your well plate, repeat using solutions 3-12. *CAUTION: Acids are corrosive and bases are caustic. Avoid spills and contact with your skin. Wash spills and splashes with plenty of cold water.*



2. Add three drops of phenolphthalein to wells A1-A12. (Although A1 is empty, a solution will be added to it in a later step.) Record in the data table the color changes that you observe. If no color is seen, record *colorless* in the data table.

3. Add three drops of the second indicator you chose to wells B1-B12. Record in the data table the color changes that you observe.

4. Add three drops of the third indicator you chose to wells C1-C12. Record in the data table the color changes that you observe.

5. Obtain from the teacher a solution of unknown pH. Record the unknowns identification letter in the data table. Add five drops of the unknown to the first three wells in column 1 (wells A1, B1 and C1).

6. Record your observations in the data table.

7. Compare the colors of the indicators in your unknown to the colors of the indicators in the known pH solutions.

8. Determine the pH of the unknown solution.

9. Wash all the solutions in the well plate down the drain with plenty of water. Clean and dry the well plate. Clean up your work area and wash your hands before leaving.

Data Table: Record color observed (no color = colorless)

			pH of SOLUTION				
	Indicator Name	Unknown Letter _____	2	3	4	5	6
A							
B							
C							

		pH of SOLUTION					
	Indicator Name	7	8	9	10	11	12
A							
B							
C							

Analysis and Conclusions:

Use the information from the introduction and Reference Table M to help you answer the following questions.

1.) Describe how the color of an indicator changes when an acidic solution is added and when a basic solution is added.

2.) What color did the phenolphthalein become in the following pH ranges?

a. pH 2-4 _____

b. pH 5-7 _____

c. pH 8-10 _____

d. pH 11-12 _____

3.) Which of the indicators provided are good indicators for strong acids?

4.) Which of the indicators provided are good indicators for strong bases?

5.) Which of the indicators can be used for substances that are weak acids or weak bases?

6.) A solution with an acid-base indicator was tested with a pH meter and found to have a pH of 5.5, and its indicator turned blue. Which of the indicators on Table M could be this be?

7.) A solution was yellow in bromthymol blue and blue in bromcresol green. According to Table M and your data, what could be the pH of the solution?

8.) A solution was tested with a pH meter and found to have a pH of 7.8. What color would the solution have if the following indicators were added?

a) bromthymol blue _____

b) thymol blue _____

c) litmus _____

d) bromcresol green _____

9.) Soils have different acidities, affecting growth of many plants. Some plants do well in more acidic soil, whereas others do better in a basic soil. Describe a method for testing the acidity of the soil near your home or school.