LAB 1 Laboratory Activity

Acids, Bases, and Indicators

You can express the acidity of a solution by using a pH scale. The pH of a solution is a measure of the concentration of the hydronium ions (H_3O^+) in that solution. The pH scale ranges in value from 0 to 14. Acids have pH values less than 7. Bases have pH values greater than 7. A neutral solution has a pH value of exactly 7.

The pH of a solution can be determined by using an indicator. An indicator is usually an organic compound that changes color at certain pH values. A universal indicator is a mixture of indicators that can be used to determine a wide range of pH values.

Strategy

You will investigate how a universal indicator is affected by acidic and basic solutions.
You will determine the pH of several common liquids.

Materials

96-well microplate
sheet of white paper
plastic microtip pipette
distilled water
0.1M hydrochloric acid solution, HCl(*aq*)
0.1M sodium hydroxide solution, NaOH(*aq*)
universal indicator solution
samples of lemon juice, milk, and liquid soap

WARNING: *The sodium hydroxide and hydrochloric acid are corrosive. The universal indicator can cause stains. Avoid contacting these solutions with your skin or clothing. Wear an apron and goggles during this experiment.*

Procedure

Part A—Preparing a Color Scale

1. Place the 96-well microplate on a piece of white paper on a flat surface. Have the numbered columns of the microplate at the top and the lettered rows at the left.
2. Using the microtip pipette, add 9 drops of the distilled water to each of the wells A2–A11.
3. Use the pipette to add 10 drops of the hydrochloric acid solution to well A1. Rinse the pipette with distilled water.
4. Use the pipette to add 10 drops of the sodium hydroxide solution to well A12. Rinse the pipette with distilled water.
5. Use the pipette to transfer one drop of hydrochloric acid solution from well A1 to well A2. Return any solution remaining in the pipette to well A1, making sure the pipette is empty. Mix the contents of well A2 by drawing the solution into the pipette and then returning it to well A2.
6. Using the pipette, transfer one drop of the solution in well A2 to well A3. Return any solution remaining in the pipette to well A2. Mix the contents of well A3 by drawing the solution into the pipette and then returning it to the well.
7. Repeat step 6, transferring A3 into A4, A4 into A5, and A5 into A6. Rinse the pipette with distilled water.
8. Use the pipette to transfer one drop of sodium hydroxide solution from well A12 to A11. Return any sodium hydroxide solution remaining in the pipette to well A12. Mix the contents of well A11 by drawing the solution into the pipette and then returning it to well A11.
9. Using the pipette, transfer one drop of the solution in well A11 to A10. Return any solution remaining in the pipette to well A11. Mix the contents of well A10 by drawing the solution into the pipette and then returning it to the well.

Laboratory Activity 1 (continued)

10. Repeat step 9 for wells A10 and A9. Do not transfer solution from well A8 to well A7. Well A7 will contain only distilled water. Rinse the pipette with distilled water.
11. Use the pipette to add 1 drop of the universal indicator to each of the wells A1–A12. Rinse the pipette with distilled water.
12. Observe the solutions in each well. Record the color of the solution in each well in Table 1 in the Data and Observations section.

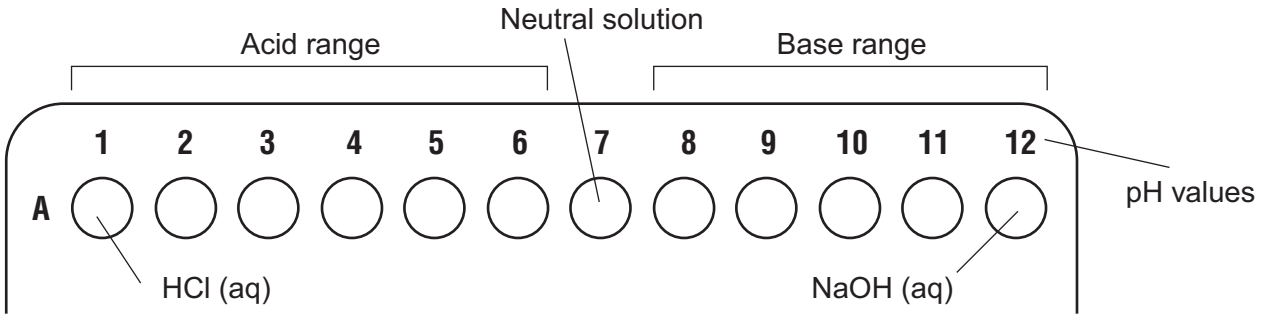
Part B—Determining the pH of Solutions

1. Use the pipette to place 9 drops of lemon juice in well C1. Rinse the pipette with distilled water.
2. Place 9 drops of milk in well C2 and 9 drops of liquid soap in well C3. Rinse the pipette in distilled water after each addition.
3. Using the pipette, add 1 drop of the universal indicator to each of the wells C1–C3.
4. Observe the solution in each well. Record the name of the solution and its color in Table 2.

Part C—Analysis

1. By adding 1 drop of the hydrochloric acid solution in well A1 to the 9 drops of water in well A2, the concentration of the hydrochloric acid in well A2 was reduced to 1/10 that of well A1. With each dilution in wells A1–A6, you reduced the concentration of the acid from one well to the next by 1/10. Likewise, by diluting the sodium hydroxide solution, the concentration of the sodium hydroxide solution is decreased by 1/10 from wells A12–A8. Because of these dilutions, the pH value of the solution in each of the wells A1–A12 will be the same as the number of the well, as shown in Figure 1. For example, the pH of the solution in well A3 will be 3.
2. The color of the solutions in wells A1–A12 can be used to determine the pH of other solutions that are tested with the universal indicator. You can determine the pH of a solution by comparing its color with the color of the solution in wells A1–A12. Using Table 1, determine the pH values of the solutions that you tested in Part B of the procedure. Record the pH values in Table 2.

Figure 1



Data and Observations

Table 1

Well	A1	A2	A3	A4	A5	A6
Color						
Well	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**
Color						

Laboratory Activity 1 (continued)

Table 2

Solution	Color	pH

Questions and Conclusions

1. What is the range of pH values of acids and bases?

2. Classify the solutions that you tested in Part B as acids or bases.

3. Distilled water is neutral. What is its pH value? What color will water appear if it is tested with the universal indicator solution?

4. What is a universal indicator?

Strategy Check

_____ Can you determine how acidic and basic solutions affect a universal indicator?

_____ Can you determine the pH of several common liquids?