PROPERTIES OF ACIDS AND BASES

Reminder – Goggles must be worn at all times in the lab!

PRE-LAB DISCUSSION:

Acids ionize in aqueous solution to produce hydrogen ions (H^+). The strength of acid depends on the degree to which it ionizes. Strong acids ionize almost completely, while weak acids ionize to a lesser degree. Bases dissociate in aqueous solution to produce hydroxide ions (OH^-). The properties of acids and bases depend on the presence of free H^+ or OH^- as the predominant ion in a solution. In this lab, you will observe the following:

1. The effects of acids and bases on various indicators

2. Reaction of an acid with a carbonate, observing the carbon dioxide produced. For example:

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

3. Reaction of an acid with a metal, observing the hydrogen produced. For example:

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

4. Neutralization reaction. Acids neutralize bases (and vice versa). For example, when HCl combines with NaOH, the reaction is

$$HCl + NaOH \rightarrow NaCl + H_2O$$

The net equation for neutralization is:

$$H^+ + OH^- \rightarrow H_2O$$

5. The feel of bases. Bases have a distinctive feel.

PURPOSE:

The purpose of this lab is to observe some typical properties of acids and bases.

PROCEDURE:

PART I: The effects of acids and bases on indicators.

1. Get two spot plates from your lab drawer.
2. Add approximately 5 drops of hydrochloric acid (HCl) and acetic acid ($HC_2H_3O_2$) to separate depressions on one spot plate. Place the other spot plate several feet away, and add 5 drops of sodium hydroxide (NaOH) and ammonium hydroxide (NH_4OH) to separate depressions. The spot plates must be several feet from each other to avoid a vapor phase reaction between the hydrochloric acid and the ammonium hydroxide.
3. Use a glass stir rod to transfer a small amount of each solution to individual pieces of dry red litmus paper resting on a glass plate from your lab drawer. Remember that you do not need a whole piece of litmus for each test – tear them into halves or even into thirds. Be certain to clean the stir rod between tests. Record your observations in the data section.
4. Repeat the tests using the same acid and base samples, but using blue litmus paper on a glass plate. Record your observations.
5. Repeat the tests using the same acid and base samples, but using small pieces of pH paper on a glass plate. Quickly compare the color you see with the colorimetric scale that comes with the pH paper. Record the pH for each solution in your Data section.
6. Add 1 drop of phenolphthalein to depressions containing samples of each acid and base. Record your observations. You may want a piece of white paper under the spot plate to make color changes easier to see.
7. Repeat Step 6 using methyl orange.
8. Repeat Step 6 using bromthymol blue.
9. Add 1 drop of methyl orange to new, unused depressions containing samples of each acid and base. Record your observations.
10. Wash the spot plates and glass plates carefully and move on to the next set of tests. Used litmus paper and pH paper go in the trash can, NOT down the sink (paper is not soluble in water!)

PART II: Reaction of an acid with a carbonate.

1. Place some calcium carbonate in a test tube. Add just enough HCl to cover the calcium carbonate. Carbonates react with acid to form water, carbon dioxide, and a salt:

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

2. Record your observation of what you see occurring.
3. Wash the un-reacted contents of test tube down the sink with lots of water. Wash your test tube thoroughly.

PART III: Reaction of an acid with a metal.

1. Put a small piece of magnesium ribbon in a clean well on a spot plate. Your teacher will provide you with the sample of magnesium. Add five drops of hydrochloric acid solution to the well with the magnesium. The reaction that should occur is

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

2. Record your observation of what you see occurring.
3. Pluck any unreacted magnesium out of the well with a pair of tweezers (lab drawer) and place the left-over magnesium in a beaker provided by your instructor. DO NOT wash the magnesium down the sink!

PART IV: Neutralization

1. Place 5 drops of HCl into a clean test tube.
2. Test the acid with pH paper (side table) and record the number.
3. Place 1 drop of bromthymol blue in the solution.
4. Add sodium hydroxide, drop by drop, shaking the test tube gently, until you see the color indication of a basic solution that does NOT go away with shaking.
5. Using pH paper, record the pH of the solution at this point. Use a glass rod, touch the solution, and then touch the paper. DO NOT try to put the pH paper into the test tube!
6. Now, add 5 more drops of sodium hydroxide and record the pH using a fresh piece of pH paper. Use a glass rod, touch the solution, and then touch the paper. Again, DO NOT try to put the pH paper into the test tube!
7. Discard the solution down the sink with lots of water. Clean and rinse your test tube.
8. Dispose of pH paper in the trash, NOT in the sink!

PART V: The feel of bases.

1. Place 1 ml of water in a test tube and add 10 drops of sodium hydroxide.
2. Rub a little of this diluted sodium hydroxide solution between your fingers and describe the effect that you notice. Associate this “feel” of a hydroxide and another common substance.
3. Rinse your fingers THOROUGHLY. It takes about a minute to get all of the dilute hydroxide off of your skin. If this were concentrated sodium hydroxide you would wash for much longer.
4. Dispose of the extra solution in the sink and clean the test tube.