



Lab #12: Reactions in Solution – Acid and Base Lab

Background: Acids and bases are two special categories of compounds with distinct properties. Later in the year we will study them at length, however, we must introduce them here because reactions between acids and bases are related to one of our driving forces. For now consider the following definitions for acids and bases: an acid is a compound that releases hydrogen ions (H^+) when in water. A base is a compound which releases/creates hydroxide (OH^-) ions in water.

In this lab we will explore four properties of acids and bases. These properties are:

Property #1: Acids react with metals.

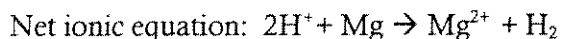
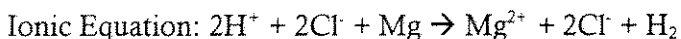
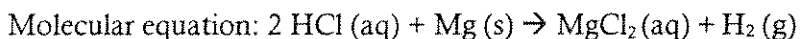
Property #2: Acids and bases are electrolytes.

Property #3: Acids and Bases will affect indicator molecules.

Property #4 Acids and Bases will react to neutralize each other.

Property #1: Acids react with metals.

The hydrogen ion (H^+) released when acids are placed in water, can be considered a part of the activity series that we learned about in the last lab. When this hydrogen ion comes into contact with an active metal, the metal will transfer its electrons to the hydrogen ion. The reaction looks something like this:



Note the product that forms, H_2 . This is hydrogen gas and can be observed as bubbles when the reaction takes place.

Property #2: Acids and bases are electrolytes

This was covered in the earlier electric solutions lab so I will not spend too much time on it here. The hydrogen and hydroxide ions released by acids and bases are charged particles. Remember that a solution with charged particles will conduct an electrical current. Also remember that some acids (or bases) are stronger than others and as a result will conduct more current.

Property #3 Acids and Bases affect indicator molecules

Indicator molecules are compounds which can take on different colors when they are in different forms. When an indicator molecule comes into contact with an acid or a base it will change its form



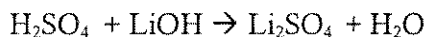
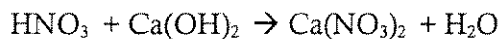
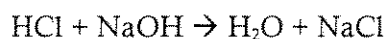
and as a result change its color. Some indicators will exhibit only two different colors, while others show a great variety of colors.

Many indicators are used as solutions, however, another way to use an indicator is by applying it to paper. This treated paper will change color in a fashion very similar to that of the liquid indicators.

Property #4: Acids and bases will react to neutralize each other

Remember that acids release hydrogen ions while bases release hydroxide ions. Both hydrogen ions and hydroxide ions can be very reactive and cause great damage. However, when a hydrogen ion (H^+) and a hydroxide ion (OH^-) come together, they form the harmless compound, water ($H^+ + OH^- \rightarrow H_2O$). Because the harmful hydrogen ions are combining with the harmful hydroxide ions to form **neutral** water this is called a **neutralization** reaction. In other words, an acid reacts with a base to form water.

Here are some examples of acid base reactions:



Note that because acids and bases are both compounds, the overall reaction is a double displacement reaction. Not only do they form water, but they form a second substance. This second substance is an ionic compound. Another word for an ionic compound is a **salt**. For this reason the general reaction for an acid and base is often stated thus:



In this lab you will explore the four properties of acids and bases.

Materials

Well plates
pH indicator paper
stirring rod
conductivity tester
goggles
apron
0.1 M Acetic acid ($HC_2H_3O_2$)
0.1 M NH_3 (a weak base)

phenolphthalein
universal indicator
litmus paper, red
litmus paper, blue
pH paper
0.1 M Hydrochloric Acid, HCl
0.1 M Sulfuric Acid, H_2SO_4
0.1 M sodium hydroxide, NaOH



Distilled water

Magnesium, zinc, and copper

Important Safety Notes:

1. Acids and bases are toxic. They are also corrosive to skin and clothing. Wipe up all spills with large volumes of water. If either an acid or a base gets on your skin or clothing, rinse the affected area thoroughly for 5 minutes and notify the teacher.
2. Wear safety goggles and a lab apron at all times in the laboratory.

Procedure:

Property #1: Acids react with metals.

1. Place a small amount of each metal in the bottom of a well. (Each metal should be in its own well.)
2. Add several drops of hydrochloric acid to each metal. Observe and record your reactions.
3. Repeat the procedure, placing each metal in a new well. This time test each metal with the sulfuric acid. Observe and record your reactions.
4. Repeat the procedure, placing each metal in a new well. This time test each metal with the acetic acid (vinegar).
5. Finally, repeat one more time, placing each metal in a new well. This time test each metal with the sodium hydroxide.
6. Remove any remaining metal with your forceps/tweezers and place in the trash. Clean your well plate and rinse with distilled water. Dry completely.

Property #2: Acids and bases are electrolytes.

7. Place 8-10 drops of each of the following in your well plate. (Each solution should be placed in its own well.)
 - a. Hydrochloric acid
 - b. Sulfuric acid
 - c. Acetic acid
 - d. Sodium hydroxide
 - e. Ammonia

8. Test each well using the conductivity tester. Be sure to wipe the conductivity tester with a damp (distilled water) towel between each well. Observe and record your observations.

Property #3: Acids and Bases will affect indicator molecules.

9. Place 8-10 drops of hydrochloric acid into two wells. In one well place 1 drop of phenolphthalein. In the second well place 1 drop of universal indicator. Observe and record your results.
10. Place 8-10 drops of acetic acid into two wells. In one well place 1 drop of phenolphthalein. In the second well place 1 drop of universal indicator. Observe and record your results.



11. Place 8-10 drops of sodium hydroxide into two wells. In one well place 1 drop of phenolphthalein. In the second well place 1 drop of universal indicator. Observe and record your results.
12. Finally, place 8-10 drops of ammonia into two wells. In one well place 1 drop of phenolphthalein. In the second well place 1 drop of universal indicator. Observe and record your results.
13. Now we will test indicator papers. Place 8-10 drops of each of the following solutions into your well plate (each solution should have its own well).
 - a. Hydrochloric acid
 - b. Acetic acid
 - c. Sodium hydroxide
 - d. Ammonia
14. Tear off a small piece of blue litmus paper. Dip one end of the blue litmus paper into the hydrochloric acid and immediately remove it. Record any changes that occur. Then dip new pieces of blue litmus paper into each of the remaining solutions. Record all observations.
15. Repeat step 14 using the red litmus paper. Observe and record.
16. Repeat step 15 using the pH (pHydrion) paper. Observe and record pH value from the vial.

Property #4 Acids and Bases will react to neutralize each other.

17. Carefully place 10 drops of hydrochloric acid into a well of your well plate. Because the hydrochloric acid and the sodium hydroxide are the same concentration, an equal amount of sodium hydroxide should neutralize our acid. Slowly add 10 drops of sodium hydroxide to your acid. Are you able to see the neutralization reaction that occurs? Record your results.
18. Now place 10 more drops of hydrochloric acid into a new well in your well plate. To this acid add 1 drop of phenolphthalein. Now slowly add 10 drops of sodium hydroxide to your acid. What change do you observe? (if at first you don't observe a change, add a few more drops of sodium hydroxide). Record your observations.

Clean up by disposing of solid materials in trash container and washing liquid material in your well plate down the drain. Clean well plates with AMPLE amounts of soap and water. Dry completely.

Signature for cleanup _____



PRELAB QUESTIONS: COMPLETE PRIOR TO COMING TO LAB

1. List the four properties that we will be testing in lab.
2. When acids combine with reactive metals, bubbling of a gas is always observed. What gas is being formed in this reaction?
3. Explain why acids and bases, in addition to soluble ionic compounds, are electrolytes.
4. What difference would you expect when testing the conductivity of hydrochloric acid versus acetic acid (vinegar)? Why?
5. What is an indicator? List two indicators that we will be using in lab?
6. What products are formed in a neutralization reaction?
7. Explain why an acid base reaction is also called a neutralization reaction.

DATA TABLE(S): COMPLETE BEFORE COMING TO LAB (USE A RULER)



Honors Chemistry Lab Manual

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