

## Lab Report: Chemistry

The present report aims at describing the experiments taken to identify the chemical properties of acids. According to Sahoo et al. (2012), there five properties of acids that can be confirmed experimentally. First, solutions of acids are electrolytes, which implies that acids ionize in water (Sahoo et al., 2012). Some acids produce an electrical current if they ionize completely, while other acids produce a weak current, as they dissolve only partially (House, 2019). Second, acids change the color of indicators, such as litmus and phenolphthalein (Sahoo et al., 2012). Third, acids react with metals above hydrogen in the activity series to form hydrogen gas ( $H_2$ ) and salt through a single replacement reaction (Boguta & Sokołowska, 2016). Finally, acids react with bases in the neutralization reaction producing a salt compound and water (Sahoo et al., 2012). These properties are crucial, as they are widely used in chemical industries (Boguta & Sokołowska, 2016). The purpose of the present paper is to test the chemical properties of acids using hydrochloric acid (HCl).

The present report will describe the results of three experiments. First, litmus will be put in hydrochloric acid to inspect the changes in color. Second, hydrochloric acid will be added to zinc and copper to observe how the acid reacts with metals. Third, hydrochloric acid will be added to sodium hydrate to observe the chemical reaction of acids with bases. The following hypotheses can be formed based on the literature review:

**H1:** Addition of litmus to a hydrochloric acid will turn the solution red due to the presence of hydrogen ions ( $H^+$ ).

**H2a:** Addition of hydrochloric acid to zinc will initiate a chemical reaction with the liberation of colorless gas, as zinc stand above hydrogen in the activity series.

**H2b:** Addition of hydrochloric acid to copper will not initiate a chemical reaction, as copper

stands below hydrogen in the activity series.

**H3:** Addition of hydrochloric acid to a solution of sodium hydrate and phenolphthalein will make it colorless due to the neutralization reaction between bases and acids.

## **Methods**

### **Participants**

The experiments described in the present report will require the participation of only one person. The person needs to be instructed about the actions that need to be performed to test the identified hypotheses. The participant needs to be equipped with protective gear to ensure the safety of hands and eyes. In particular, the participant needs to use protective goggles and gloves. All the experiments described in the present report were performed by a student supervised by his chemistry teacher.

### **Materials**

The experiments described in the introduction section of the present report require the presence of the following materials:

- Four (4) test tubes with three (3) milliliters of hydrochloric acid (HCl);
- One (1) test tube with three (3) milliliters of sodium hydrate (NaOH);
- One (1) test tube with copper wire;
- One (1) test tube with zinc chipping;
- Available indicators (phenolphthalein and litmus);
- Protective gear (safety goggles and gloves), a desk, and a test-tube holder.

### **Procedure**

Four experiments were performed in a sequential order to test the four hypotheses identified in the introduction section of the present report. First, two drops of litmus solution were added to a

test tube with hydrochloric acid. The contents of the test tube were shaken to increase the speed of the chemical reaction, and changes in the color of the solution were observed. Second, the contents of a test tube with hydrochloric acid were added to a test tube with zinc chipping. The contents of the test tube were shaken to increase the speed of the chemical reaction, and changes in the solution behavior were observed. Third, the contents of a test tube with hydrochloric acid were added to a test tube with copper wire. The contents of the test tube were shaken to increase the speed of the chemical reaction, and changes in the solution behavior were observed. These three procedures were performed to test the first three hypotheses.

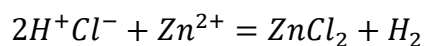
The final procedure included several manipulations, as three substances needed to be mixed. First, three drops of phenolphthalein were added to a test tube with sodium hydrate, and the changes in the color of the solution were observed. After that, 3 milliliters of hydrochloric acid were added to the solution, and the changes in color were observed. During the final procedure, the contents of the test tube were frequently shaken and exposed to light to increase the speed of the chemical reaction.

### **Results and Discussion**

The results of four experiments confirmed the hypotheses stated in the introduction section of the present report. During the first experiment, the solution of the hydrochloric acid and litmus changed the color to red after being shaken several times. These confirmed the presence of  $H^+$  ions in the solutions, as litmus is sensitive to free ions of hydrogen in the solution. The results of these tests confirmed H1, which was crucial to confirmation of the first two chemical properties of acids described in the introduction section of the present report. In particular, the experiment confirmed that solutions of acids produce an electric current and change the color of indicators due to the presence of hydrogen ions.

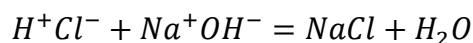
The results of the second and the third experiment confirmed hypotheses H2a and H2b

correspondingly. During the second experiment, the mixing of zinc and hydrochloric acid produced colorless gas. This was hydrogen gas, as can be seen from the chemical reaction equation:



The experiment confirmed that acids react with metals above hydrogen in the activity series. However, during the third experiment, no reaction was observed between copper and hydrochloric acid even after shaking and exposure to light. This confirmed H2b, as copper is below hydrogen in the activity series.

The final experiment confirmed H3, as the solution changed color twice. After adding phenolphthalein to sodium hydrate, the solution in the test tube turned red, which demonstrated the presence of OH<sup>-</sup> ions. After adding hydrochloric acid to the test tube, the solution turned colorless. This demonstrated that the condition of the solution changed from alkaline to neutral due to the neutralization process. As a result, salt solution and water was produced, which can be seen in the chemical reaction equation demonstrated below.



### **Conclusion**

Acids have four central chemical properties that can be confirmed through relatively simple experiments. First, the solutions of acids are electrolytes, which can be explained by the presence of hydrogen ions. These ions can create an electrical current and change the color of litmus paper to red. Second, acids react with metals above hydrogen in the activity series, producing hydrogen gas and salt solution. Finally, mixing of acids with bases leads to a neutralization reaction, which produces salt solution and water. All these chemical properties were confirmed using the procedures described in the present report.

## References

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