Group Names

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Class

Date

USING CONDUCTIVITY TO PREDICT BONDING

INTRODUCTION

Conductivity is a measure of the ability of water to carry an electrical current, related to the amount of ions in the solution. Micro siemens (µS/cm) is the unit for measuring conductivity. There are two main chemical bonds: ionic and covalent. In ionic bonds, one atom loses an electron to form a positive ion and the other atom gains an electron to form a negative ion. Since ions are formed in ionic compounds, these solutions are conductive. In contrast, solutions with covalent bonds are not conductive. Covalent bonds are formed when two atoms share electrons to form molecular compounds. Distilled water (H_2O), Boric Acid, Glycerin, Isopropyl alcohol, Ethanol, and Sugar are all covalent bonds. Sodium Chloride (NaCl) is the only solution that had an ionic bond. Tap water and Ammonium (NH_4) are the abnormal solutions; they are usually covalent bonds, but because they are not pure substances (they have ionic like substances in them) they are conductive. **(Author)**

In this study, we tested the different conductivity levels of many solutions. We hypothesized that the amount of conductivity depends on the bond type. Solutions with a covalent bond type will not be conductive and solutions with ionic bonds will be conductive. Our data agrees with our hypothesis. Solutions with ionic bonds were conductive and the solutions with covalent bonds were not conductive. The same 9

solutions were tested for conductivity with two different methods. The first method said that 3 solutions each were not conductive, partially conductive, and fully conductive. The second method said that 1 solution was not conductive, 5 solutions were partially conductive, and 3 solutions were fully conductive. **(Author)**

MATERIALS AND METHODS

To determine whether the solutions were able to conduct an electrical current a conductivity tester was created. In step one an alligator clip connected the positive terminal of a 9V battery to one end of a 1 Kilo Ohm resistor. The resistor (2) was then connected to one end of a light emitting diode (LED step 3 and 4). The LED was then connected with an alligator clip to a 4cm copper wire (Step 5 and dashed line). The copper wire was inserted into a plastic drinking straw (step 6). A similar sized wire was also inserted into the straw 2cm away and connected to the negative terminal of the 9V battery (step 7). The circuit was completed and the LED (4) would light if the two wires (step 6) were inserted into a solution that could conduct an electrical current. After the copper wires were inserted into test solutions, the results were noted as: Yes – LED completely lit; Partial – weak lighting of the LED; or NO- LED remained unlit. **(Author)**

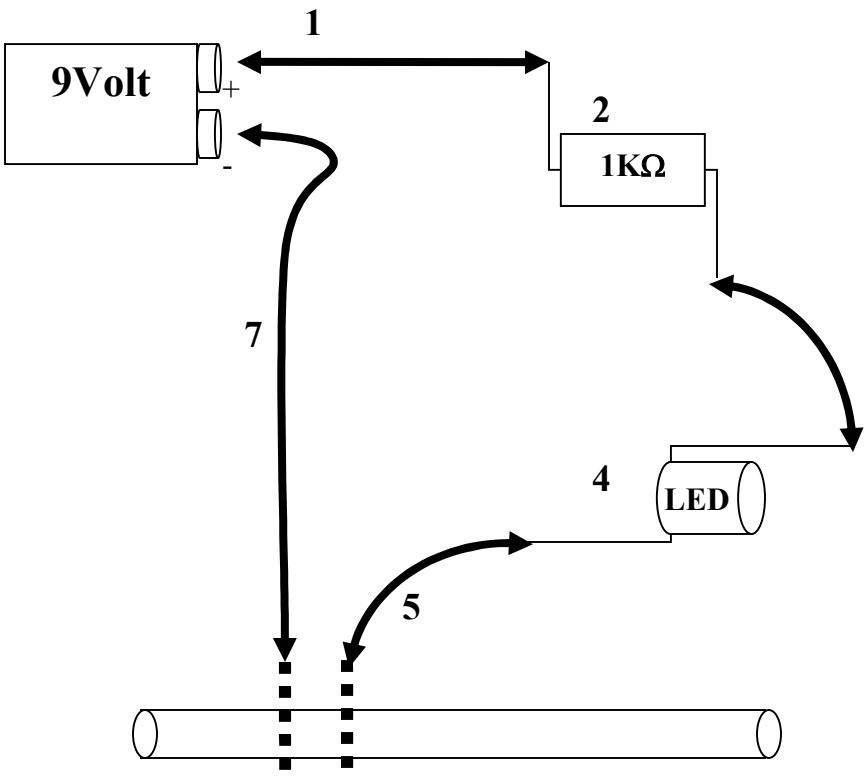

Figure 1: Circuit layout testing conductivity

To test the solutions, place ~2ml of each solution in an individual well. Then insert the electrodes of the tester into a well that contains a solution. The electrodes must not touch each other. Depending on the solution, the LED will light up thus determining which substances are conductive. **(Author)**

RESULTS

Conductivity is a measure of the ability of water to carry an electrical current, related to the amount of ions in the solution. The purpose of this lab is to build a simple conductivity tester to determine which substances produce ions in an aqueous solution. After constructing a conductivity tester and measuring the conductivity of the solutions, the solutions are then classified into conductors, partial conductors, or nonconductors. They results are then related to bond type. **(Author)**

Table 1: Results based on LED conductivity tester

Compound – solution	Conduction (Y – N – P)[A]
Distilled H_2O	N
Boric acid	P
NaCl	Y
Glycerin	P
Isopropyl alcohol	N
Ethanol	N
Tap Water	Y
NH_3 solution	Y
Sugar	P

A= Conduction is determined by the lighting of the LED. Results are denoted as follows: Y-yes; N-No; P-partial.

When testing the conductivity of various solutions the results varied individually. Distilled water (H_2O), Isopropyl alcohol, and Ethanol were not conductive. Boric acid, Glycerin, and Sugar were only partially conductive. On the contrary, Sodium Chloride (NaCl), Tap Water, and Ammonium (NH_4) Solution were fully conductive. **(Author)**

Table 2: Conductance of each solution measured with a Vernier conductance probe.

Compound – solution	Conductance[A]
Distilled H_2O	0µS/cm[B]
Boric acid	35-40[C]µS/cm
NaCl	7820µS/cm
Glycerin	3-5µS/cm
Isopropyl alcohol	3-5µS/cm
Ethanol	3-5µS/cm
Tap Water	841µS/cm
NH_3 solution	524µS/cm
Sugar	3-5µS/cm

A = all measurements taken on the 0-20,000µS/cm setting.
B = The siemens is the SI derived unit of electric conductance. It is equal to inverse ohm. It is named after the German inventor and industrialist Ernst Werner von Siemens, and was previously called the mho.
C = The hyphen denotes a range.

The same solutions were then tested with a Venier conductance probe. Most of the nine of the solutions' results agreed. Distilled Water (H_2O) was the only solution that was not conductive. Boric acid, Glycerin, Isopropyl alcohol, Ethanol, and Sugar all were only partially conductive. The same three solutions above, Sodium Chloride (NaCl), Tap Water, and Ammonium (NH_4) Solution were conductive. **(Author)**

The same 9 solutions were tested for conductivity with two different methods. The first method said that 3 solutions each were not conductive, partially conductive, and

fully conductive. The second method said that 1 solution was not conductive, 5 solutions were partially conductive, and 3 solutions were fully conductive. **(Author)**

There are two types of bonds that can be formed: ionic and covalent. Ionic bonds are conductive whereas covalent bonds are not conductive, primarily because ionic bonds create ions (ions are conductive). The results correlate directly to bond type. For example, Distilled Water (H_2O) is bonds covalently and is not conductive and Sodium Chloride (NaCl) is an ionic bond that is conductive. **(Author)**

CONCLUSION

Our data agrees with our hypothesis. The amount of conductivity produced depends on the bond type. If a solution is covalently bonded they will not be conductive. In contrast, if the solution was an ionic bond it will be conductive. Both methods of testing the conductivity levels of the solutions gave exactly the same results. Conductivity levels thus depend on bond type. **(Author)**