Conducting Solution

by

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Introduction

A solution is a homogeneous mixture of two or more substances, which may be solids, liquids, gases, or a combination of these. In this experiment, solids are dissolved into liquids. The solid is used as a solute and pure water is used as solvent. When solute is dissolved into solvent, it is called an aqueous solution. One experiment which may be conducted with such a solution is conducting electricity. In order to conduct electricity, there should be some mobile ions in the solution. Since solid substances and pure water don't contain any free ions, they can't conduct electricity individually.

Molecules of a solid ionic bonding substance are crystalline in structure. They are held by ionic bonds to prevent them from moving around freely, and they have a net charge. Once an ionic solid substance is dissolved into a solution, ions can move around freely. Since there are some mobile ions and different charges in the solution, it can conduct electricity and become a conducting solution. A Conductivity level of a solution can be determined by the proportion of mobile ions in a solution. When sodium chloride, $NaCl(s)$, dissolves into solution, it breaks down completely to one $Na+$ ion and one $Cl-$ ion. When, aluminum chloride, $AlCl_3$ (s), dissolved into solution, it breaks down completely to one $Al3+$ ion and three $Cl-$ ion. Since aluminum chloride disassociates into more ions than sodium chloride, $AlCl_3$, be able to conduct more electricity.

How is electricity conducted with ions? The positive ions will flow to the anon (-); the negative ions will flow to the cathode (+). Ions flow around in the solution and create a potential

difference. Therefore, a solution where there are free ions able to move about can produce electricity. It works similarly to the electrons flow inside a wire. Additionally, the nerve system in our bodies applies the same concept. There are a lot of ions flowing inside our bodies, and they can carry some electrons flowing along with them. When we are stimulated, our nerve system send an electricity impulse to delivery signals to our brain through those charged ions.

Objectives of this lab

1. Determine the conductivity level of different solutions.

2. Understand the relationship between concentration of solutions and conductivity level.

3. Understand how the number of ions in a solution relates to the conductivity level.

4. Comprehend more about chemical equations and reactions.

Equipment List

Computer
Vernier computer interface
Logger Pro Software
1 balance
Sodium Chloride, NaCl
Manganese(II) Oxide, MgO

Conductivity Probe
Distilled water
Two 150 ml Beakers
One 100 ml Graduated Cylinders
One stirring rod
Glucose, $C_6H_{12}O_6$

Experimental Procedure

1. Measure 80 ml of distilled water in a graduated cylinder and pour it into the 150 ml beaker

2. Connect the Vernier computer interface to the computer and connect the pH Probe into Channel 1 of the interface.

3. Run the Logger Pro Software and get ready to collect data by opening the file "Conducting Solution" from the Living Environment folder.

4. Each time before you use the conductivity probe, you have to rinse its tip thoroughly with distilled water. Be careful, the tip is extremely sensitive.

5. In the Logger Pro software, a table will appear when you run the program. Label the header of the table by double clicking on the header and typing "Distilled Water" into the window that opens. Put the conductivity probe into the 150 ml beaker and collect the data by clicking [▶ Collect] to measure the conductivity level for 1 minute.

6. When one minute is over, store the collected data by clicking "Store Latest Run" from "Experiment Menu".

7. Rinse the conductivity Probe thoroughly.

8. Select the data from the graph which is the most constant values part, and then draw the best fit line by clicking [⊠] to get the general equation of your data. The y-intercept is the average conductivity, if the slope of the best fit line is very small.

9. Record the general equation of the graph into Table 1.

10. Use a balance to measure 5 g of NaCl. Pour the NaCl into the 150ml beaker and dissolve it within the distilled water. Stir the solution thoroughly using a stirring rod. Again, collect the data by clicking [▶ Collect] to measure the conductivity level for 1 minute.

11. Rinse the conductivity Probe thoroughly. Dump the mixed solution in the appropriate receptacle and get another portion of distilled water for the next testing sample. Repeat Step 4 through Step 10 for the remaining samples.

12. After recorded all the data, rinse the conductivity probe thoroughly and wash all the equipment using tap water.

References

Chang, Raymond, Essential Chemistry: A Core Text for General Chemistry 2nd edition, 2000, McGraw-Hill Higher Education, New York, New York

Masterman, David, Holman, Scott, Biology with Computers: Biology Experiments Using Vernier Sensors 3rd edition, 2003, Vernier Software & Technology, Beaverton, Oregon

Results

Name:

Date:

Teacher:

Please use the data obtained from the experiment to fill in Table 1

Table 1			
Samples	General Equation	Conductivity	Conductivity Ranking

Analysis

1. What is the reason to measure the conductivity of distilled water in this experiment?

2. What happened after dissolving the NaCl, MgO and $C_6H_{12}O_6$, into the distilled water? For each case, did it increase or decrease the conductivity level? Why?

3. Plot a bar graph for the sample solutions using the data from Table 1.

Bar Graph of Samples

Conductivity (us/cm)

Name of the Samples