

Experiment GB-6: Conductivity of Solutions

Exercise 1: The Conductivity of Various Electrolytes.

Aim: To determine the conductivity of different electrolyte solutions.

Procedure:

Note: Always begin testing samples with the conductivity selector switch in the 0-200 μS range. While recording the conductivity of each test sample, toggle the switch to the 0-20,000 μS position. This is especially important for measuring solutions with higher conductivities.

1. Fill a 100 ml beaker with approximately 50 ml of 0.05M NaCl. Fill a 250 ml beaker with 100ml deionized water.
2. Make sure the conductivity selector switch is in the 0-200 μS position.
3. With the CM-100 conductivity meter in the beaker of deionized water, click Record on the LabScribe Main window to begin recording.
4. When the recording on the Conductivity channel reaches a stable baseline, type DI Water in the Mark box to the right of the Mark button. Press the Enter key on the keyboard to mark the recording.
5. Type 0.05M NaCl in the Mark box to the right of the Mark button.
6. Remove the meter from the deionized water and carefully blot the tip.
7. Place the CM-100 in the beaker of 0.05 M NaCl.
8. When the recording on the Conductivity channel reaches a stable baseline, type 0.05 NaCl in the Mark box to the right of the Mark button. Press the Enter key on the keyboard to mark the recording. The recording should look like [Figure GB-6-L1](#).

Note: You may need to toggle the conductivity selector switch to the 0-20,000 μS range to get an accurate reading of conductivity.

9. Click Stop to halt the recording.
10. Select Save in the File menu.
11. Remove the conductivity meter from the beaker. Hold the meter over the 500 ml beaker used for collecting waste deionized water, and rinse it with a wash bottle. Blot any drops of DI water from the meter and place the meter in a beaker containing fresh DI water. The meter will be used in the next section of the exercise.

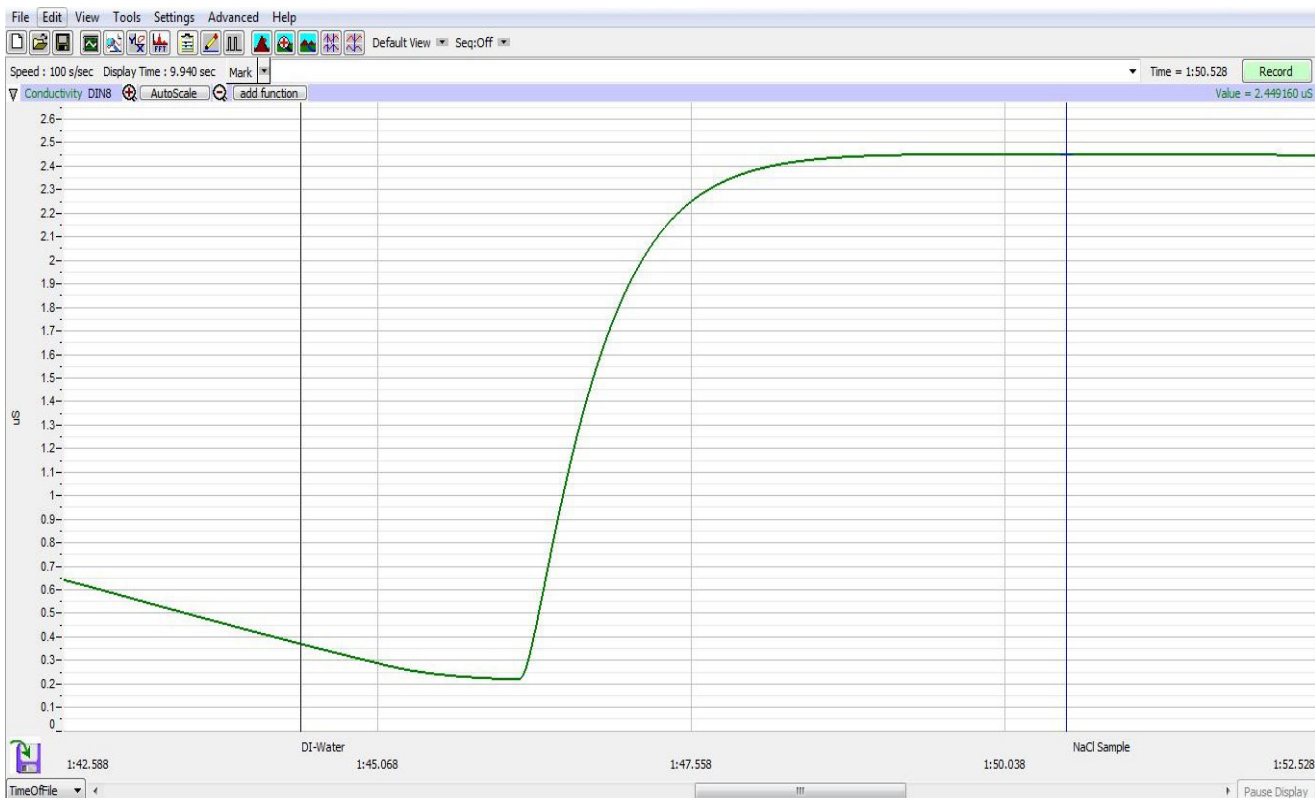


Figure GB-6-L1: Recording showing the conductivity of a solution in the Main window.

12. Repeat steps 1 through 11 using the following solutions.

- 0.05 M CaCl_2
- 0.05 M AlCl_3
- 0.05 M $\text{HC}_2\text{H}_3\text{O}_2$
- 0.05 M H_3PO_4
- 0.05 M H_3BO_3
- 0.05 M HCl
- 5% $\text{C}_2\text{H}_4\text{O}_2$
- 5% $\text{C}_3\text{H}_7\text{OH}$

Note: Be sure to mark the recording appropriately for each of these solutions for ease of data analysis.

13. Place the CM-100 conductivity probe in a beaker of fresh deionized water during data analysis.

Data Analysis

1. Scroll to the section of data for deionized water and 0.05 M NaCl recorded during Exercise 1.
2. Use the Display Time icons on the LabScribe toolbar to position this section of recording on the Main window. The required data can also be selected by:
 - Placing the cursors on either side of the section of data needed. Place one cursor on the stable conductivity value recorded from pure deionized water. Place the second cursor on the stable conductivity value recorded after moving the meter to the 0.05 M NaCl solution.
 - Clicking the Zoom between Cursors button on the LabScribe toolbar to expand the segment of data to the width of the Main window.
3. Look at the Function Table that is above the uppermost channel displayed in the Analysis window. The mathematical functions that are listed should include Title, Value1, and Value2. The values for these parameters from each channel are seen in the table across the top margin of each channel.
4. Once the cursors are placed in the correct positions for determining the conductivity, the values can be recorded in the on-line notebook of LabScribe by typing the names and values directly into the Journal.
5. The functions in the channel pull-down menus of the Analysis window can also be used to enter the names and values of the parameters from the recording to the Journal. To use these functions:
 - Place the cursors at the locations used to measure the conductivity from the Conductivity channel.
 - Transfer the name of the mathematical function used to determine the conductivity to the Journal using the Add Title to Journal function in the Conductivity channel pull-down menu.
 - Transfer the value for the conductivity to the Journal using the Add Ch. Data to Journal function in the Conductivity channel pull-down menu.
6. Place one cursor on the stable conductivity value of the pure deionized water. Place the second cursor on a stable point in the recording of the 0.05 M NaCl solution.
7. Measure the values for the following parameters from the Conductivity channel for the region of data selected:
 - Conductivity-DI Water, which is Value1 on the Conductivity channel.
 - Conductivity-NaCl, which is Value2 on the Conductivity channel.
8. Record the values for these parameters in the Journal using one of the procedures described in Step 5, and on [Table GB-6-L1](#).
9. Click the down arrow next to the Mark box to choose the next section of data.
 - Highlight and click on the next Mark on the list - CaCl₂.
 - This will automatically move the recording to the section of data with that Mark.

10. Repeat steps 3 through 8 for the 0.05 M CaCl_2 solution.
11. Repeat step 9, moving to the next Mark on the list - AlCl_3 .
12. Repeat steps 3 through 8 for the 0.05 M solution of AlCl_3 .
13. Continue steps 3 through 9 for each of the successive solutions, recording conductivity values in μS on the data table.

Exercise 2: The Effect of Concentration on the Conductivity of Solutions

Aim: To determine the effect of concentration on the conductivity of various solutions.

Note: Always begin testing samples with the conductivity selector switch in the 0-200 μS range. While recording the conductivity of each test sample, toggle the switch to the 0-20,000 μS position. This is especially important for measuring solutions with higher conductivities.

Procedure:

1. Add 50 ml deionized water to a 100 ml beaker.
2. Place the CM-100 conductivity meter in the beaker and click Record on the LabScribe Main window to begin recording.
3. When the recording on the Conductivity channel reaches a stable baseline, type DI Water in the Mark box to the right of the Mark button. Press the Enter key on the keyboard to mark the recording.
4. Add 1 drop of 1.0 M NaCl solution to the deionized water. Carefully swirl the CM-100 to ensure thorough mixing.
5. Type 1 in the Mark box to the right of the Mark button. Press the Enter key on the keyboard to mark the recording as it reaches a stable level.
6. Type 2 in the Mark box to the right of the Mark button as a second drop of 1.0 M NaCl solution is added to the beaker. Press the Enter key on the keyboard to mark the recording as it reaches a stable level.
7. Type 3 in the Mark box to the right of the Mark button as a third drop of 1.0 M NaCl solution is added to the beaker. Press the Enter key on the keyboard to mark the recording as it reaches a stable level.
8. Continue following these steps until 10 drops on 1.0 M NaCl have been added to the beaker.
9. Click Stop to halt the recording.
10. Select Save in the File menu.
11. Remove the conductivity meter from the beaker. Hold the meter over the beaker used for collecting waste deionized water, and rinse it with a wash bottle. Blot any drops of DI water from the meter and place the meter in the beaker containing fresh DI water. The meter will be used in the next section of the exercise.

12. Repeat steps 1 through 11 for both 1.0 M CaCl_2 and 1.0 M AlCl_3 .
13. Discard the contents of each beaker as directed by your instructor.

Note: Remove the conductivity meter from the beaker. Hold the meter over the beaker used for collecting waste deionized water, and rinse it with a wash bottle. Blot any drops of DI water from the meter and place the meter in the beaker containing fresh DI water. Make sure the CM-100 is clean and dry prior to storage.

Data Analysis

1. Scroll to the section of data for deionized water and 1 drop of 1.0 M NaCl recorded during Exercise 2.
2. Use the Display Time icons on the LabScribe toolbar to position this section of recording on the Main window. The required data can also be selected by:
 - Placing the cursors on either side of the section of data needed. Place one cursor on the stable conductivity value recorded from pure deionized water. Place the second cursor on the stable conductivity value recorded after adding 1 drop of 1.0 M NaCl.
 - Clicking the Zoom between Cursors button on the LabScribe toolbar to expand the segment of data to the width of the Main window.
3. Look at the Function Table that is above the uppermost channel displayed in the Analysis window. The mathematical functions that are listed should include Title, Value1, and Value2. The values for these parameters from each channel are seen in the table across the top margin of each channel.
4. Once the cursors are placed in the correct positions for determining the conductivity, the values can be recorded in the on-line notebook of LabScribe by typing the names and values directly into the Journal.
5. The functions in the channel pull-down menus of the Analysis window can also be used to enter the names and values of the parameters from the recording to the Journal. To use these functions:
 - Place the cursors at the locations used to measure the conductivity from the Conductivity channel.
 - Transfer the name of the mathematical function used to determine the conductivity to the Journal using the Add Title to Journal function in the Conductivity channel pull-down menu.
 - Transfer the value for the conductivity to the Journal using the Add Ch. Data to Journal function in the Conductivity channel pull-down menu.
6. Place one cursor on the stable conductivity value of the pure deionized water. Place the second cursor on a data point in the recording of the 1 drop of 1.0 M NaCl solution.

7. Measure the values for the following parameters from the Conductivity channel for the region of data selected:
 - Conductivity-DI Water, which is Value1 on the Conductivity channel.
 - Conductivity-1, which is Value2 on the Conductivity channel.
8. Record the values for these parameters in the Journal using one of the procedures described in Step 5, and on [Table GB-6-L2](#).
9. Click the down arrow next to the Mark box to choose the next section of data.
 - Highlight and click on the next Mark on the list - CaCl₂.
 - This will automatically move the recording to the section of data with that Mark.
10. Repeat steps 1 through 9 for CaCl₂.
11. Repeat steps 1 through 9 for AlCl₃.

Data Tables

Table GB-6-L1: Data Table for Exercise 1 - Conductivity of Different Solutions

Conductivity Values for Various Solutions		
Solution	Deionized water prior to test (uS)	Conductivity of Solution (uS)
0.05 M NaCl		
0.05 M CaCl ₂		
0.05 M AlCl ₃		
0.05 M HC ₂ H ₃ O ₂		
0.05 M H ₃ PO ₄		
0.05 M H ₃ BO ₃		
0.05 M HCl		
5% C ₂ H ₄ O ₂ (acetic acid)		
5% C ₃ H ₇ OH (isopropyl alcohol)		

Table GB-6-L2: Data Table for Exercise 2 - Concentration

Effect of Concentration on Conductivity					
1.0 M NaCl		1.0 M CaCl ₂		1.0 M AlCl ₃	
# of drops	Conductivity (uS)	# of drops	Conductivity (uS)	# of drops	Conductivity (uS)
1		1		1	
2		2		2	
3		3		3	
4		4		4	
5		5		5	
6		6		6	
7		7		7	
8		8		8	
9		9		9	
10		10		10	

Questions

Exercise 1

1. Which solution had the highest conductivity? The lowest?
2. What is the main contributor to the difference in conductivity values between the solutions tested?
3. What is the reason that acetic acid and isopropyl alcohol showed little, if any, conductivity?
4. How do strong and weak electrolytes compare in their conductivity values?

Exercise 2

1. What was the effect of adding drops of 1.0 M NaCl to deionized water?
2. What was the effect of adding drops of 1.0 M CaCl₂ to deionized water?
3. What was the effect of adding drops of 1.0 M AlCl₃ to deionized water?
4. Graph Concentration vs. Conductivity for each of the 3 solutions.