

Conductivity of Solutions

Target audience: 9-12

Background and Notes:

Solutions containing ions e.g. salts or acid or bases will conduct electricity. Solutions that conduct electricity contain substances (ionic) known as electrolytes. Solutions that do not conduct electricity contain substances (molecular) known as nonelectrolytes.

Knowledge and skills:

- Students should understand and know the following terms: ions in solution, electrolytes, nonelectrolytes, polar and nonpolar
- Students should be able to test for the conductivity of unknown solutions using a conductivity apparatus such as a light bulb connected to a probe or use Conductivity Probes with a Lab Pro or CBL from Vernier.

Fundamental understanding:

- Ions in solution will conduct electricity. Molecular substances do not conduct electricity.

Essential Questions:

- What substances will conduct electricity in solution?

National standard (s):

National content standard B, students should develop an understanding of the structure of atoms and the structure and properties of matter. Students should understand the motions and forces with Interactions of energy and matter.

State standard(s):

1.07 Ionic Bonds, 4.043 Electrical Conductivity: Objectives for North Carolina Chemistry Standard Course of Study Objective

Purpose: to observe which compounds in solution are electrolytes i.e. conduct electricity. Determine which compounds are ionic or molecular based on the ability to conduct electricity.

Safety Precautions:

- Be aware of electrical hazards.
- Wash hands thoroughly when working with acids, bases and salts.
- Dispose of acids after neutralization as instructed by teacher.

Materials:

Equipment:

1. 100 ml beakers
2. light bulb apparatus to detect conductivity
3. Or conductivity probes with Lab Pros or CBLs from Vernier

Reagents: suggested solutions should be 0.1 M

1. Hydrochloric acid (strong acid)
2. sodium hydroxide (strong base)
3. copper II chloride (salt)
4. sodium chloride (salt)
5. potassium iodide (salt)
6. acetic acid (weak acid)
7. ammonium hydroxide (weak base)
8. sugar (glucose or sucrose)
9. methanol
10. isopropyl alcohol
11. distilled water

Procedure:

1. Place ~ 60.0 ml of each solution into a well labeled 100 ml beaker.
2. Place probe into solution and observe (note brightness of light qualitatively)

Results and Observations:

Record qualitative observations of the light brightness.

Data table: Design a data table for all observations including electrolyte and nonelectrolyte

Calculations and Data Analysis:

Conclusion:

1. Restate Purpose and/or hypothesis
2. Which compounds were ionic?
3. Which compounds were molecular?
4. Which compounds were nonelectrolytes
5. Which compounds were electrolytes?
6. How would you change this experiment and what other compounds would you test.

References and Resources:

High School or College Chemistry Textbook containing information on Ions in Solution, Acids, Bases, Ionic versus Molecular compounds

Vernier Software and Technology: info@vernier.com

Teacher Notes:

Set up the apparatus the day before with well-labeled solutions at each lab table for four students. This can be set up as an inquiry lab, having the students decide the day before which substances to test and predict which would conduct electricity and which would have the brightest lights.