Your name________________________________ Lab & Table Number____________

Names of students present in your group ________________________________

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SCI 265: SOLUTIONS AND ELECTROLYTES

IONIC AND COVALENT COMPOUNDS

1. What is an ion?

2. What is a molecule?

3. What is the difference between an ionic and a covalent bond?

4. What is the difference between a polar covalent and a nonpolar covalent compound?

5. Classify the following compounds as ionic or covalent:

A. O_2	B. H_2O
C. NaCl	D. $C_6H_{12}O_6$
E. $CaCO_3$	F. NaOH
G. HCl	H. NH_3
K. N_2	L. CH_3OH.

6. Give examples of ionic and covalent compounds (two examples of each, other than the ones already mentioned in question 5).

POLAR AND NONPOLAR COMPOUNDS

"Like dissolves like" is a principle in chemistry that describes the ability of covalent compounds to dissolve other covalent compounds of the same type: polar or nonpolar.

PAPER AND THIN LAYER CHROMATOGRAPHY (TLC)

INTRODUCTION

Paper and thin layer chromatography (TLC) are simple, quick, and inexpensive techniques for checking the solubility of a substance in a solvent. Chromatographic methods are used by scientists to determine the purity of a compound or determining the number of components in a mixture.

We all have gotten some substance (spots) on our clothing, such as ink from a leaking pen. The question is "What can we use to remove it?" It all depends on the polarity of the substance and the polarity of what we use to remove it.

In this activity, you will determine the relative polarity of food coloring and inks. A practical application of this is determining what solvent would be best to remove the substance from clothing.

Materials and Chemicals:

chromatography paper	isopropanol (rubbing alcohol)
chromatography jars	acetic acid (vinegar).
food coloring	pens

PROCEDURE

1. Select different food colorings and different colors of ink.

Preparing the Plate

2. Obtain a piece of TLC paper.

3. Draw two *pencil* lines 1 cm from the top and bottom ends. Place five light pencil marks equally spaced along the bottom line, and label them above the top line according to what you will be applying to the sheet.

4. Using capillary tubes, spot the paper in the appropriate place with 1-2 applications of each food coloring to give adequate spot intensity. When placing the spots on the plate, it is best to place the spot on the pencil mark drawn. When you make a second application of the sample, place each spot on top of the previous one for each specific coloring. For the ink, simply use the pen to make a small, solid circular dot on the paper.

Developing the Plate
5. Place the filter paper in one of the chromatography jars (beakers) using tweezers.

6. Develop one of the plates in isopropanol (rubbing alcohol) and one in dilute acetic acid (vinegar). Do not move the beakers during the development phase.

7. When the solvent has migrated to about 1 cm from the top of the sheet, remove the sheet and lay it on a paper towel. Allow the solvent to evaporate for about 5 min. Recap the developing chamber (beaker) with the foil and leave it on the lab bench. **Do not discard the solvent**.

Visualizing the Spot(s): Examine the plate and circle the visual spots lightly with pencil.

Q1: Which solvent would be best for removing food coloring from clothing?

Q2: Which would be best for removing ink from clothing?

Q4: What types of compounds are:
*(find their chemical formula and structure in the section **Chemical Structure**)*

A. isopropanol (rubbing alcohol): *ionic* *covalent nonpolar* *covalent polar*

B. acetic acid (vinegar): *ionic* *covalent nonpolar* *covalent polar*

Q3: Which color in the different dyes and colors in the ink is the most polar?
(*consider in your answer the principle "like dissolves like"*)

PART B: ELECTROLYTES AND NONELECTROLYTES

At a young age, we learn not to bring electrical devices into the bathtub so as not to electrocute ourselves. That is a useful lesson because most of the water we encounter in daily life is electrically conductive. Pure water, however, is a very poor conductor of electricity. The conductivity of bathwater originates from the substances dissolved in the water, not from the water itself. Not all the substances that dissolve in water make the resulting solution conducting.

Electrolytes are important compounds in our bodies and are involved in the delicately balanced composition of our blood and other body fluids; thus they are involved in homeostasis. They are capable of conducting electricity and thus are involved in nerve impulse transmission. In this exercise, you will study the ability of ionic and nonionic compound to conduct electricity.

INTRODUCTION

Electrolytes are substances that consist of charged particles called ions. When electrolytes are dissolved in water (or other polar solvents) they ionize into positive (cation) and negative (anion) ions. In this experiment, you will explore what types of compounds can become electrolytes, what determines electrolyte strength, and how electrolytes are involved in the conduction of electricity.

DISCUSSION

Before we can discuss the properties that make a compound an electrolyte, we must first understand something about the properties of electricity. Electricity results from the movement of charged particles through a conductor. The charged particles can be either electrons or ions (positive or negative). In some cases, both types of particles can be involved. When the movement of electricity is through a metal, the electrons move from one metal atom to another which serves as the means for carrying the charge in the electrical circuit. If a liquid is included as part of the electric circuit, something must carry the charge through this solution, otherwise no electrical current will flow. When a non-electrolyte is added, no current flows. Therefore, if a light bulb is also included in an electrical circuit containing a polar liquid, it is possible to tell whether the compound being added to the liquid is an electrolyte or a non-electrolyte by whether or not the light bulb lights up.

Determining/Predicting Electrolyte Behavior

There are three types of chemical compounds: strong, weak and non-electrolytes. A **polar solvent** (eg water) is necessary for an electrolyte to function.

Classification of ionic and covalent compound in terms of their property to conduct electricity:

Ionic compounds that are soluble are **strong electrolytes**. Ionic compounds that are insoluble are **non-electrolytes**.

Polar covalent compounds can be strong, weak, or non-electrolytes. Most acids (eg. HCl, and H_2SO_4) have weak polar covalent bonds to the hydrogen, allowing water to pull the H^+ off of the molecule – thus an acid will be an electrolyte – either strong or weak (**strong acids are strong electrolytes, weak acids are weak electrolytes**). The other covalent compounds form **non-electrolytes**.

In addition, many salts when dissolved in water will dissociate into ions. For example, the ionic compound NaCl, when dissolved in a polar solvent, dissociates (splits apart) completely to form sodium ions and chloride ions. These ions form because the electrostatic forces present in the polar solvent help to stabilize the ions.

Equipment

Conductivity tester
Light bulb conductor
Five 100-mL beakers (30 total)
DI water bottles (six)

Chemicals

0.1 M NaCl (500 mL total)
NaCl (150 g)
Sugar (150 g)
Isopropanol (rubbing alcohol)

Sports drink
Orange juice
0.2 M acetic acid (vinegar)

PROCEDURE
Technique tip: Rinse the electrodes between solutions by using a water wash bottle to rinse the electrodes into a waste beaker.

1. Add 20 ml of DI water to a beaker. Check the conductance of the solution. Record your observation.

2. Add 20 ml of tap water to a beaker. Check the conductance of the solution. Record your observation.

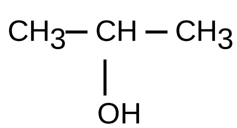
3. Repeat the experiment using about 5 g NaCl to 20 mL of H_2O. Check the conductance of the solution. Record your observation.

4. Add about 3 g sugar to 20 mL of H_2O. Check the conductance of electricity by using the light bulb. Record your observation.

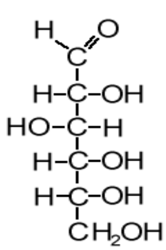
5. Repeat the experiment using individually acetic acid (vinegar), methanol, orange juice and a sports drink. Record your observation in the data table below.

Chemical Structures:

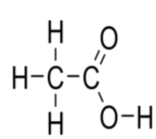
The structures of isopropanol, acetic acid, and sugar (main component is glucose) are:



Isopropanol (rubbing alchohol)



Glucose



Acetic acid (vinegar)

Data Table:

Solution Tested	Formula	Conductivity (strong, weak or nonelectrolyte)	Type of Compound/ Type of mixture (ionic, polar covalent, or nonpolar covalent/ homogeneous, heterogeneous)
DI water			
Tap water			
Salt solution			
Sugar solution			
Isopropanol			
Acetic acid			
Orange Juice			
Sport Drinks			

FOLLOW-UP QUESTIONS

1. Provide an example of a polar solvent you use in everyday life.

2. What ions are produced when sodium chloride (NaCl) is dissolved in water?

3. What are the components of the solution from dissolving sugar in water?

4. How would you explain the concept of electrolytes to elementary school students?