Name: _____

Lab Instructor:_____

PREPARATION FOR CHEMISTRY LAB: SOLUTIONS

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1. Define the terms:

   solution:

   solute:

   solvent:

2. In this week's lab you will be working with solutions containing a variety of solutes. Write the formula if the name is given and the name if the formula is given for each of the following: (Be sure to use the Stock system (Roman numeral) when appropriate.)

   $BaCl_2$ _____

   $CuSO_4$ _____

   calcium chloride _____

3. What is an exothermic reaction? If you were holding a beaker in which an exothermic reaction just took place, would the beaker feel hot or cold?

4. Calculate the molar mass of NaCl and enter this number on the appropriate blank on page 5 of the report sheet.

   Calculate the molar mass of sucrose, $C_{12}H_{22}O_{11}$, and enter this number on the appropriate blank on page 5 of the report sheet.

SOLUTIONS

INTRODUCTION

This week in lab you will be looking at several solution-based chemical reactions. You will work with "invisible inks", produce solutions that get hot or cold, observe and compare the freezing points of water, a sugar solution, and a salt solution, and make colors appear or disappear.

Review and/or review Chapter 4 on naming compounds and Chapter 11 in your textbook.

Three activity sites are set up in the laboratory corresponding to the three parts to the lab. You don't have to do the experiments in the order in which they are listed, but you must do them all. Make careful observations as you go along and **RECORD** all of your observations in report style.

Part 1: Invisible Ink

1. Label (pen or pencil) two filter paper circles. Write your name on circle #1 with phenolphthalein indicator and on circle #2 with copper(II) sulfate solution. The solutions are in test tubes. Use the swab in each solution as your "pen".

2. Let the papers dry. Speed up drying by fanning the air with the paper.

3. Swab circle #1 with a solution of sodium hydroxide. Use the swab in the test tube.

4. Set circle #2 over one of the glass containers containing concentrated NH_3 located in the hood. Replace the container cover after your paper has developed.

Part 2: Energy Changes

1. Sprinkle a thin layer of **magnesium sulfate heptahydrate** into a 50 mL beaker (beaker #1). Add 5 mL of water to dissolve the salt and monitor the temperature change with the LabQuest temperature probe.

2. Repeat, in a second beaker (beaker #2), using **anhydrous magnesium sulfate**. (anhydrous: without associated water)

Part 3: Freezing Points

1. Plug the temperature probe into one of the sensor ports on the front edge of the LabQuest.

2. Turn on the LabQuest with the power button which is located on the upper left corner.

3. Make a freezer containing about 200 mL of a saturated common salt solution in a Styrofoam-jacketed beaker as follows.

   Add some ice and sprinkle a spoonful of salt on top of the ice. Add more ice, layering salt and ice to within an inch of the top.

   Push the LabQuest temperature probe into the salt solution. Remove the probe when the reading falls below **-10°C** and rinse it off. Gently insert a glass thermometer in the ice bath to monitor its temperature during the rest of the experiment.

4. Using the stylus, touch: Sensors; Data Collection; change length from 180 s to an appropriate time interval (900 s should be long enough for each run in this experiment, you can always stop collecting data, but you can't add in more time once you have started); touch OK.

5. Put 10 mL of deionized water in a large test tube. Place a stirring loop inside the test tube and lower the LabQuest temperature probe through the loop. Place the test tube in the ice bath. Immediately touch the begin data collection button (triangle) on the lower left of the screen. Hold the probe in place with either hand and stir the liquid occasionally with a slow up-and-down motion. Do not stir vigorously. When the water freezes, make a few more temperature readings and touch the stop data collection button (square) on the lower left of the screen.

6. If the graph is not displayed, touch the graph button.

7. You may want to periodically save your data. Touch: File; Save (enter a unique data file name); Save.

8. Print out one copy of the graph (cooling curve). You only need one copy for both you and your lab partner. Using a USB cable that is already attached to a printer, connect the LabQuest to the printer. Touch: File; Print; Graph; Print Footer (box), Replace "Enter name or comment here." with the names of all lab partners. Be sure the Time/Date and Page Number boxes have a check mark in them.

9. Dissolve between 4.05 and 4.15 g of sucrose in 10 mL of water in a test tube, record the exact mass on the report sheet. Using the same technique as you used before (Steps 4 through 8; don't forget to do Step 4; you don't want the LabQuest to time out before the freezing point has been reached), track the temperature change in this solution as it cools to freezing. Print out one copy of the graph. You only need one copy for both you and your lab partner.

10. Dissolve between 0.62 g and 0.65 g of NaCl in 10 mL of water in a test tube, record the exact mass on the report sheet. Using the same technique as before (Steps 4 through 8; don't forget to do Step 4; you don't want the LabQuest to time out before the freezing point has been reached), track the temperature change in this solution as it cools to freezing. Print out one copy of the graph. You only need one copy for both you and your lab partner.

DATA AND ANALYSIS SHEET: SOLUTIONS

Name: _____

Date _____ Lab Partner _____

**** Throughout this ENTIRE experiment you must explain each of your observations in a sentence or two. Identify those changes that are chemical and those that are physical in nature. Give your reasons for classifying the changes as one or the other. ****

Part 1: Invisible Ink

Circle #1:

Circle #2:

Part 2: Energy Changes

Beaker #1:

Was the process that took place in Beaker 1 exothermic or endothermic? _____

Beaker #2:

Was the process that took place in Beaker 2 exothermic or endothermic? _____

Part 3: Freezing Points:

Split up the copies of the graphs among all lab partners. Each person must have at least one of the graphs attached to their lab report and between you; all graphs must be attached to at least one lab report. The date and all names must be on the printouts and be in the footnote to the graph generated by LabQuest.

3.1:

3.2:

3.3: Exact mass of sucrose used: _____

Molar mass of sucrose: _____

Moles of sucrose used: _____

Freezing point of the solution: _____

3.4: Exact mass of NaCl used: _____

Molar mass of NaCl: _____

Moles of NaCl used: _____

Freezing point of the solution: _____

Did the sucrose solution or the NaCl solution have the lower freezing point?

Both solutions contained approximately the same amount of water and approximately the same number of moles of solute. How do you explain the differences you observe in the freezing points of the two solutions?

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QUESTIONS ABOUT THIS LAB: SOLUTIONS

1. Give the formulas for the following compounds.

   ammonium nitrate: _____

   cobalt(III) acetate: _____

   aluminum sulfate: _____

   lead(II) chlorate: _____

2. The freezing point of an aqueous solution is lower than the freezing point of pure water. Furthermore the amount the freezing point is lowered is related to the number of solute particles in solution. When a solution is prepared from an ionic compound, the number of ions resulting from each formula unit of the compound must be taken into consideration. For example, a 50 mL solution containing 1 mole of $CaCl_2$ will have a lower freezing point than a 50 mL solution containing 1 mole of KBr. This is because three moles of ions are released into solution for each mole of $CaCl_2$ that dissolves and two moles of ions are released into solution for each mole of KBr that dissolves.

   In separate flasks, you add 0.3 moles of the following solutes, all of which are soluble in water, to 50 mL of water. How would you arrange the solutions, based on the solute present, in order of lowest freezing point to the highest freezing point of the resulting solution?

   ammonium nitrate , cobalt(III) acetate , aluminum sulfate , lead(II) chlorate

3. Heat is produced when acids and bases react in neutralization reactions. Would a neutralization reaction be classified as an endothermic or an exothermic reaction?