CHEMISTRY 113 LAB PREPARATION FORM

EXPERIMENT 2: Determination of the Sugar Content of Commercial Beverages

Name_____ Lab Section_____

Purpose of Experiment:

Objectives:

1. To gain experience using burets for volume measurments.
2. To gain experience using pipets for volume measurments.
3. To gain experience using top-loading balances for mass measurments.
4. To draw a graph correctly.
5. To use a graph as a calibration curve.

Key Terms:

Percent by Mass (% w/w):

"Best Straight Line" :

Density:

Calculations:

Percent by Mass (% w/w):

Density:

Safety Warnings:

Procedure Notes:

Questions before starting experiment:

Comments from Briefing:

EXPERIMENT 2: Determination of the Sugar Content of Commercial Beverages

PRELAB EXERCISE

Name_____ Lab Section_____

1. A solution has a mass of 95.00g and a density of 2.147g / mL. What is the volume of the solution?

2. If 5.05 grams of sugar are mixed with 25.04 grams of water, what is the % (w/w) sugar in the solution?

CHEM 113L #2 Determination of the Sugar Content of Commercial Beverages
(Based on J. Chem. Ed., Vol 75, No. 9, pp. 1122 – 1123, 1998.)

INTRODUCTION

Most commercial beverages on the market today are aqueous **solutions** (the **solvent** is water) "sweetened" with sucrose (the **solute** of greatest concentration). Because the other solutes (electrolytes, colorings, preservatives, caffeine, etc) are present in fairly small amounts, the density of a given beverage is dependent primarily on sucrose content.

Chemists regularly prepare solutions of known composition for their research. In this experiment you will prepare four solutions of sucrose, each with a different percentage by mass of sucrose. You will then measure the density of water and your four solutions. You will graph your data to determine the relationship between density and % by mass. Finally, you will use the graph of your "standard" sucrose solutions and measured densities of beverages to determine the sugar content of several beverages.

The following equations will be helpful in your calculations:

$$Density\ of\ solution = \frac{Mass\ of\ solution}{Volume\ of\ solution}$$, typical units are g/mL

$$Percent\ by\ Mass = \frac{Mass\ of\ Sucrose}{Mass\ of\ Solution} x100\%$$, typical units are % (w/w)

$$Mass\ of\ Solution = Mass\ of\ Sucrose + Mass\ of\ H_2O$$

Your solutions will have Percent by Mass of Sucrose between 0 and 25%(w/w) and will have Densities which will be approximately 0.99 -1.15 g/mL .

EXPERIMENTAL (Work in Groups of Two)*

(Note: if working as a group of three, each person should prepare two solutions, the two additional solutions can be labeled F and G and can have masses of sugar of about 3.00 and 5.00 g. Every student is responsible for preparing two solutions!)

Obtain, rinse, dry, and label five 50 mL beakers A, B, C, D, and E. Into Beaker B add 1.50 grams of the"sugar", into Beaker C add 3.50 grams of the"sugar", repeat this process for beakers D and E according to Table 1 below. (Note: These masses are approximate, but actual masses should be recorded to two decimal places. Also note: Beaker A will only contain water!)

Table 1. Approximate masses for solution preparation.

Label	A	B	C	D	E
grams of sugar	0.00 g	1.50 g	3.50 g	5.50 g	7.50 g

grams of water	30.00 g	30.00 g	30.00 g	30.00 g	30.00 g

Fill a clean 50-mL buret with distilled water and make sure the column is continuous, i.e. no trapped air bubbles in the tip. Record the water temperature to the nearest 0.1º C. Drop the upper level of the water column until the water meniscus lies some where between the zero and the one milliliter calibrations. Record this initial volume to the nearest 0.01mL. Now deliver approximately 30 mL to Beaker A; that is, open the stopcock of your buret allowing the water level to drop about 30 mL below its initial volume before closing it. Read this value as your final volume. Refill your buret, and repeat this procedure for Beaker B. The volume of water delivered in each case is the difference between the initial and final readings. Record this volume to the nearest 0.01mL. Record the mass of this volume of water by using the density of water vs temperature shown in Table 2 below.

Now carefully swirl (and/or stir) your beakers until the "sugar" is completely dissolved. Once the solution is homogenized. Acquire a 15.00 mL pipet. Rinse it with a small portion of your solution, and then fill it to the calibration mark. Then deliver the 15.00 mL to one of your other clean, dried, preweighed (or tared) 50 mL beakers. Record the volume and mass of the solution.

While you are preparing solutions B and C, your partner can take the two 50 mL beakers labeled D and E, preparing two additional solultions accordint to Table 1 and the directions above. Every student should prepare two solutions!

Unknown Beverage: Your instructor will provide you with one (or more) unknowns. Determine the density of your assigned unknown(s) by pipetting 15.00 mL of your unknown into a clean 50 mL beaker and determining its mass.

CALCULATIONS AND GRAPH

Calculate the densities and % (w/w) of Sugar for each of the solutions (A, B C, D, and E). Prepare a graph whose x-axis is labeled % (w/w) Sugar and whose y-axis is labeled Density of Solution (g/mL). Plot your data points on this graph and determine the best straight line through them. Your graph should be computer generated. (See Figure 1 showing an example graph.) Compare your unknown's density to the graph. Using the equation for the best fit line, calculate the %(w/w) sugar for your unknown

Important! Proper graphing technique includes the following:

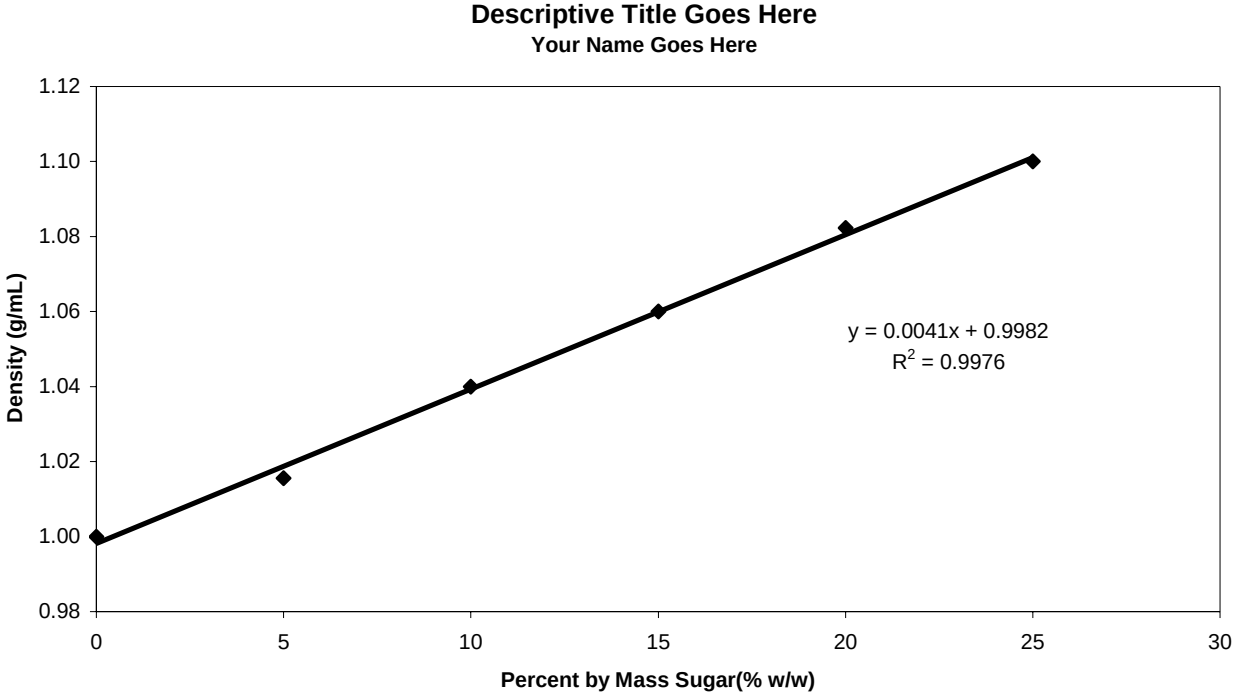
1. A specific title with your name as a subtitle.
2. Each axis is labeled.
3. Units are identified on each axis.
4. A best line is drawn; i.e., do not just connect data points.
5. Spread the graph out to fit as much of the page as possible.

GRAPHING TIPS USING EXCEL:

Instructions for graphing using Microsoft® Excel.

1. Open the Microsoft® Excel Program.
2. The program should default you to cell A1. This is column A and Row 1. Starting with this cell and going down the A column, enter your X values (volume in this case). Do not include Units. Now go to cell B1 and going down that column enter the corresponding Y values (Mass in this case). Do not include Units.
3. Highlight your data set and select the red, yellow and blue "Chart Wizzard".
4. Select XY scatter and then select next. Select next again.
5. Add a descriptive Title. Remember to Capitalize first letters of main words. Add a few spaces after the title and type your name.
6. Add a title for the X and Y-axes. Include an abbreviation for the units inside parenthesis.
7. Select the Gridlines tab. Remove the gridlines.
8. Select the Legend tab. Remove the legend.
9. Select next.
10. Place the chart as a new sheet and select finished.
11. Click on the title just before your name. A cursor will appear. Press enter. This will place your name below the title. Highlight the title and make it a larger fontsize.
12. Right Click on the gray background of the graph and select clear. This will remove the gray background.
13. Move the cursor to one of your data points. Right click. Select add trendline. Under options select display equation on chart. Click ok.
14. If your graph looks ok, print it. Remember that your graph should fill the page.

Figure 1: A Sample Graph



EXPERIMENT 2: Determination of the Sugar Content of Commercial Beverages

DATA SHEET 1

Name______________________ Lab Section____________________

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Part A. Sugar Standards

	A	B	C	D	E	F
Mass of beaker (g)	_____	_____	_____	_____	_____	______
Mass of beaker +"sugar"(g)	_____	_____	_____	_____	_____	______
Mass of sugar(g)	_____	_____	_____	_____	_____	______
Final Volume Buret (mL)	_____	_____	_____	_____	_____	______
Initial Volume Buret (mL)	_____	_____	_____	_____	_____	______
Volume H_2O delivered (mL)	_____	_____	_____	_____	_____	______

Temperature H_2O _____ ^oC Density of H_2O _____

	A	B	C	D	E	F
Mass of H_2O delivered(g)	_____	_____	_____	_____	_____	______

<u>Pipetting of sugar solutions</u>

	A	B	C	D	E	F
Volume of Solution (mL)	_____	_____	_____	_____	_____	______
Mass of Pipetted Solution(g)	_____	_____	_____	_____	_____	______

<u>Calculations</u>

	A	B	C	D	E	F
Mass of prepared solution(g)	_____	_____	_____	_____	_____	______
% by mass of "sugar"	_____	_____	_____	_____	_____	______
Density of solution (g/mL)	___	_____	_____	_____	_____	______

Equation from Graph ____

EXPERIMENT 2: Determination of the Sugar Content of Commercial Beverages

DATA SHEET 2

Name_____ Lab Section_____

Part B. Unknowns

Pipetting of unknown solutions

Unknown Name	_____	_____	_____
Volume of Solution (mL)	_____	_____	_____
Mass of Pipetted Solution(g)	_____	_____	_____

Calculations

Density of unknown (g/mL)	_____	_____	_____

Equation from Graph _____

% (w/w) sugar in unknown	_____	_____	_____

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POSTLAB EXERCISE

Name_____ Lab Section_____

For questions 1 and 2

A solution was prepared by mixing 2.55 grams of sugar with 22.45 grams of H_2O to produce 24.1 mL of solution.

1. Show the set up and calculation of density of this solution.

2. Show the set up and calculation of % (w/w) sugar for this solution.

3. A best fit line from a graph plotting density of solution (g/mL) on the x-axis and % (w/w) sugar on the y-axis gives the equation, $y = 0.00405\ x + 0.995$.

   If an unknown beverage has a density of 1.055 g/mL, what is its %(w/w) sugar?