Chem2014 Name(s)_____ _____ Per____

Soda Pop Lab

Nutritionists have recently raised concerns about the increasing popularity of sodas, fruit drinks, and other beverages due to their high sugar content. Do you know how much sugar is in your favorite beverage? Is it related to the density of the beverage?

Purpose:

To measure the densities of popular beverages and determine their sugar contents using a calibration curve obtained by plotting the densities for a series of reference solutions versus percent sugar. The experimentally determined percent sugar for the beverages will be compared against the information provided on their nutritional labels to evaluate the accuracy of this method.

Background:

The density of a solution depends on its concentration, that is, how much solute (solid) is dissolved in the solvent (liquid). If the density of a solution is plotted on a graph against the concentration of solute, a regular pattern is evident—density is proportional to concentration.

The resulting graph, called a calibration curve, shows a straight-line relationship between the density of a solution and the concentration of solute. A calibration curve can be used to determine the concentration of solute in an unknown
solution whose density has been measured.

Density: _____
_____

Solvent:_____
_____

Solute:_____
_____

Concentration:_____
_____

Hypothesis: (answer the question)

How well does the sweet taste of a soda correlate with the amount of sugar it contains and the soda's density? (Based on your memory of their taste, predict the relative sugar content in the following beverages: Regular Cola, Diet Cola, & Other Drink. *Rank the beverages from 1, highest sugar content, to 3, lowest sugar content.)*

_____
_____

Materials:

Regular Cola	Diet Cola	Juice/Soda	
Electronic Scale	Empty Can	Graph Paper	Ruler

Procedure: (ALL NUMBERS WRITTEN IN THE DATA TABLE MUST HAVE 3 SIGNIFICANT FIGURES)

1. You and a partner must choose 3 flavors of soda: 1 cola, 1 diet, 1 juice
2. Record the "Name Brand" of your soda pop ***on the data table below.***
3. Find the mass of your full can of soda pop by using the electronic scale and ***record on the data table below***. DO NOT OPEN IT YET! Make sure that no CO_2 has escaped!

4. If you brought your own can or paid for it *(I take 50 cent I OWE YOU's)*, you can open your soda pop. You must drink it all in order to find the mass of the empty can. *(If you do not want to drink it, you can use a sample empty can.)* While you are drinking it, plot the known density on the y-axis versus percent sugar on the x-axis for the following sugar reference solutions. Use a ruler to draw a ***"best fit" straight line*** through the data points.

Percent Sugar	0%	1%	5%	10%	15%	20%
Density	0.99 g/mL	1.002 g/mL	1.018 g/mL	1.038 g/mL	1.059 g/mL	1.081 g/mL

5. Making sure that your can is EMPTY, find the mass of the EMPTY can. *(Or use the sample empty can up front.)* ***Record on the data table below.***
6. Record the volume of the soda pop in MILLILITERS (mL). ***(Hint: Look on the side of the can)***

7. Calculate the density of the soda. ***Record in the data table below.***
8. Use the graph you made to estimate the sugar concentration in the beverage: Locate the point on the y-axis that corresponds to the beverage density. Follow that point on the y-axis across horizontally to where it meets the best-fit straight line through the data points for the reference solutions. Draw a vertical line from this point on the best-fit line down to the x-axis. The point where this vertical "line" meets the x-axis corresponds to the percent sugar in the beverage. ***Estimate and record the <u>Experimental Percent Sugar</u> for the beverage in the data table below.***

9. Consult the nutritional label for the beverage—it should list the sugar content in grams of sugar per serving size. This value can be converted to percent sugar in the beverage by dividing the grams of sugar per serving size by the volume of the serving size (in mL), dividing this result by the measured density of the beverage, and multiplying by 100. ***Record the <u>Calculated Percent Sugar</u> for the beverage in the table below.***

   Sample calculation: Measured density = 1.04 g/mL

   Nutritional label = 42.0 g of sugar per 355 mL

   (42.0 g/355 mL) × (1 mL/1.038 g) = 0.114 g sugar per g of beverage

   Percent sugar = 0.114 g sugar per g of beverage × 100% = 11.4%

10. Calculate the percent error in the experimental determination of the sugar content using the following equation.

$$\text{Percent error} = \frac{|\text{Calculated value} - \text{Experimental value}|}{\text{Calculated value}} \times 100\%$$

Data Table:
(YOU MUST USE UNITS FOR ALL NUMBERS & ALL NUMBERS MUST HAVE 3 SIGNIFICANT FIGURES)

Name Brand of Soda	**Mass of full can**	**Mass of Empty Can**	**Mass of Soda**	**Volume**	**Density**	**Percent Sugar (Experimental)**	**Nutrition Label**	**Percent Sugar (Calculated)**	**Percent Error**
Cola:									
Diet:									
Other:									

Analysis:

1. Which drink has the greatest density? _____ Why? _____
   _____

2. How could you increase the density of the diet soda? _____
   _____

3. How do the densities of diet and regular soda pop compare to the density of water? _____
   _____

Conclusion Statement:

This lab examines the relationship between the density of a beverage and its sugar content. What assumption is made concerning the other ingredients in the beverage and their effect on its density?