Introductory Chemistry Lab: Percentage of Sugar in Soda Pop

Outcomes

As a result of today's laboratory you will have:

Prepared sugar solutions with known concentrations.
Calibrated a hydrometer using the prepared sugar solutions.
Prepared a calibration curve to represent your data.
Used a hydrometer to indirectly measure the percentage of sugar in a brand of soda.

Prelab

Prepare a Title (can use the lab handout for this), Purpose (a concise statement) and a Procedure (short "to do" list … see "Writing a Procedure" in the lab handouts folder), and Data Tables.

Purpose

To determine the percent concentration of sugar in a soft drink.

Background Information

Solution concentrations are ways chemists represent the amount of solute (substance dissolved) present in a solution. One method is percent concentration. Percent concentration can be expressed in several ways. This experiment uses concentration expressed as "weight solute / volume solution" percent (W/V %).

$$W / V\ \% = (\text{mass of solute} / \text{volume of solution}) \times 100\%$$

(W/V% may also be expressed as w:v % or more rigorously using mass for weight as M/V % or m:v %)

A hydrometer is a device that measures the density of a solution. A hydrometer operates on the principle that an object floats when it has displaced an amount of liquid equal to its own weight. So, a hydrometer floats higher in a denser solution having a high concentration and lower in a solution having a low concentration. By measuring how high a hydrometer floats in a solutions of different concentrations of sugar, it is possible to calibrate a hydrometer. Preparation of a graph called a calibration curve from a series of concentration vs. height measurements, makes is possible to determine the % sugar in an unknown (a commercial soft drink).

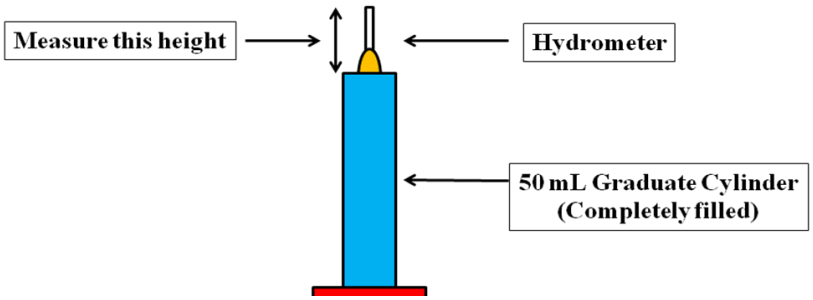
Procedure (Work In Pairs)

Part I. Prepare Known Sugar Solutions

1. Place ~ 3.00 g of sugar on the weighing paper. Record the Mass of sugar in Table l. Add the sugar to a clean 100-mL graduated cylinder and then add 40-50 mL of deionized water. Gently stir with a glass stirring rod until the sugar is completely dissolved. Rinse the stirring rod into the solution in the graduated cylinder using deionized water. Then, add deionized water to the 75.0 mL mark. Record the volume of solution in Table 1. Pour this solution into a clean dry beaker labeled #1.
2. Repeat three more times using ~ 6.00, 9.00, and 12.00 grams of sugar in 75 mL of solution. Label the beakers "#2", "#3", and "#4", respectively.

Part II. Determine Density of the Known Sugar Solutions

1. Put a clean dry 50-mL graduated cylinder into a 400-mL beaker. The beaker will catch the overflow. Fill the graduated cylinder to the top with deionized water. This is the 0.0% sugar (reference) solution.
2. Gently place the hydrometer in the graduate cylinder with the sand-filled bulb at the bottom. Liquid will overflow and the hydrometer will float. Make sure the hydrometer is free floating - not touching the sides
3. Measure the height of the hydrometer stem that is above the fluid. Record the height in Table 1.



4. Drain the graduate cylinder, rinse with deionized water, the next solution to be measured and dry (or use a different clean dry cylinder).

5. Fill the cylinder to the top with your #1 sugar solution. Repeat steps 2-3.

6. Repeat the above determination for the rest of your known "#2", "#3", and "#4" sugar solutions.

Part III. Determine the Density of the Unknown Decarbonated Sugar Solution (soda pop)

1. Fill the 50 mL cylinder to the top with the unknown soda pop. Repeat steps 2-3 above. Record the color of the soft drink and the height of the hydrometer in the Table 1.

Clean up

Rinse all glassware and the outside of the hydrometer 3 times with deionized water. (Be careful to cover the hydrometer tip while you are rinsing so as to prevent any water from getting inside of the hydrometer.) Wipe up any sticky spills.

Data

Table 1: Solutions Measured

Solution #	Reference	1	2	3	4	Soda Color
Mass of sugar (g)	-					-
Volume of solution (mL)	-					-
Hydrometer height (cm)						

Calculations

1. Determine the w:v (weight volume) percent of sugar for each solution. Record result in Table 2

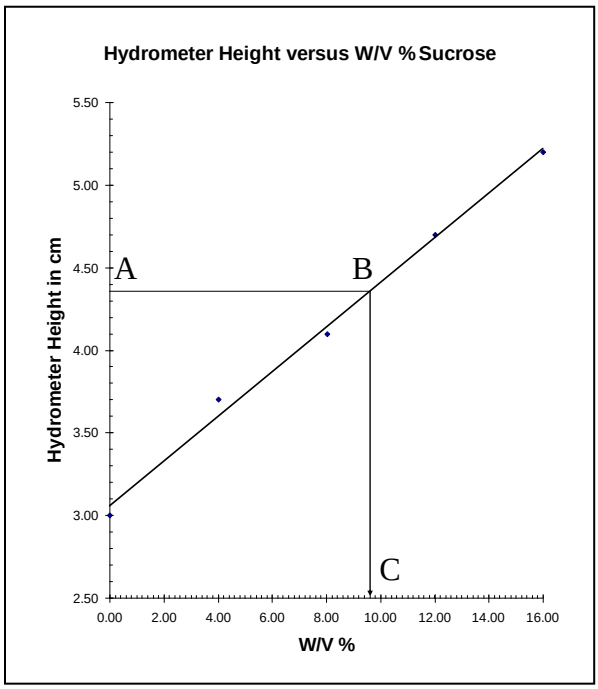
w:v% = mass sugar (g) / volume solution (mL) x 100

Results

1. Plot the "Hydrometer height (Table 1) versus the w:v % (Table 2) of the known sugar solutions you prepared. Your graph should be one full page (use graph paper download in lab handouts).

2. Determine the w:v % of the unknown sugar solution using YOUR calibration graph and YOUR value for YOUR Unknown soda's "Hydrometer height". Record this value in Table 2.

Sample Graph



For The Unknown:

Measure hydrometer height on Y -Axis (A)

Find this value on your calibration line (B)

Drop down to find the % value on the X axis (C)

Table 2: Mass - Volume Percent of Experimental Solutions

Solution	w:v %
Reference	
1	
2	
3	
4	
Soda	From Graph

Insert the value you determined from the graph in this space

Conclusion

State the percentage sugar in your unknown solution and indicate if any observed differences between soda and water seem consistent with your understanding of density.

Questions

1. Why was de-carbonated soda used in this experiment?

2. How would your value for the density of the soda be changed (increase, decrease, or remain the same) if:
   a. you mistakenly recorded the height of the hydrometer to be 3.75 cm instead of 3.95 cm?
   b. the hydrometer was tipped to the side?
   c. you used a 25-mL graduated cylinder instead of a 50-mL graduated cylinder to do the experiment?

3. Suggest a method that could be used for determining the percentage of sugar in a sample of apple juice. Consider that apple juice has a different sugar (fructose) than soda pop (which has sucrose).