

## **LAB - Sugar Content in Beverages (Density Analysis)**

**Introduction:** 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?

**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 a solute. A calibration curve can be used to determine the concentration of solute in an unknown solution whose density has been measured.

**Purpose:** The purpose of this activity is 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.

### **Materials:**

- Beverages (at room temperature)
- Balance, centigram (0.01 g) precision
- 2 Beakers, 250 mL
- Graduated cylinder, 25 mL
- Thermometer

### **Procedure:**

1. Place a clean 25 mL graduated cylinder on the balance and hit the “zero” button
2. Fill the cylinder to the 10.0 mL mark with a beverage. Measure and record the mass of the beverage in the graduated cylinder (use the data table below)
3. Measure and record the temperature of the beverage (use the data table below)
4. Repeat this with the two other beverages.
5. Calculate and record the density of each beverage sample. Hint: Since the sample volume is always 10.0mL, the calculation should be easy – you don’t even need a calculator!

Beverage	Temperature	Mass	Volume	Density

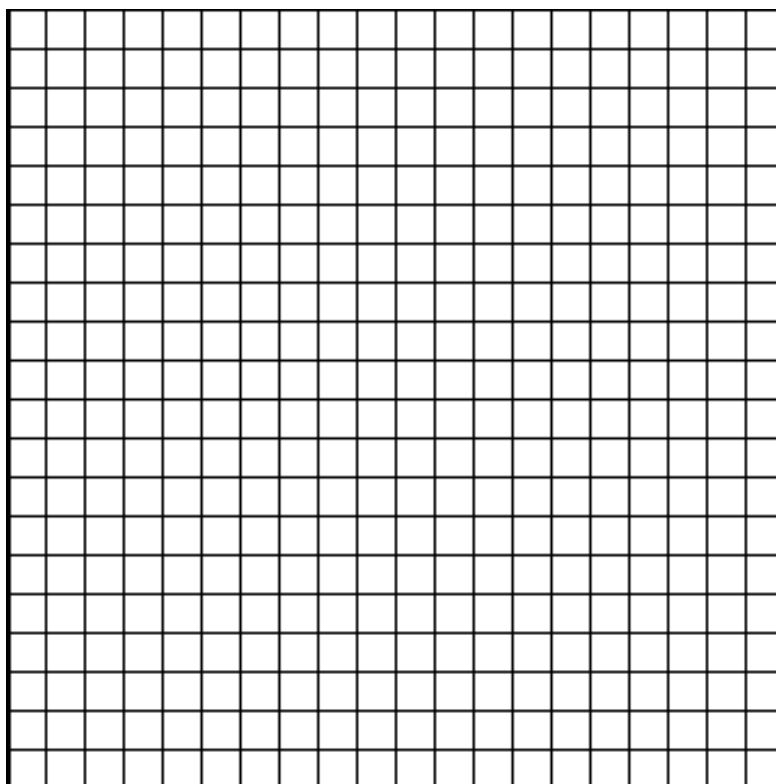
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**Data Analysis:**

Beverage	Density	Percent Sugar (Experimental)	Nutrition Label	Percent Sugar (Calculated)	Percent Error

- 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. Note that “percent sugar” corresponds to mass percent and has units of grams of sugar per 100 g of solution.

Percent Sugar	1%	5%	10%	15%	20%
Density at 20°C	1.002 g/mL	1.018 g/mL	1.038 g/mL	1.059 g/mL	1.081 g/mL



2. Use the graph 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 percent sugar for the beverage.
3. 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 nutrition label information and the calculated percent sugar for the beverage.

*Sample calculation:* Measured density = 1.038 g/mL

Nutritional Label = 42 g of sugar per 355 mL

$(42 \text{ g}/355 \text{ mL}) \times (1 \text{ mL}/1.038 \text{ g}) = 0.114 \text{ g sugar per g of beverage}$

Percent sugar =  $0.114 \text{ g sugar per g of beverage} \times 100\% = 11.4\%$

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

$$\text{Percent error} = \frac{\left| \text{Calculated value} - \text{Experimental value} \right|}{\text{Calculated Value}}$$

### **Questions:**

This lab examines the relationship between the density of a beverage and its sugar content.

1. What assumption is made concerning the other ingredients in the beverage and their effect on its density? Is this a valid assumption? Why or why not?
2. Compare your percent error calculation to other students' calculations. Why might your percent error be different theirs?

**DON'T forget to write a Conclusion in your lab report! (This should not be a summary of the procedure!)**

*This should include:*

- What you learned
- Explanation of your results (use scientific vocabulary!)
- Relate this lab to the real world