Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

Lab Section: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**CHEM 131 Lab Experiment: Determination of the Density**

**of Green Tea Drinks**

**Background**

Recall from last week’s experiment that becoming familiar with the analytical balance and volumetric glassware is key to your success in the chemistry laboratory. You learned how to accurately transfer chemicals and take measurements. This week, the skills you developed will be put to the test. You will use a volumetric pipet and analytical balance to determine the density of regular and diet tea drinks.

Density can be defined as the ratio of an object’s mass to its volume. In chemistry, the density of a liquid is commonly used as a conversion factor between a liquid’s mass and its volume. The equation for calculating the density is:

𝒅=𝒎/𝒗

*In the density equation,* ***d*** *represents the density in units of g/mL,* ***m*** *is the mass in units of grams (g), and* ***v*** *is the volume in units of milliliters (mL).*

Though we may not know it, we all observe density within our everyday lives. A common example of that is a lava lamp. Lava lamps contain two liquids with different densities: water and a colored oil. When the lamp is at room temperature, the oil rests at the bottom of the lamp. Once you turn on the lamp, the incandescent light bulb heats the two solutions and reduces the density of the oil solution, causing it to rise. As the oil cools down at the top of the lamp, its density increases causing the oil solution to fall back down to the bottom of the lamp.



 *Figure 1*. A lava lamp works by changing the density of two immiscible liquids upon heating, thereby causing blobs of oil to rise.

In today’s lab, you will be working with two unknown tea drink samples. You will then be tasked with identifying which sample is regular and which is diet by determining their densities from volume and mass measurements. The main difference between the two beverages is that regular drinks contain sugar, while diet beverages contain sugar substitutes. Diet drinks contain less calories than regular drinks and they also contain less sugar. The significant difference in sugar content between regular and diet beverages account for differences in their density.

**Goals/Objectives**

The specific goals of this experiment are to: (1) use a volumetric pipet to accurately measure the volume, and the analytical balance to measure the mass, of 10-mL of each of two unknown tea samples; (2) calculate the density of the samples from volume and mass measurements; (3) use the calculated density to identify which sample is regular tea and which sample is diet tea

**Pre-lab Questions**

1. Look up the ingredients in regular green tea and diet green tea drinks. Make sure they are the same brand. Indicate the brand that you chose and list all the major ingredients for each type of tea drink.
2. How do you expect the density of diet green tea and regular green tea to compare? Explain your reasoning.

**Materials List**

* 50mL beakers
* 10mL volumetric pipets
* Unknown Tea Samples A & B
* Balances

**Experimental Procedure**

1. Obtain two clean, dry 50-mL beakers and mark them “A” and “B” using labeling tape. Measure their mass using the same analytical balance. Record the mass of beaker A in ***Table 1*** and the mass of beaker B in ***Table 2***. ***Make sure you record the entire mass displayed in the balance (up to three decimal places).***
2. Using the 10mL volumetric pipet, transfer 10mL of **Unknown Sample A** into your labeled beaker (A).



*When using the pipet, be sure to measure*

 *the 10mL based on the lower meniscus.*

1. Slowly empty 10.00 mL of the first unknown sample from the pipet into beaker A. Using the same balance, measure and record the mass of beaker A and 10.00 mL sample in the “Successive mass” column, Table 1. *Do not empty beaker A.*
2. Using the same pipet, repeat volume and mass measurements of two more 10.00-mL aliquots of your first unknown sample into beaker A ***without emptying the beaker between additions***. Be sure to record the mass of the beaker in the “Successive mass” column, Table 1, after each addition of 10.00 mL of the sample. You should have a total of three replicates or trials.

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**DO NOT empty beaker A** until all three 10-mL aliquots of the sample have been added and each successive mass has been recorded.

1. Once you are sure that Table 1 is complete with three trials, and you have all your necessary measurements recorded, pour the contents of beaker A down the drain.
2. Repeat steps 2-5 for your **Unknown Sample B**, making sure to dispense volume aliquots into ***beaker B and record your data in Table 2*** below.

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**DO NOT empty beaker B** until all three 10-mL aliquots of the sample have been added and each successive mass has been recorded.

1. Once you have all of your necessary measurements recorded, clean the dirty glassware and wipe down your lab bench.

**Treatment of Data**

1. Determine the mass of 10.00 mL of tea samples from the difference between two successive mass readings. For trial 1, use the difference between the mass of empty beaker and the first successive mass reading. Enter your results in the third column of Tables 1 and 2.
2. Using the density equation, the mass of 10.00 mL of tea sample, and the 10.00 mL for volume of tea sample in each of Tables 1 and 2, calculate the density of each trial measurement for each unknown tea samples. Enter results in the last column of Tables 1 and 2.
3. Calculate the average (mean) density, and record results in Tables 1 and 2.
4. Complete the summary table (Table 3) using relevant results from Tables 1 and 2. Based on the density of each unknown tea sample, determine which unknown is the regular tea and which is the diet tea.

**Data and Results**

Table 1. Mass readings for the first unknown sample of green tea (A) and calculated density

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Trial # | Successive mass (g) | Mass of 10.00 mL aliquot of tea sample (g) | Volume of tea sample (mL) | Calculated density of tea sample (g/mL) |
| **Empty Beaker** |  |  |  |  |
| **1** |  |  | **10.00** |  |
| **2** |  |  | **10.00** |  |
| **3** |  |  | **10.00** |  |
| **Mean Density (g/mL)** |  |

Table 2. Mass readings for the second unknown sample of green tea (B) and calculated density

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Trial # | Successive mass (g) | Mass of 10.00 mL aliquot of tea sample (g) | Volume of tea sample (mL) | Calculated density of tea sample (g/mL) |
| **Empty Beaker** |  |  |  |  |
| **1** |  |  | **10.00** |  |
| **2** |  |  | **10.00** |  |
| **3** |  |  | **10.00** |  |
| **Mean Density (g/mL)** |  |

Table 3. Summary of density calculations with experimental uncertainty and identity of unknown tea samples

|  |  |  |
| --- | --- | --- |
| **Tea Sample** | **Mean Density (g/mL)** | **Regular or Diet?** |
| Unknown A |  |  |
| Unknown B |  |  |

**Post-Lab Questions:**

1. In the pre-lab assignment, you were asked to look up the ingredients of regular green tea

and diet green tea and predict their densities. Did your findings match your prediction? Explain your reasoning.

1. The density of a liquid can be used to determine other properties, such as the *sugar content* of a beverage. Below is a table that shows the calculated densities of sugar solutions with varying % sugar content.
	* 1. a. Compare your *mean calculated density* for regular tea drink sample with the information from the table below, then ***estimate the % sugar content of your regular tea drink sample.***
		2. b. What can you tell about the sugar content of regular tea? Are you surprised with your finding? Why or why not?

|  |  |
| --- | --- |
| **Calculated density (g/mL)** | **% Sugar Content** |
| 1.016 | 5.04 |
| 1.025 | 7.50 |
| 1.036 | 10.2 |
| 1.045 | 12.5 |
| 1.056 | 15.4 |