Determining the Densities of Liquids

Background Information

Mass and volume are properties of all matter. **Density** is the ratio of an object's mass to its volume. The density of a specific kind of matter helps to identify it and distinguish it from other kinds of matter. It is possible to determine the densities of liquids in grams per milliliter (g/mL).

In this investigation, you will determine the densities of several liquids by measuring their masses and volumes.

Problem

How can you determine the densities of liquids?

Pre-Lab Discussion

Read the entire investigation. Then, work with a partner to answer the following questions.

1. **Formulating Hypotheses** For identical volumes, what will the relationship be between the mass and the density of a sample?

2. **Controlling Variables** What are the manipulated and responding variables in this investigation?

3. **Controlling Variables** What is the controlled variable in this investigation?

4. **Calculating** Why is it necessary to know the mass of the graduated cylinder in order to find the mass of the liquid?

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5. **Predicting** Predict which liquid will be the most dense and which will be the least dense.

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Materials *(per group)*

2 100-mL graduated cylinders
triple-beam balance
50 mL denatured ethanol (ethyl alcohol)
50 mL salt water
paper towels

Safety

Put on safety goggles and a lab apron. Be careful to avoid breakage when working with glassware. Always use caution when working with laboratory chemicals, as they may irritate the skin or stain skin or clothing. Never touch or taste any chemical unless instructed to do so. Keep alcohol away from any open flame. Wash your hands thoroughly after carrying out this investigation. Note all safety alert symbols next to the steps in the Procedure and review the meaning of each symbol by referring to the Safety Symbols on page xiii.

Procedure

1. Place a clean graduated cylinder on the laboratory balance. In the data table, record the mass of the graduated cylinder.
2. Place about 50 mL of water in the graduated cylinder. Record the exact volume to the nearest tenth of a milliliter. Use a paper towel to wipe any water from the outside of the cylinder. Find the mass of the graduated cylinder and the water. Record this mass in the data table. **CAUTION:** *Wipe up any spilled liquids immediately to avoid slips and falls.*
3. Calculate the mass of the water by subtracting the mass of the graduated cylinder from the mass of the graduated cylinder and water. Record your answer in the data table.
4. Calculate the density of water, using the following equation. Record the density of water in the data table.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

5. Repeat Steps 1 through 4. This time, use a clean graduated cylinder and denatured ethanol instead of water. **CAUTION:** *Denatured ethanol is poisonous and flammable. Do not drink it. Do not use denatured ethanol near an open flame.*
6. Empty the graduated cylinder containing water and dry it thoroughly with a paper towel. Repeat Steps 1 through 4, using this graduated cylinder and the sample of salt water.

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Observations

DATA TABLE

Liquid	Mass of Graduated Cylinder (g)	Mass of Graduated Cylinder and Liquid (g)	Mass of Liquid (g)	Volume of Liquid (mL)	Density of Liquid (g/mL)
Water					
Ethanol					
Salt water					

Analysis and Conclusions

1. **Analyzing Data** List the three liquids you studied in order of increasing density.

2. **Comparing and Contrasting** Which has the greater mass—1 L of water or 1 L of denatured ethanol? Explain your answer.

3. **Comparing and Contrasting** Which has a greater volume—1000 g of water or 1000 g of denatured ethanol? Explain your answer.

4. **Inferring** Which is more dense—1 mL of water or 50 L of water? Explain your answer.

5. **Predicting** Predict what would happen to the density of the salt solution if more salt was dissolved in a given volume of solution. Explain your answer.

Go Further

Use your data to predict the position of a small wooden dowel (or small pencil) placed in samples of the liquids used in this investigation. Would more or less of the dowel be visible above the surface of the liquid in each case? Plan a new investigation to test your predictions. Show your plan to your teacher. If your teacher approves your plan, carry out your experiment and report your results.