Experiment 3

DENSITY

Materials and Equipment

Balance, graduated cylinder, beaker, watch glass, small rubber stoppers, metal cylinder and unknown liquid.

Introduction

The density of a substance is a physical property that requires measurements of mass and volume. The ratio of the mass per unit volume is density, d and is written as d = m/V. Using the metric system, the ratio for solids and liquids is expressed in g/cm^3 or g/mL. Since the density of gases is much less than the densities of liquids and solids, the density of gases is usually expressed in grams per liter, g/L.

Matter expands and contracts according to temperature. For liquids and solids, the change in volume is very small, but for gases, a temperature change results in a proportional change in the volume. Therefore, gas density is dependent upon temperature; for liquids and solids, the small effect on volume is often ignored.

It is important to understand how density plays a role in everyday life. For example, wine makers measure densities to determine sugar content in the fermentation process and auto mechanics measure the density of the acid in car batteries to determine charge.

Procedure

All weighings and volumes should be read to the highest precision. This is usually 0.1 mL for volume, and 0.1 g to 0.001 g for mass. The precision to which you measure mass depends on the type of balance called for in the experiment. Follow all safety procedures throughout the experiment.

Part 1: Density of a Rubber Stopper

Obtain a small rubber stopper, it must be small enough to fit inside a 50 mL graduated cylinder. Weigh and record the mass of the dry stopper. Use tap water to fill your graduated cylinder to approximately 25 mL. Read and record this volume to the nearest 0.1 mL remembering to read the volume at the bottom of the meniscus. Carefully submerge the rubber stopper in the graduated cylinder. Read and record the new volume. What is the volume of the rubber stopper? Show your calculation. What is the density of the rubber stopper? Once again, show your calculation. Use the graduated cylinder containing the water and rubber stopper for Part 2.

Part 2: Density of a Metal Cylinder

Obtain a metal cylinder from your instructor and record the cylinder number on your data sheet. Record the final volume in step 1 on your data sheet as the "initial volume" in Part 2. Read and record the mass of the metal cylinder. Slightly tilt the graduated cylinder containing the tap water and rubber stopper. Carefully slide and submerge your metal cylinder. The rubber stopper will act as a bumper and prevent the graduated cylinder from breaking. Read and record the new volume. Return the metal cylinder. Calculate the volume and density of the metal cylinder. Show your calculations.

Part 3: Density of an unknown liquid

Weigh and record the mass of a clean dry 150 mL beaker and watch-glass cover to the highest precision of the balance. Place about 25-35 mL of the unknown liquid in a 50 mL graduated cylinder. Read and record the volume to the nearest 0.1 milliliter. Carefully transfer as much liquid as possible to the clean, dry 150 mL beaker, cover with the watch glass and reweigh. Repeat the procedure with a different volume of the same liquid. Calculate the density of your unknown liquid for each trial. Be sure to show your calculations. Take an average of the two density determinations that you made.

Report

Name	
Date	
Section	

Part I: Density of a Rubber Stopper	Trial 1	Trial 2
Mass of rubber stopper (g)		
Initial volume of water in cylinder (mL)		
Final volume of water in cylinder (mL)		
Volume of rubber stopper (mL)		
Density of rubber stopper (g/mL)		
Average density of rubber stopper (g/mL)		
Show sample calculations here.		

Part 2: Density of a Metal Cylinder	Trial 1	Trial 2
Number stamped on metal cylinder		
Mass of metal cylinder (g)		
Initial volume of water in graduated cylinder (mL)		
Final volume of water in graduated cylinder (mL)		
Volume of metal cylinder (mL)		
Density of metal cylinder (g/mL)		
Average density of metal cylinder (g/mL)		
Show sample calculations here.		

Name

Part 3: Density of Unknown Liquid	Trial 1	Trial 2
Mass of beaker and cover (g)		
Mass of beaker cover and liquid (g)		
Mass of liquid (g)		
Volume of liquid (mL)		
Density of liquid (g/mL)		
Average density of liquid (g/mL)		

Show sample calculations here.

Post Lab Questions

1. A stone is found to have a volume of 34.9 cm^3. It has a mass of 30.8 g. What is the density of the stone?

2. A graduated cylinder was filled to 30.0 mL with a liquid. An unknown metal cylinder having a mass of 60.27 g was submerged in the in the liquid. The final volume of the liquid level was 45.2 mL.

    a. Calculate the density of the unknown metal cylinder.

    b. The density of the liquid is 0.899 g/mL. What is the mass of the liquid in the graduated cylinder?

3. The density of gasoline is 0.6775 g/cm^3. Calculate the volume of 200.0 grams of gasoline.