CHM201 General Chemistry and Laboratory I
Laboratory 2 – Density Measurement
Spring 2021

IMPORTANT NOTE:

These laboratory directions are designed for in-person labs. Please read the directions as you enter/examine the predetermined data that come with the lab. This will afford you the opportunity to visualize the process and procedures used in the acquisition of the data. Your interpretation of data (calculations and observations) will be the same as if you performed the procedures yourself.

You should also view the accompanying YouTube videos to make the procedures clearer.

Purpose:

This laboratory introduces you to basic measurements of mass and volume. You will measure density using direct and indirect determinations of volume. After calculating the density of various metals, you will draw some conclusions on the relationship between the density of a metal and its position in the periodic table.

Introduction

Density is the ratio of mass to volume. Density is well defined for solids, liquids and gases. The density of gases is much smaller than the densities solids and liquids. The density of gases is usually reported in grams per liter (g/L), where solids and liquids are reported in grams per milliliter or cubic centimeter (g/mL, g/cm^3).

Procedure

General Note: *The data gathered for the following procedures is historical. Real students collected and recorded these values. Their errors are now your errors. This is intended. You may be expected to take these errors into account when you interpret the results in your report.*

1. Measuring the density of a solid by volume displacement

1.1 Add approximately 5-7 mL of water to a 10 mL graduated cylinder. In some cases, the amount may need to be more or less to be sure that the solid being measured will be completely covered.

1.2 Record the volume of water in the graduated cylinder as V_i. If you are unsure of how much accuracy must be recorded, ASK.

1.3 Place a small, dry and clean beaker or other container on a balance – a top-loading balance will be accurate enough for this measurement – and press the "TARE" button. Be sure the reading is zero before proceeding.

1.4 Determine the approximate amount of the solid to be measure by gauging its approximate volume – this should be about 3-5 mL. Transfer that amount of the solid to be measured into the beaker and record the exact mass. Also record the form of the solid used (powder, beads, strips, etc.).

1.5 Transfer the solid to the graduated cylinder without splashing any of the water. Be sure that the solid is below the level of the water and that the water level does not go above the scale markings on the graduated cylinder. If both of these conditions are not met you will need to repeat the measurement with more water or less solid. Record the volume of the water level after all of the solid has been submerged as V_f.

1.6 After measuring the V_f, decant (pour off) the water and transfer the solid the appropriate waste container for that solid.

1.7 Repeat for five other solids, recording the data for each solid in the table provided. You must measure copper in two different physical forms, glass beads, iron chips and aluminum pieces. Record the necessary measurements of what you measure. Be aware of significant figures throughout this experiment.

1.8 Calculate the density of the solids by using the following formula:

$$\textbf{\textit{Density}} = \frac{\textbf{\textit{mass of material}}}{V_f - V_i} = \frac{\textbf{\textit{Gross Wt} - \textit{Tare Wt}}}{V_f - V_i} = \frac{\textbf{\textit{Net Wt}}}{\textbf{\textit{Vol of material}}}$$ (*do this part later*)

1.9 Tabulate all the densities obtained (record the units) for each solid measured. Label the method used as "Volume Displacement." (*do this part later*)

2. Determination of the density of a solid by direct measurement:

2.1 Take one piece of copper wire as measured in Part 1 and measure as accurately as possible its dimensions (length and diameter). You may *borrow* my digital caliper to make these measurements. Record the value.

2.2 Measure and record the mass of the piece of wire on an *analytical* (0.1 mg) balance.

2.3 Take one glass bead as measured in Part 1 and measure as accurately as possible its diameter. You may *borrow* my digital caliper to make this measurement. Record the value.

2.4 Measure and record the mass of the glass bead on an *analytical* (0.1 mg) balance.

2.5 Calculate the density of these two samples by dividing the mass by the volume. Include this data in the density of solids table and label the method used as "Direct Measure." (*do this part later*)

3. Direct and volume displacement measurement of pennies

3.1 Obtain a sample of pennies and record the mass and date of oldest and newest pennies in the table provided.

3.2 Measure and record the mass of the oldest and newest pennies (any balance will do for this measurement).

3.3 Measure and record the dimensions (thickness and diameter) of the oldest and newest pennies. Again, you may borrow a caliper for this.

3.4 Using a 50 mL graduated cylinder, measure the mass and volume of the entire *group* of pennies by measuring the mass directly and the volume by volume displacement as in part 1.

3.5 Determine the volume and densities of the oldest and newest pennies. (*do this part later*)

3.6 Compare the densities of the oldest and newest pennies and compare those values the actual density of copper. (*do this part later*)

4. Copy data from the previous tables into the table of densities for comparison. Fill in blanks with the information from the other tables. The actual densities of the solids you measured may be found somewhere in cyberspace – ***look them up***. This will centralize the data you have collected for easier analysis while answering questions. (*do this part later*)