Lab Activity – Mass, Volume and Density

Identification of metal samples through density values

Purpose:

In this experiment, you will
- measure the mass and volume of known and unknown metal samples using a balance and the displacement method
- use your raw data to calculate the density of the metal samples
- compare your density values with the values listed for the pure metals in reference tables and calculate the percent error
- identify the unknown metals

Background Information:

Density is defined as the ratio of a substance's mass to the volume it occupies.

Density (g/mL) = mass (g) ÷ volume (mL)

or

density (g/cm^3) = mass (g) ÷ volume (cm^3)

Density is a physical property that can be used to characterize a substance. It is a constant – i.e. the density of a pure substance does not vary with the size or shape of the sample. The densities of the elements are listed in regents reference table S. We can therefore use density values to help in identifying unknown samples.

Guiding Questions:

How does one determine the density of a metal object?
How do my results compare with the density values of some identified metal samples?
Can I use my method to identify an unknown metal sample?

Materials and Equipment:
Goggles
Graduated cylinder
Metal samples
Paper towel
Water
Reference Tables – metal densities

Safety:
1. Wear Goggles at all time
2. Follow the instructions of your teacher.

Procedure:

As you perform the experiments record your data in a data table. Be sure to include units and record to the correct number of significant figures.

1. Determine the mass (in grams) of two known metal samples using an electronic balance. Record the data in a data table.
2. Using the water displacement method, find the volume (in mL) of each of the metal samples. Fill a graduated cylinder about half full with water and measure the "volume of the water alone". Record this value in your data table. Tilt the graduated cylinder and carefully slide the metal sample into the cylinder – be sure that the sample is completely submerged. Measure the volume and record it as "volume of metal and water" in your data table. Next determine the "volume of the metal alone".
3. Repeat steps 1 and 2 for the unknown sample.
4. Calculate the density values and record these values in your data table.

Analyses:
- Compute the volume of each metal sample. Show calculations and record the value in your data table.
- Compute the density for each metal sample. Show calculations and record the value in your data table.
- Calculate the percent error for the density calculations of the known metals
- Identify the unknown metal samples