Name:_____

Lab Partner:_____

Density Lab

In all scientific work, proper measurement is incredibly important. In this experiment you will make measurements using a metric ruler, graduated cylinder, and balance.

Density (D) is an important physical property of substances. It can often be used to help identify a particular substance. In fact, a well-known story tells of how Archimedes is said to have screamed "Eureka!" while trying to determine, using density, if the king's crown was made of pure gold. (As Archimedes was supposedly sitting in his bathtub, he noticed that the amount of water displaced by an object is equal to the object's volume. This helped him realize that the king had been duped and that his crown was, in fact, only partially gold.)

Density is calculated by relating the mass of an object to its volume:

$$D = \frac{\text{mass}}{\text{volume}} \quad \text{or} \quad D = \frac{m}{v}$$

Densities are usually expressed with units of $\frac{\text{grams}}{\text{cm}^3}$ or $\frac{\text{g}}{\text{mL}}$. (Remember that 1 cm^3 = 1 mL.)

From the measurements made during this experiment, you will calculate the densities of several substances. Using these densities, you will identify an unknown liquid and an unknown metal by comparing your values to accepted values.

Finally, you will use length measurements made on a piece of aluminum foil and the accepted density of aluminum to calculate the thickness of aluminum foil.

NOTE: Mass measurements should be made to 0.01 g (record all numbers shown on the balance display), and all other measurements should be made to the highest degree of precision permitted by the instrument (using tolerances). Make sure to record all measured zeroes, too!

Part I: Density of a Solid

A. Regular Solid

1. Select a block of wood and measure its dimensions.

2. Determine the mass of the block.

B. Irregular solid

1. Obtain a *small* handful of marble chips. Mass the marble chips together.

2. Determine the volume of the marble chips. Do this by partially filling a 100 mL graduated cylinder with water and recording the volume. Then place the marble chips into the graduated cylinder and measure the new volume. Tap the cylinder gently to dislodge any bubbles.

3. Dry the marble chips and return them to the beaker.

Part II: Density of a Liquid

1. Find the mass of a clean, DRY 10 mL graduated cylinder.

2. Fill the cylinder exactly to the 10 mL mark with water, using a dropper to adjust the volume if necessary. Record the volume (watch significant figures!).

3. Find the mass of the filled graduated cylinder.

Part III: Determination of Aluminum Foil Thickness

1. Obtain a rectangular piece of aluminum foil from the teacher.

2. Properly and exactly measure the length and width of the foil.

3. Determine the mass of the foil.

Part IV: Identification of an Unknown Solid

1. Prepare a data table that will contain all pertinent data for the determination of density of an irregular solid.

2. Show this data table to your teacher to obtain a sample of unknown solid. BE SURE TO RECORD THE SAMPLE NUMBER!

3. Perform all necessary measurements.

4. Return your **dry** sample to the teacher.

Part V: Identification of an Unknown Liquid

1. Prepare a data table that will contain all pertinent data for the determination of density of a liquid.

2. Show this data table to your teacher to obtain a sample of unknown liquid. You should bring a 10 mL graduated cylinder to hold the liquid. BE SURE TO RECORD THE SAMPLE NUMBER!

3. Perform all necessary measurements.

4. Return your liquid to the CORRECT container on the front desk.

******Do not pour the liquid down the drain!!!******

Data and Calculations (SHOW ALL WORK!):

Part IA:

Data:

Calculate the volume of the block.

Calculate the density of the wood in $\frac{g}{cm^3}$.

Part IB:

Data:

Calculate the volume of the marble chips.

Calculate the density of the marble chips in $\frac{g}{cm^3}$.

Part II:

Data:

Calculate the mass of the water used.

Calculate the density of water in $\frac{g}{cm^3}$.

What is the accepted value for the density of water?

Calculate the % error in your density of water calculation.

Part III:

Data:

The accepted density of aluminum is 2.70 $\frac{g}{cm^3}$. Use this density, along with your mass measurement, to calculate the volume of the sheet of aluminum foil (this will require the use of some algebra).

Think of your piece of foil as a very thin block. Using the volume calculated above, as well as your measurements, calculate the thickness of your foil.

Data and Calculations for Unknowns (SHOW ALL WORK!):

Part IV (Unknown Solid):

Unknown:_____

Data table:

Calculate the density of your unknown solid:

Identify your solid:

Actual identity (provided by teacher):

Based on the actual identity of your solid, calculate the % error in your density calculation.

Part V (Unknown Liquid):

Unknown:_____

Data table:

Calculate the density of your unknown liquid:

Identify your liquid:

Actual identity (provided by teacher):

Based on the actual identity of your liquid, calculate the % error in your density calculation.

DENSITIES OF SOME COMMON SUBSTANCES

Substance	Density (g/mL)
Pine Wood	0.36 – 0.63

METALS

Aluminum	2.70
Bismuth	9.78
Gray Tin	5.75
Iridium	22.65
Lead	11.3
Magnesium	1.74
Nickel	8.90
Tungsten	19.3
Zinc	7.14

LIQUIDS

Acetone	0.790
Chloroform	1.26
Hexane	0.659
Methyl Acetate	0.930
Water	1.00