Name: _____ Period: _____ Group #: _____

DENSITY LAB Std 4e

PURPOSE:

1. To calculate the different densities of several substances and become familiar with the use of calibrated metric or SI measuring instruments and their units.

$$\textbf{density} = \frac{\text{mass}}{\text{volume}}$$

2. To determine the level of accuracy by determining the percent of experimental error.

$$\textbf{\% error} = \left| \frac{\text{value (from experiment) - theoretical value (given by teacher)}}{\text{theoretical value}} \right| \times 100$$

(note: vertical lines indicate absolute value)

MATERIALS:

10 ml & 50 ml graduated cylinders, metric ruler, thread, rectangular metallic object. irregular metallic object, water, methanol, corn oil, and centigram balance.

PROCEDURE 1: **Finding density of a rectangular piece of aluminum (Al)**

1. Measure and .record the-length, width, and height of the aluminum.to the nearest tenth of a centimeter (0.1 cm).
2. Calculate and record the volume, and then the density.

Data Table 1 – Calculating the density of a rectangular Al object

your measurements	**calculations**
length _____ cm	volume _____ cm^3
width _____ cm	density _____ g/cm^3
height _____ cm	given density _____ g/cm^3
mass _____ g	

CALCULATIONS: (show your work)

Compare your measured density with the given (theoretical) value given in the information in Date Table for Procedure 1 and **calculate the percent error** .

PROCEDURE 2: **Find the volume of an irregularly shaped metallic object**

1. Select an irregular object. Note the symbol on the metal and then record the name of the element the metal is made from.
2. Mass the metal on the balance to the nearest hundredth of a gram (.01g) and record that mass in the data table below.
3. Fill the 10 ml graduated cylinder with enough water so that your metal wilt be covered by water when
4. Read the level of the water at the meniscus and record that volume.
5. Immerse the massed metal. Read the new level of water at the meniscus and record that volume.
6. Calculate the volume of the metal by subtracting the two water levels.
7. Calculate the experimental density of your metal and record it. Look up and record the known theoretical density of your metal from the reference table.
8. Calculate the percent of experimental error and record it.

Data Table 2 – Density of an irregular metal object

Element object made from	_____
Mass of metal (your massed)	_____ g
Initial water level in graduated cylinder without sinkers	_____ ml (cm^3)
Water level with lead sinkers	_____ ml (cm^3)
Volume of metal (calculated)	_____ ml (cm^3)
Density of metal (calculated)	_____ g/cm^3
Theoretical density (given)	_____ g/cm^3
Percent experimental error (calculated)	_____ % error

CALCULATIONS: (show your calculations)

volume of object =

density of object =

% error =

QUESTIONS:

1. Whose principle did you employ to find the density of the objects? _____

2. **State at least two reasons** why we have experimental errors (concentrate on the equipment we are using and the materials supplied)

PROCEDURE 3: **Determining the density of two liquids**

1. Measure the mass of a 10ml graduated cylinder to the nearest hundredth of a gram (.01 g). *Do not change graduated cylinders throughout the experiment or it will affect your results.*
2. Fill the graduated cylinder with 7-8 mL of water. (The second time you do this procedure you will be using Methanol instead of water.). Read the volume of the liquid at the meniscus to the nearest tenth of a ml (0.1 ml).
3. Mass the graduated cylinder with the liquid and record. *Be careful not to spill any of the liquid.*
4. Calculate the experimental density of the liquid with the proper number of significant digits.
5. Look at theoretical density in **Information Table 1** below (last page) and record the theoretical density for the liquid.
6. Calculate the % error.
7. When you are finished, be sure and wash out the cylinder with soapy water and rinse thoroughly.

DATA TABLE 3: Calculating the density of two liquids

mass of 10 ml cylinder_____ g

Mass	**Volume**	**Exp. Density**	**Theo. (from chart) density**	**% Error**
cyl. & water = **g**	XXXXX	XXXXXX	XXXXXX	XXXXX
water (calc) = **g**	ml	g/ml	g/ml	%
cyl. & alcohol = **g**	XXXXX	XXXXXX	XXXXXX	XXXXX
alcohol (calc) = **g**	ml	g/ml	g/ml	%

CALCULATIONS: (show your work)

water density = % error = _____

alcohol density = % error = _____

QUESTIONS:

1. How does water's density compare with alcohol?

2. Give **two** reasons why there is a difference between the given density and the your calculated density (concentrate on the equipment you had to use) .

PROBLEMS: (show your work)
After doing this lab and completing the chart, you should be able to do these problems:

1. What is the volume of 66.6 g of magnesium (Mg) if it has a density of 1.74 g/cm^3 ?

2. Tin (Sn) has a density of 7.28 g/cm^3. What is the volume of 4.32 kg of Sn?

3. What is the mass of 3.00 m^3 of nitrogen gas (N_2) if its density is 1.25 g/dm^3 ?

Information Table 1 **THEORETICAL** (precise to 2 decimals)

Known Densities of Some Common Materials

Zinc (Zn)	7.14 g/cm^3	Pure Water	1.00 g/cm^3
Copper (Cu)	8.92 g/cm^3	Methanol	0.78 g/cm^3
Aluminum (Al)	2.70 g/cm^3	Corn oil	0.93 g/cm^3
Iron (Fe)	7.89 g/cm^3		
Tin (Sn)	7.27 g/cm^3		
Lead (Pb)	11.34 g/cm^3		

Biography - Archimedes (287-212 BC)

Archimedes was a Greek mathematician and scientist who made discoveries about the behavior of solids and liquids, and unlike other Greek philosophers- at the time, he actually tested his ideas. One of his most famous discoveries was the method of measuring the volume of an object. He *did* so by measuring the volume of water that the object displaces. Legend has- it that he developed this method of measurement when he was asked to find a way to detect if the crown of the King of Sicily was made of pure gold, because the King suspected his goldsmiths had made it from something other than gold. When taking a bath he realized how he could determine the volume of the crown, and thus he was then able to identify the metal from its density after determining the mass.