

**Lab 2 – Density of a Solid and a Liquid****60 Points****Introduction**

In this lab we will be solving for density, the mass (weight) of an object based on the object's volume (*size*). To solve for density we need to measure the volume and mass of the sample using the following lab techniques:

*Volume by Length Measurements*

The volume of a solid is determined through a mathematical equation based on the shape of the object where the volume is measured in milliliters (mL);  $1\text{mL} = 1\text{cm}^3 = \text{cm} \bullet \text{cm} \bullet \text{cm}$

$$\text{Cube: } V = l \bullet w \bullet h$$

$l$  = length,  $w$  = width,  $h$  = height

$$\text{Cylinder: } V = \pi \bullet r^2 \bullet h$$

$\pi = 3.14$ ,  $r$  = radius,  $h$  = height

Density is found using the density equation:

$$D = m / v, \text{ where } D = \text{Density (g/mL), } m = \text{mass (g), and } v = \text{volume (mL)}$$

*Volume by Water Displacement*

The volume of a solid can also be found using the displacement method. To use the displacement method the initial volume (*initial, without solid*) and final volume (*with solid*) using the equation below:

$$V_{\text{solid}} = V_{\text{after}} - V_{\text{start}}$$

*Density Tables for Metals*

Element	Aluminum	Brass	Copper	Gold	Iron	Lead	Nickle
Density	2.60g/mL	8.50g/mL	8.96g/mL	19.3g/mL	7.87g/mL	11.3g/mL	8.90g/mL
Element	Platinum	Silver	Steel	Tin	Tungsten	Vanadium	Zinc
Density	21.5g/mL	10.5g/mL	7.86g/mL	7.26g/mL	4.51g/mL	6.0g/mL	7.14g/mL

**Lab Procedure***Part 1 – Density of a Solid*

## Volume by Measurement

1. Measure radius and height of the cylinder
2. Use equation above to find volume of the cylinder
3. Measure mass of solid and solve for density
4. Determine metal based on chart above/properties

## Volume by Displacement

1. Add water to the halfway mark on a graduated cylinder (*record volume*)
2. Add metal and record new volume (*record volume*)
3. Subtract new volume from original volume
4. Use volume and mass above to solve for density
5. Determine metal based on chart above/properties

Data Table with Initial Calculations ( $V_{\text{metal}}$  and  $\text{Radius}$ )

Metal	Diameter ( <i>cm</i> )	Radius ( $r = d/2$ )	Height ( <i>cm</i> )	$V_{\text{start}}$ ( <i>ml</i> )	$V_{\text{after}}$ ( <i>ml</i> )	$V_{\text{metal}}$ ( $V_{\text{after}} - V_{\text{start}}$ )	Mass ( <i>g</i> )
Silver ( <i>Shiny</i> )							
Silver ( <i>Not Shiny</i> )							
Gold							

### Calculations

#### Density (*Solid Measurements*)

Silver ( <i>Shiny</i> )	Silver ( <i>Not Shiny</i> )	Gold

#### Density (*Volume by Different Measurements*)

Silver ( <i>Shiny</i> )	Silver ( <i>Not Shiny</i> )	Gold

### Results

What were the metals for each metal cylinder?

Compare results from each density calculations to chart on front of lab document

Cylinder	Silver ( <i>Shiny</i> )	Silver ( <i>Not Shiny</i> )	Gold
Metal			