Name:____

Class ID Number:______________________________

Lab #1: Density of Solids

In this particular experiment you will have three tasks: (1) to determine the densities of several objects and (2) to determine the identity of unknown metal objects by matching their experimentally derived densities to a list of known densities (3) to determine a percent deviation for your calculated value with that of the known density.

Matter occupies space and therefore has volume. Materials have different masses. We say that lead is heavy and that cork is light. This has little meaning unless we have equal volumes of lead and cork. This means a piece of lead is heavier than a piece of cork of the same size that is the same volume. The mass of a unit volume of a material is called its density which is expressed by equation (1).

$$\text{Denisty} = \frac{\text{mass}}{\text{volume}} \quad \text{or} \quad D = \frac{m}{v}$$ Equation (1)

Where M is mass (usually measured in grams; g), V is the volume (usually in cubic centimeters; cm^3 or milliliters; mL). D is the density (usually in g/mL or g/ cm^3). Under the same conditions of temperature and pressure, the density of a particular substance is always the same. Density is one of the characteristics by which a substance can be identified.

You will compare the density of each object to a chart containing the accepted density values of several substances and determine the identity of the substance. Table 1 gives the accepted densities for several different metals.

Table 1. Accepted Densities of Metals

Metal	**Density (g/cm^3)**
Aluminum	2.7
Copper	9.0
Brass	8.5
Bronze	8.8
Gold - 14ct	12.9 to 14.6
Magnesium	1.7
Niobium	8.6
Palladium	12.0
Platinum	1.4
Silver - Sterling	10.2 to 10.3
Stainless steel	8.0
Titanium	4.5

Percent Deviation

Calculate the percent deviation of each object using equation (2).

Name:____

Class ID Number:______________________________

$$\text{Percent Deviation} = \frac{(\text{Measured Value}) - (\text{Accepted Value})}{(\text{Accepted Value})} \times 100\% \qquad \text{Equation (2)}$$

In equation (2) the accepted value is the accepted density from the given chart and the measured value is the density you calculated in the experiment. The percent deviation measures the amount of error between your answer and the correct answer.

Determining Volume

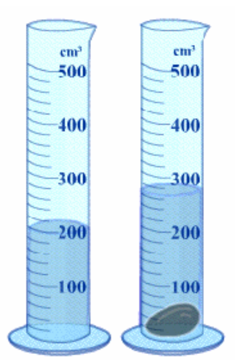
To determining the volume of a liquid is easy; you simply place it in a graduated cylinder and record the resulting volume from the calibration of the side. In order to determine the volume of your metal objects, you can use two methods: (1) volume by calculation or (2) volume by displacement.

To calculate volume by calculation, measure the object (or use given measurements) and use the formula for the shape to calculate volume. For your reference, the following are the formulas for how to calculate the volume of different shapes.

Volume formulas

Shape	Equation	Variables
A cube	a^3	*a* = length of any side (or edge)
A rectangular prism:	$l \cdot w \cdot h$	l = length, w = width, h = height
A cylinder:	$\pi r^2 h$	*r* = radius of circular face, *h* = height
A sphere:	$\frac{4}{3}\pi r^3$	*r* = radius of sphere

The second method, volume by displacement, uses the displacement of water in a graduated cylinder to determine the volume of the metal object. The volume of water that is displaced by the metal object is exactly equal to the volume of the meal object itself.

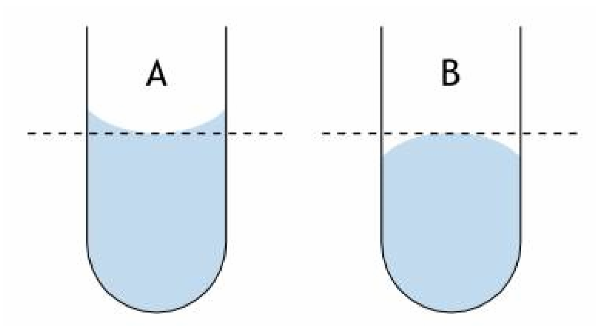


Name:____

Class ID Number:______________________________

Reading a Graduated Cylinder

Accurate measurement of this volume depends on the scientist's ability to correctly read the scale on the graduated cylinder. This reading is made more complicated by the formation of a meniscus caused by capillary action. Whenevere liquids are held in a narrow container, the surface tension of the liquid causes a marked curvature of the upper surface. Specifically, this is referred to as a meniscus.



A: Read the bottom of a concave meniscus.
B: Read the top of a convex meniscus.

In the case of water, the meniscus is concave and in order to accurately record the volume, you have to observe where the center of the curve is located.

Copy and complete the following data table into the results section of your lab notebook. Show all calculations for volume, density and percent deviation in your notebook.

Object	Mass (g)	Volume (cm^3)	Density (g/cm^3)	Identity	Actual Density (g/cm^3)	Percent Deviation (%)
Rectangle						
Cylinder						
Cube #1						
Cube #2						
Sphere						

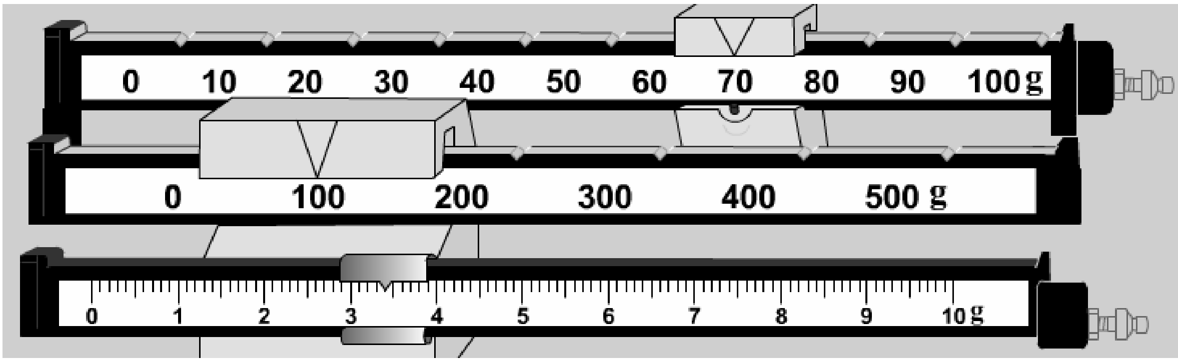
You will not need to include a hypothesis in your lab report.

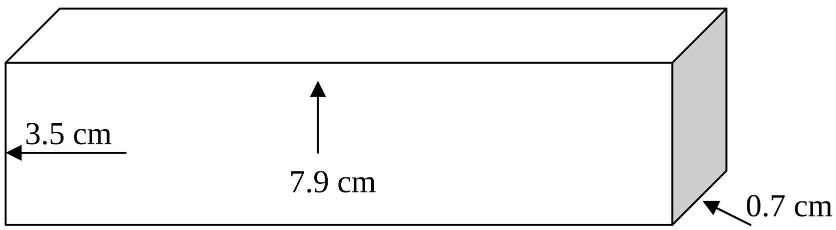
Name:_______________________________________

Class ID Number:______________________________

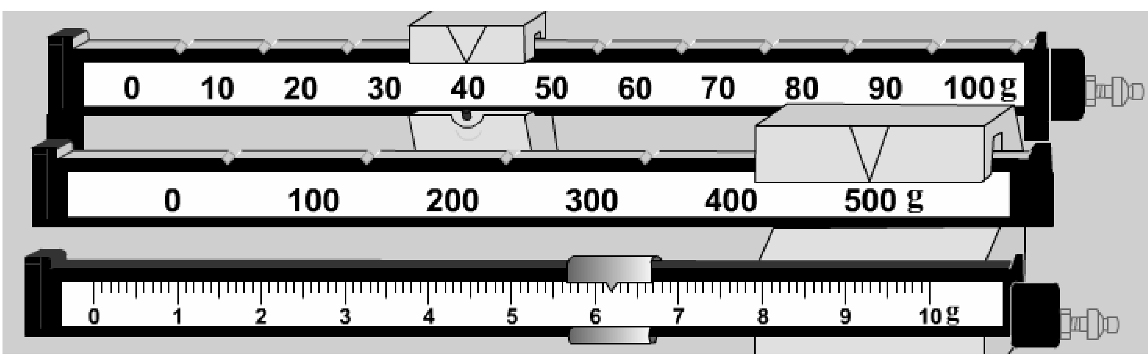
Use the following information to calculate the mass and volume of your objects:

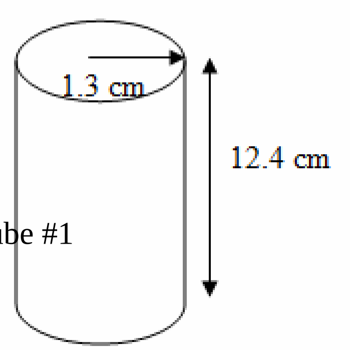
Rectangle:





Cylinder

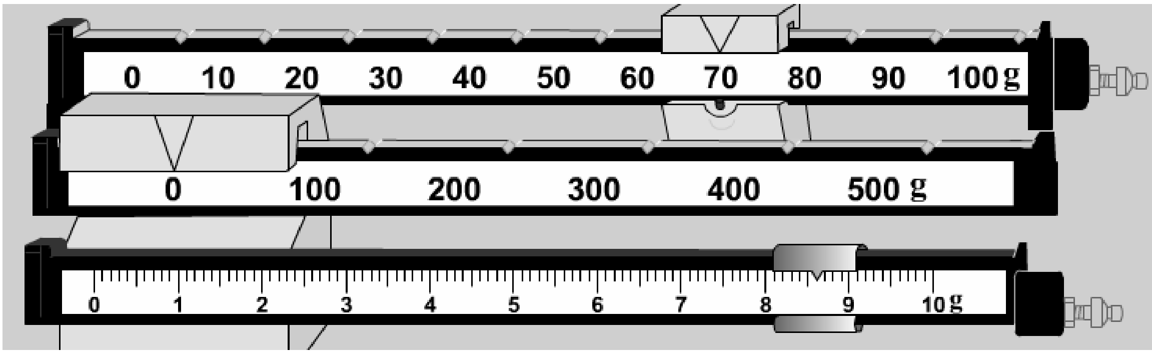


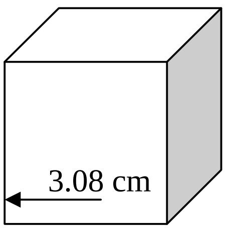


Cube #1

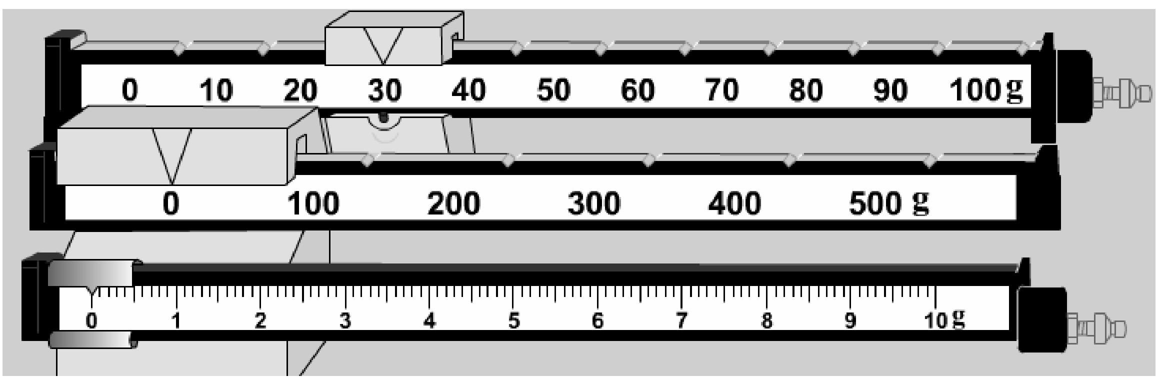
Name:____

Class ID Number:_______________________________

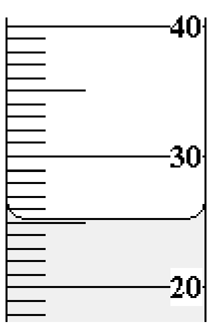




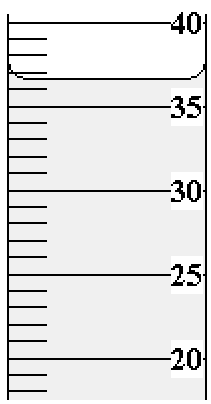
Sphere



Volume of the Sphere: Graduated cylinder (a) shows the initial volume and graduated cylinder (b) shows the volume of liquid after the sphere was placed in the liquid.



a.)



b.)