Density Lab Handout

FASTly
FAITH & SCIENCE TEACHING

Background

Mass *(M)* and volume *(V)* are characteristics of all matter:

- *Mass:* the amount of matter in an object, commonly measured in grams (g) or kilograms (kg).
- *Volume:* the amount of space an object occupies, commonly measured in milliliters (ml), cubic centimeters (cm^3), liters (l), cubic meters (m^3), or gallons (gal).

Mass and volume are physical properties of matter and vary with different objects:

- If two samples of metal of the same shape are made out of the same material, yet one is smaller than the other, their volumes will differ.
- If the first sample is 1/3 the size of the second, then you would expect that it is also 1/3 the mass.
- If both samples are made of the same material, the ratio of mass to volume (this ratio is called "density") will be the same.

Density *(ρ)* is defined as: the ratio of the mass of an object to the volume of the object. This is represented by the following equation:

$$\rho = \frac{M}{V}$$

The symbol *M* stands for the mass of the object and *V* the volume. Density is expressed in units of mass per units of volume, such as: grams per cubic centimeter (g/cm^3) or kilograms per liter (kg/l).

Sample problem 1

A block has a mass of 20g and occupies a volume of $23cm^3$. What is the density of the block?

Solution

$$\frac{20g}{23cm^3} = 0.87g/cm^3$$

Activity: Determine the Density of an Object—Regular Shape

Your instructor will give you a set of six density blocks. To calculate the density of each one, begin by measuring its mass and volume.

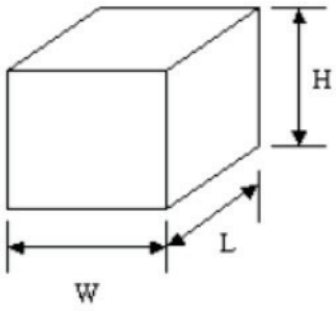
Measure the mass:

- Measure the mass of your samples using the balance provided.
- Take this measurement three times for each sample block and calculate the average.
- Record your results in the table below.

Trial	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
1						
2						
3						
Average						

Determine the volume:

- To determine the volume of a cube, use the following equation:



Cube

$V = L \times W \times H$

- Measure the length (L), width (W), and height (H) of your 6 sample blocks. Record the readings in the tables below. Take these measurements three times for each sample block and calculate the average.

Sample 1

Trial	Length (cm)	Width (cm)	Height (cm)
1			
2			
3			
Average			

Calculate the volume of Sample 1, using the equation for determining a cube's volume (above) and the average length, width, and height measurements from the table. Show all work.

Volume = _____.

Sample 2

Trial	Length (cm)	Width (cm)	Height (cm)
1			
2			
3			
Average			

Calculate the volume of Sample 2, using the equation for determining a cube's volume (above) and the average length, width, and height measurements from the table. Show all work.

Volume = _____.

Sample 3

Trial	Length (cm)	Width (cm)	Height (cm)
1			
2			
3			
Average			

Calculate the volume of Sample 3, using the equation for determining a cube's volume (above) and the average length, width, and height measurements from the table. Show all work.

Volume = _____.

Sample 4

Trial	Length (cm)	Width (cm)	Height (cm)
1			
2			
3			
Average			

Calculate the volume of Sample 4, using the equation for determining a cube's volume (above) and the average length, width, and height measurements from the table. Show all work.

Volume = _____.

Sample 5

Trial	Length (cm)	Width (cm)	Height (cm)
1			
2			
3			
Average			

Calculate the volume of Sample 5, using the equation for determining a cube's volume (above) and the average length, width, and height measurements from the table. Show all work.

Volume = _____.

Sample 6

Trial	Length (cm)	Width (cm)	Height (cm)
1			
2			
3			
Average			

Calculate the volume of Sample 6, using the equation for determining a cube's volume (above) and the average length, width, and height measurements from the table. Show all work.

Volume = _____.

Calculate the density:

Calculate the density of each block using the equation for density at the top of this handout. Record your results in the table below:

Sample	Volume (cm^3)	Mass (grams)	Density (g/cm^3)
1			
2			
3			
4			
5			
6			

Determine the experimental error:

Experimental error is a useful tool for determining the precision of a calculation. You will determine the experimental error for your results by using this equation:

$$\text{Experimental Error} = \frac{\text{Experimental Value - Known Value}}{\text{Theoretical Value}} \times 100$$

- Experimental Value is the value calculated in the lab.
- Known Value is the accepted value. Your teacher will give you the known value for each material.

Using the known values provided by your teacher, calculate the experimental error for each sample. Record your results in the table on the next page.

Sample	Experimental Value	Known Value	Experimental Error
1			
2			
3			
4			
5			
6			

Conclusion:

1. Which sample block had the highest experimental error?

2. Which sample block had the lowest experimental error?

3. What do you think was the biggest contributing factor to any experimental error you experienced?

4. Can two objects of significantly different volumes have the same mass? Why or why not?

Optional Activity: Determine the Density of an Object—Irregular Shape

Your teacher will give you a set of irregularly shaped objects. To calculate the density of each one, begin by measuring its mass and volume.

Measure the mass:

Trial	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
1						
2						
3						
Average						

Determine the volume:

The volume of an irregularly shaped object can be determined by using the displacement method:

- Fill the graduated cylinder about halfway with water.
- Note the initial level of the water and record it in the table below.
- Submerge the sample, note the final water level, and record it in the table below.

(1 ml = 1 cm^3)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Initial volume of water						
Final volume of water						
Volume of sample						

Calculate the density:

Calculate the density of each block using the equation for density at the top of this handout. Record your results in the table below:

Sample	Volume (cm^3)	Mass (grams)	Density (g/cm^3)
1			
2			
3			
4			
5			
6			

