Prelab Information

**Purpose** Explore mass, volume, and density using a laboratory procedure.

**Time** Approximately 45 minutes

**Question** How do you measure the mass, volume, and density of various types of objects?

**Summary** You will measure the mass, volume, and density of both regularly and irregularly shaped solids and a liquid using several different techniques.

Safety

 Always wear safety goggles and a lab coat when performing an experiment.

 Behavior in the lab needs to be purposeful. Use caution when handling glassware.

 Check glassware, such as graduated cylinders, for cracks and chips prior to use.

 Report all accidents—no matter how big or small—to your teacher.

Lab Procedure

1. Gather Materials
* Metric ruler
* Customary ruler
* Graduated cylinder
* Distilled water
* Electronic mass balance
* Block of wood
* Small rock
* Calculator
1. Compare Metric and Customary Units

**a)** Using a metric ruler, measure the length in centimeters of one side of the wooden block. Be sure to estimate to one place value beyond the ruler’s gradations. For example, if the ruler

is marked in centimeters, estimate millimeters. Record in table A of the data sheet.

**b)** Using a customary ruler, record the length of the same side of the wooden block in inches.

Be sure to estimate to one place value beyond the ruler’s gradations. For example, if the ruler is marked to a 16th of an inch, estimate to a 32nd of an inch. Record in table A.

**c)** Calculate ratios for the number of centimeters in an inch and the number of inches in a centimeter. Record in table A.

1. Measure the Volume of a Regularly Shaped Object

**a)** Using the metric ruler, measure the other two dimensions of the wooden block in centimeters. Be sure to estimate to one place value beyond the gradations on the ruler. Record all three measurements in table B.

**b)** Calculate the volume of the block using the formula *V = l* × *w* × *h*. Be sure to use the correct number of significant figures. Record in both tables B and E

1. Measure the Mass of a Solid

**a)** Tare the balance. Place the wooden block on the pan, and record the block’s mass in grams in table E.

**b)** Tare the balance again. Place the rock on the pan, and record the rock’s mass in table E.

1. Measure the Mass of a Liquid

**a)** Tare the balance. Record the mass of the graduated cylinder (with air in it) in table C.

**b)** Remove the cylinder from the balance, and fill it approximately halfway with distilled water.

**c)** Tare the balance again. Record the combined mass of the cylinder and water in table C.

**d)** Find the mass of the water using subtraction. Record the result in tables C and E. Save the cylinder and water for steps 6 and 7.

1. Measure the Volume of a Liquid

Place the graduated cylinder from step 5 on a flat surface. View the meniscus at eye level. (The meniscus is the curve that forms at the top of the water in the graduated cylinder.) Measure the volume of water in mL at the *bottom* of the meniscus, and record in tables D and E.

1. Measure the Volume of an Irregularly Shaped Object

**a)** Gently add the rock to the water in the graduated cylinder from steps 5 and 6, taking care to avoid spills. Make sure the rock is fully submerged in the water.

**b)** Record the combined volume of the water and rock in table D.

**c)** Calculate the volume of the rock by subtracting the volume of the water from the volume of the rock and water. Note the change of unit from mL to cm3 because 1 mL = 1 cm3. Record the result in the tables D and E.

1. Calculate Density

Density is defined by the equation *d* = $\frac{m}{v}$. Calculate the density of the wooden block, the rock, and the water by dividing the mass of each object by its volume. Record the density (g /cm3) for each object in table D.

1. Dispose of all materials according to the directions of your teacher.

Data

Record your data either in your lab notebook or in the space below.

Table A: Comparing Metric and Customary Units

|  |  |  |  |
| --- | --- | --- | --- |
| **Length of Block****(cm)** | **Length of Block****(in)** | **Ratio****(cm/in)** | **Ratio****(in/cm)** |
|  |  |  |  |

Table B: Volume of a Regularly Shaped Object

|  |  |  |  |
| --- | --- | --- | --- |
| **Length (cm)** | **Width (cm)** | **Height (cm)** | **Calculated Volume****(cm3)** |
|  |  |  |  |

Table C: Mass of a Liquid

|  |  |  |
| --- | --- | --- |
| **Mass of the Graduated****Cylinder (only air) (g)** | **Combined Mass of Graduated****Cylinder and Water (g)** | **Calculated Mass of Water (g)** |
|  |  |  |

Table D: Volume of an Irregularly Shaped Solid

|  |  |  |
| --- | --- | --- |
| **Volume of Water****(mL)** | **Combined Volume of****Water and Rock (mL)** | **Calculated Volume of Rock****(cm3)** |
|  |  |  |

Table E: Density of Objects

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Mass (g)** | **Volume (cm3)** | **Density (g/cm3)** |
| **Wooden Block** |  | (*from table B*) |  |
| **Rock** |  | (*from table D*) |  |
| **Water** | (*from table C*) | (*from table D*) |  |