**BIOL 104 Forensic Biology**

**Lab 1 Scientific Measurements**

1. **Introduction**

Density is a property of material that may be used for comparison between objects and identification of the material itself. We will determine the density of three objects: a rectangular solid, a cylindrical solid, and an irregularly shaped solid. Density is calculated according to the following formula:

Density (D) = Mass of Object (M)

Volume of Object (V)

To determine the mass of our objects, we will use laboratory balances and record the mass in grams (g). For our rectangular solid we will use a ruler to find the length, width, and height of the object in centimeters (cm) and then calculate the volume as centimeters cubed (cm3):

Volume (V) = length x width x height

For our cylindrical solid we will measure the diameter (d) as well as the height (h). We will then calculate the volume:

Volume (V) = πr2h

where π may be estimated to 3.14 and the radius (r) is equal to half the value of the diameter. However, it is often easier to calculate the volume of irregularly shaped solids using the displacement of water. We will use a graduated cylinder to measure the volume of our irregularly shaped solid in milliliters (ml). Note that centimeters cubed (cm3) and milliliters (ml) are equivalent volumes.

Finally, forensic scientists often receive information in United States customary units, such as pounds, inches or fluid ounces (oz), and must convert these units to the International System of Units (SI), or metric system, for calculations. The SI uses base units of grams (g) for mass measurements, meters (m) for linear measurements, and liters (L) for volume measurements. These base units can be combined with prefixes such as:

kilo- (k) 1,000

hecto- (h) 100

deka- (dk) 10

gram/meter/liter 1

deci- (d) 0.1

centi- (c) 0.01

milli- (m) 0.001

micro- (μ) 0.000001

We will practice converting within and to the metric system using the factor label method:

units you have x conversion factor = units you want

where the conversion factor used contains the units you want as the numerator (top number) and the units you have as the denominator (bottom number).

1. **Materials & Methods**

**Wipe down your lab bench and wash your hands.**

1. Rectangular Solid
2. Determine the mass of your rectangular solid using a laboratory balance. Record the mass in grams (g) in your Results section.
3. Use a ruler to measure the length, width and height of your rectangular solid in centimeters (cm). Record these values in your Results section.
4. Calculate the volume of your rectangular solid. Show your calculations and include the appropriate units.
5. Calculate the density of your rectangular solid. Show your calculations and include the appropriate units.
6. Cylindrical Solid
7. Determine the mass of your cylindrical solid using a laboratory balance. Record the mass in grams (g) in your Results section.
8. Use a ruler to measure the diameter and height of your cylindrical solid in centimeters (cm). Record these values in your Results section.
9. Calculate the radius of your cylindrical solid. Show your calculations and include the appropriate units.
10. Calculate the volume of your cylindrical solid. Show your calculations and include the appropriate units.
11. Calculate the density of your cylindrical. Show your calculations and include the appropriate units.
12. Irregularly Shaped Solid
13. Determine the mass of your irregularly shaped solid using a laboratory balance. Record the mass in grams (g) in your Results section.
14. Add enough water to your graduated cylinder so that you will be able to completely submerge your irregularly shaped solid. Record the volume in milliliters (ml) in your Results section.
15. Add your irregularly shaped solid to the water in your graduated cylinder. Record the new volume in milliliters (ml) in your Results section.
16. Calculate the volume of your irregularly shaped solid by subtracting the volume of the water alone from the volume of the water containing your irregularly shaped solid. Show your calculations and include the appropriate units.
17. Calculate the density of your irregularly shaped solid. Show your calculations and include the appropriate units.
18. Rectangular/Cylindrical Solid Using Displacement of Water
19. Choose either your rectangular or your cylindrical solid and re-calculate the density using the displacement of water method. Show your calculations and include the appropriate units.

**Return all materials to the bins. Wipe down your lab bench and wash your hands.**

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Score:

Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Lab 1 Scientific Measurements**

1. **Results**
2. Rectangular Solid

Mass = \_\_\_\_\_\_\_\_\_\_

length = \_\_\_\_\_\_\_\_\_\_

width = \_\_\_\_\_\_\_\_\_\_

height = \_\_\_\_\_\_\_\_\_\_

Volume =

Density =

1. Cylindrical Solid

Mass = \_\_\_\_\_\_\_\_\_\_

diameter = \_\_\_\_\_\_\_\_\_\_

height = \_\_\_\_\_\_\_\_\_\_

radius = \_\_\_\_\_\_\_\_\_\_

Volume =

Density =

1. Irregularly Shaped Solid

Mass = \_\_\_\_\_\_\_\_\_\_

Volume of water = \_\_\_\_\_\_\_\_\_\_

Volume of water and irregularly shaped solid = \_\_\_\_\_\_\_\_\_\_

Volume of irregularly shaped solid =

Density =

1. Rectangular/Cylindrical (Circle choice.) Solid Using Displacement of Water

Mass = \_\_\_\_\_\_\_\_\_\_

Volume of water = \_\_\_\_\_\_\_\_\_\_

Volume of water and irregularly shaped solid = \_\_\_\_\_\_\_\_\_\_

Volume of irregularly shaped solid =

Density =

**IV. Conclusions**

1. Compare the densities you obtained for your rectangular or cylindrical object using both methods. Does one method seem more reliable? Why?
2. Are there materials for which the displacement of water method would not produce reliable results? Give an example.
3. Based on your calculated densities, can you determine the identity of any of the metals used to make our objects? If so, what are they?
4. Convert the following units within the metric system:
5. 62 kg = \_\_\_\_\_\_\_\_\_\_ g
6. 7 cm = \_\_\_\_\_\_\_\_\_\_ m
7. 500 μl = \_\_\_\_\_\_\_\_\_ ml
8. Convert the following units to the metric system. Please show your calculations.
9. 120 pounds = \_\_\_\_\_\_\_\_\_\_ kg (2.2 pounds = 1 kg)
10. 13 inches = \_\_\_\_\_\_\_\_\_\_ cm (1 inch = 2.54 cm)
11. 10 fluid ounces = \_\_\_\_\_\_\_\_\_\_ ml (1 fluid ounce = 29.6 ml)
12. A 0.6 inch bullet casing is found in an 8 fluid ounce pool of blood next to a 180 pound victim. What is the size of the bullet in cm, the blood pool in ml and the victim in kg, respectively?