DETERMINING THE DENSITY OF LIQUIDS & SOLIDS - *worksheet*

Density, like color, odor, melting point, and boiling point, is a physical property of matter. Therefore, density may be used in identifying matter. Density is defined as mass per unit volume and is expressed mathematically as d = m/V (d is density, m is mass, and V is volume).

The system of measurement used universally by scientists is the metric system. In the metric system, the unit of mass is the gram (g), the unit of volume for a liquid is milliliters (mL), and the unit of volume for a solid is a cubic centimeter (cm^3). Therefore, the density of a liquid is usually expressed as grams per milliliter (g/mL), and the density of a solid is expressed as grams per cubic centimeter (g/cm^3). **[Note: 1 mL = 1 cm^3]**

When we say that gold (density =19.7 g/cm^3) is more dense than aluminum (2.70 g/cm^3), we mean that a gold cube is heavier (has a larger mass) than an aluminum cube of the same size. For example, a block of gold that is 1 cm^3 would have a mass of 19.7 grams while the same size block of aluminum would have a mass of only 2.70 grams.

Determination of density of certain physiological liquids is often an important screening tool in medical diagnosis. For example, if the density of urine differs from normal values, this may indicate a problem with the kidneys secreting substances that should not be lost from the body. The determination of density is almost always performed as part of an urinalysis. Another example utilizing density is the determination of total body fat. Muscle is more dense than fat; therefore, by determining total body mass and volume, the muscle-to-fat ratio can be calculated.

In this worksheet you will determine the densities of various substances using techniques similar to that in an actual lab (i.e. by measuring their mass with a balance and their volume with graduated cylinders.) Make sure you follow the rules of significant figures!
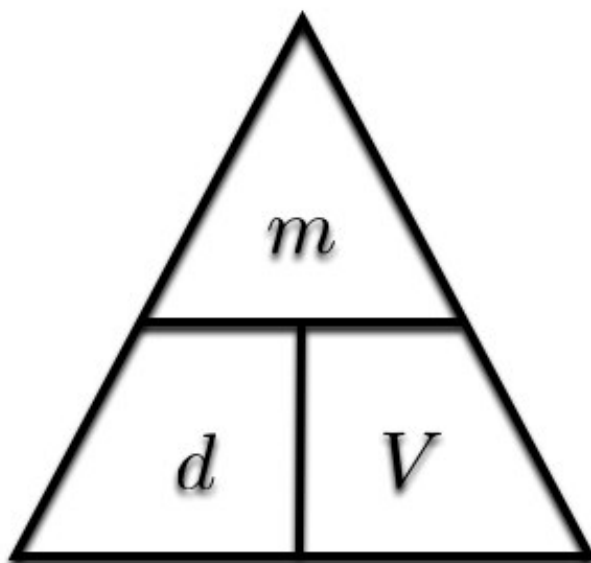
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Density Lab

Name:

Calculate the density and identify substances using a density chart

Density is a measure of the amount of mass in a certain volume. This physical property is often used to identify and classify substances. It is usually expressed in grams per cubic centimeters, g/cm^3, or grams per milliliter, g/mL. The chart on the right lists the densities of some common materials.

Remember that **1 mL = 1 cm³**. **Use significant figures in all problems!**

Equation: **Density**   **= mass**   **or**   **D = m**
                              Volume   **V**

Substance	Density (g/cm^3)
Gold	19.3
Mercury	13.5
Lead	11.4
Iron	7.87
Aluminum	3.7
Bone	1.7-2.0
Gasoline	0.66-0.69
Air (dry)	0.00119

Problem Statement	Formula	Define	Substitution	Answer
Sample: What is the density of a billiard ball that has a volume of 100. cm³ and a mass of 250 g?	D = $\frac{m}{V}$	M = 250 g, V = 100 cm³	D = $\frac{250\ g}{100\ cm^3}$	2.5 g/cm³
1. A loaf of bread has a volume of 2270 cm³ and a mass of 454 g. What is the density of the bread?				
2. A block of wood has a density of 0.60 g/cm³ and a volume of 1.2 cm³. What is the mass in grams of the block of wood?				
3. A 801g boulder has a density of 7.98 g/cm³. What is the volume in mL of the boulder?				
4.A rectangular block of iron (see table) has a length of 3.0 cm, a height of 10. cm and a width of 4.0 cm. What is the mass in grams of the iron block?				

Use the data below to calculate the density of each unknown substance. Then use the density chart above to determine the identity of each substance.

Mass (g)	Volume (cm³)	D = m/v (show values)	Density calculation (g/cm³)	Substance
4725	350.	D = $\frac{4725}{350}$	D = 13.5	Mercury
171	15.0			

20

148	40.			
475	250			
680	1.0×10^3			

Word Problems:

1.   A gold-colored ring has a mass of 18.9 grams and a volume of 1.12 mL. Is the ring pure gold? Show calculations! (The density of gold is 19.3 g/cm^3)

2.   What volume in mL would a 0.871 gram sample of air occupy if the density of air is 1.29 g/L?

3.   **Circle** the following substances which will **sink** when placed in sea water (d = 1.025 g/mL)

Gasoline (0.66 g/mL)   **Asphalt** (1.2 g/mL)   **Mercury** (13.6 g/mL)   **Cork** (0.26 g/mL)

4.   A sample of lead is found to have a mass of 32.6 g. A graduated cylinder contains 2.80 mL of water. After the lead sample is added to the cylinder the water level reads 5.70 mL. Calculate the density of the lead sample.

5.   A piece of magnesium is in the shape of a cylinder with a height of 5.62 cm and a diameter of 1.34 cm. If the magnesium sample has a mass of 18.9 g, what is the density of the sample? (Note that the volume of a cylinder $= \pi r^2 L$)

6.   Mercury is a liquid metal having a density of 13.6 g/mL.   What is the volume in Liters of 1.00 lb of mercury metal? (1.00 lb = 453.6 g)

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