Learning Task: Density

Density is the amount of matter that an object has in a given unit of volume. The density of an object is calculated by dividing its mass by its volume.

$$density = \frac{mass}{volume}$$ grams / cm^3

Different materials have different densities, so density can be used to distinguish between materials that look similar. For example, table salt and sugar look alike. However, table salt has a density of 2.16 grams per cubic centimeter, while sugar has a density of 1.58 grams per cubic centimeter.

Example 1: A piece of copper with a volume of 2.85 cubic centimeters has a mass of 73.92 grams. A piece of iron with a volume of 5 cubic centimeters has a mass of 39.35 grams. Which metal has the greater density?

Copper density $= \frac{73.92}{2.85} = 25.9\ g/cm^3$

Iron density $= \frac{39.35}{5} = 7.87\ g/cm^3$

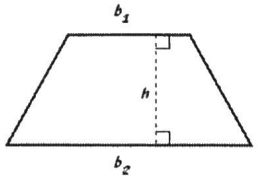
Another use of the word density occurs in the term **population density**. The population density of a city, country, or state is a measure of how many people live within a given area.

$$population\ density = \frac{number\ of\ people}{area\ of\ land}$$

Population density is usually given in terms of square miles, but can be expressed using other units such as city blocks.

The area of a trapezoid can be calculated by :

$$A = \frac{1}{2}(b_1 + b_2) \cdot h$$



Use the area of a trapezoid formula to help answer the next question.

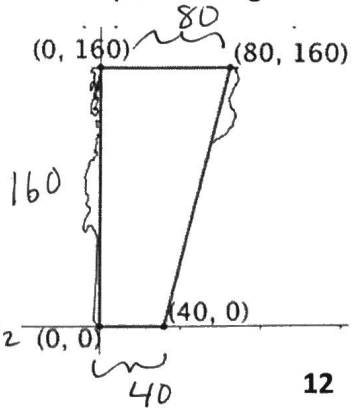
Example 2: The population of Vermont in 2009 was 621,760. The state can be modeled by a trapezoid with vertices at (0,0) , (0, 160), (80, 160), and (40,0), with each unit on the coordinate plane being 1 mile.

a. Calulcate the area of Vermont.

$A = \frac{1}{2}(40+80)160 = 9600$ units^2

b. Find the population density of Vermont.

$D = \frac{621,760}{9600} = 64.77$ people / area units^2



Density = Mass / Volume

Skills Practice

Answer all the questions below. When necessary round all answers to the nearest hundredth.

1. A piece of tin has a mass of 16.52 g and a volume of 2.26 cm^3. What is the density of tin?

$$D = \frac{16.52}{2.26} = 7.31\ g/cm^3$$

2. A man has a 50.0 cm^3 bottle completely filled with 163 g of slimy green liquid. What is the density of the liquid?

$$D = \frac{163}{50} = 3.26\ g/cm^3$$

3. Different kinds of woods have different densities. The density of oak wood is generally .74 g/cm^3. If a 35 cm^3 piece of wood has a mass of 21g, is the wood likely to be oak?

Density of oak = .74 g/cm^3 Wood piece $D = \frac{21}{35} = .6\ g/cm^3$

not likely oak

4. The density of pine is generally about 0.5. What is the mass of 800 cm^3 piece of pine?

$$D = \frac{m}{V}$$

$$\frac{.5}{1} = \frac{m}{800} \qquad m = 400g$$

* 5. What is the volume of 325g of metal with a density of 9.0 g/cm^3?

$$D = \frac{m}{V} \qquad \frac{325}{V} = \frac{9.0}{1} \qquad \frac{9.0V}{9.0} = \frac{325}{9.0} = 36.11cm^3$$

6. Diamonds have a density of 3.5 g/cm^3. How big is a diamond that has a mass of 0.10g?

$$D = \frac{m}{V} \qquad \frac{3.5}{1} = \frac{.10}{V}$$

$$\frac{3.5V}{3.5} = \frac{.10}{3.5} = .03m^3$$

7. Which has more mass: a solid cylinder of gold with a height of 5 cm and a diameter of 6 cm, or a solid cone of platinum with a height of 21 cm and a diameter of 8cm? Use the following table to help you answer the question.

Metal	Density
Gold	19.30 g / cm^3
Platinum	21.40 g / cm^3

a. Find the volume of the cylinder of gold. Then use the density formula and volume to calculate the mass.

1.) $V = \pi r^2 h$

$V = \pi(3)^2(5) = 45\pi = 141.37 cm^3$

2) $19.30 = \frac{m}{141.37}$ $\quad m = 2728.44 g$

b. Find the volume of the cone of platinum. Then use the density formula and volume to calculate the mass.

1) $V = \pi(4)^2(21) = 336\pi = 1055.58 cm^3$

2) $21.40 = \frac{m}{1055.58}$ $\quad m = 22,589.41 g$

c. Which has more mass, the cylinder of gold or the cone of platinum?