

Density

Volume: The amount of space that a substance or object occupies, or that is enclosed within a container.

Mass: The amount of matter an object contains.

Density: Measure of mass per volume.

How to Calculate Density:

$$\text{Density} = \frac{\text{mass}}{\text{Volume}} \rightarrow D = \frac{m}{V}$$

Example 1: What is the density of CO gas if 19.6 grams occupies a volume of 100 milliliters?

$$D = \frac{19.6g}{100ml} = 0.196g/ml$$

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Example 2: A block of wood 3 centimeters on each side has a mass of 27 grams.

What is the density of the block? (Hint, don't forget to find the volume of the wood.)

$$V = (3\text{cm})^3 = 27\text{cm}^3$$

$$D = \frac{m}{V} = \frac{27\text{g}}{27\text{cm}^3} = 1\text{gram/cm}^3$$

Day 1 Assignment Solve the following problems. Answers should be expressed to the nearest hundredth (3 decimals).

1. A metal ball has a mass of 2 kg and a volume of 6 cubic meters. What is the density of the ball?

$$D = \frac{2\text{kg}}{6\text{m}^3} = 0.333\text{kg/cm}^3$$

2. Water has a density of 1 gram per milliliter. What is mass of the water if it fills a 10 milliliter container.

$$D = 1\text{gram/ml}$$

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

$$m = VD$$

$$m = \frac{1\text{gram}}{\text{ml}} \cdot \frac{10\text{ml}}{1} = 10\text{grams}$$

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3. A certain gas expands to fill a 3 liter cylinder. Its mass is measured to be 0.6 kilogram. What is the density.

$$D = \frac{0.6 \text{ kg}}{3 \text{ l}} = 0.2 \text{ kg/l}$$

4. A solid is 5cm tall, 3cm wide and 2cm thick. It has a mass of 129 grams. What is its density?

$$V = 5 \text{ cm} \cdot 3 \text{ cm} \cdot 2 \text{ cm} = 30 \text{ cm}^3$$

$$D = \frac{129 \text{ g}}{30 \text{ cm}^3} = 4.3 \text{ g/cm}^3$$

5. A graduated cylinder is filled to an initial volume of 12.7 milliliter. A rock is dropped into the graduated cylinder. The final volume of the graduated cylinder is 18.2 milliliter. What is the rock's volume in ~~both~~ milliliter and cubic centimeters?

$$IV = 12.7 \text{ ml}$$

$$FV = 18.2 \text{ ml}$$

$$\begin{array}{r} \text{Rock Volume} = 18.2 \text{ ml} \\ - 12.7 \text{ ml} \\ \hline 5.5 \text{ ml} \end{array}$$

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6. Samples of three unknown liquids have been obtained. Calculate the density of each.
- Sample A has a mass of 24 grams and a volume of 6 milliliters.

$$D = \frac{24g}{6ml} = 4g/ml$$

- Sample B has a mass of 12 grams and a volume of 6 milliliters.

$$D = \frac{12g}{6ml} = 2g/ml$$

- Sample C has a mass of 12 grams and a volume of 3 milliliters.

$$D = \frac{12g}{3ml} = 4g/ml$$

Day 2 Assignment Solve the following problems. Answers should be expressed to the nearest hundredth (2 decimals).

- A block of butter weighs 200 grams. The dimensions of the block are 8 cm x 6cm x 5cm. What is the density of the block of butter?

$$V = 8 \cdot 6 \cdot 5 = 240cm^3$$

$$D = \frac{200g}{240cm^3} = 0.833g/cm^3$$

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2. A shipping container weighs 100 kilograms. The dimensions are five meters by five meters by 8 meters. What is the density of the shipping container?

$$V = 5\text{m} \cdot 5\text{m} \cdot 8\text{m} = 200\text{m}^3$$

$$m = 100\text{kg}$$

$$D = \frac{100\text{kg}}{200\text{m}^3} = 0.5\text{ kg/m}^3$$

3. A sculpture is made of bronze and has a density of 8.5 grams per cubic centimeter. It has dimensions of 2 cm x 2 cm x 147 cm. Find the mass of the bronze sculpture.

$$D = 8.5\text{g/cm}^3$$

$$V = 2\text{cm} \cdot 2\text{cm} \cdot 147\text{cm} = 588\text{cm}^3$$

$$M = DV = \frac{8.5\text{g}}{\text{cm}^3} \left(\frac{588\text{cm}^3}{1} \right) = 4998\text{g}$$

4. A box has dimensions of 0.1 meters x 4 meters x 5 meters and has a mass of 25 kilograms. Find the density.

$$V = 0.1\text{m} \times 4\text{m} \times 5\text{m} = 2.0\text{m}^3$$

$$m = 25\text{kg}$$

$$D = \frac{25\text{kg}}{2\text{m}^3} = 12.5\text{ kg/m}^3$$

Density

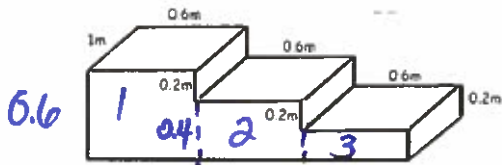
5. Olympic medals have diameter of 6 cm and thickness of 1 cm . Gold has a density of 19 grams per cubic centimeters. Find the mass of the Olympic medal.

$$V = B \cdot h = \pi(3\text{cm})^2 1\text{cm} = 9\pi\text{cm}^3$$

$$D = 19\text{g}/\text{cm}^3$$

$$m = VD = \frac{9\pi\text{cm}^3}{1} \left(\frac{19\text{g}}{\text{cm}^3} \right) = 537.212\text{g}$$

6. The density of concrete is 2400 kilogram per meter. How much will the step weigh?



$$V_1 = 1\text{m} \times 0.6\text{m} \times 0.6\text{m} = 0.36\text{m}^3$$

$$V_2 = 1 \times 0.6\text{m} \times 0.4\text{m} = 0.24\text{m}^3$$

$$V_3 = 1 \times 0.6\text{m} \times 0.2\text{m} = 0.12\text{m}^3$$

$$0.72\text{m}^3$$