Density

By Shawn P. Shields, Ph. D.

First, A Bit About Units…

- Mass is generally defined as the amount of matter contained in an object.
  - Mass can be thought of as "weight," although they are not technically the same. See the link below for a discussion of the difference.*
  - The SI unit for mass is the kilogram (kg)
  - In this course, we will often use "grams" (g). (1 kg = 1000 g)

- Volume is the 3D space occupied by an object.
  - The SI unit for volume is the liter (L)

- *NOTE: This concept will not be tested.

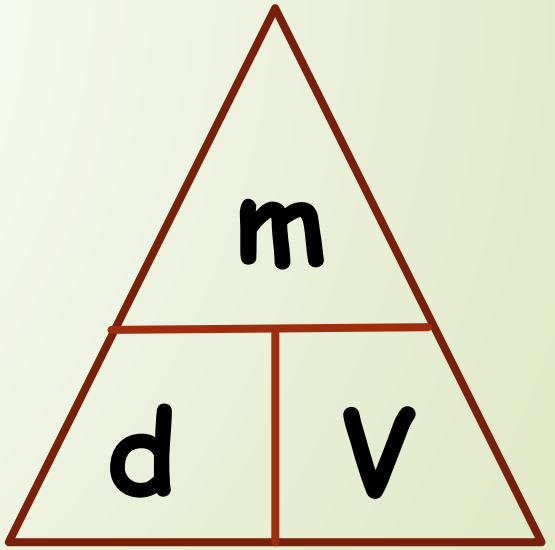
  Mass vs Weight: http://en.wikipedia.org/wiki/Mass_versus_weight

Density (d)

- Defined as the mass per unit volume of a substance
- Units commonly used in density calculations are
  - Mass (m) in grams
  - Volume (V) in mL or "cubic centimeters (cm^3)" or "cc"
  - 1 mL = 1 cm^3

- The equation for density is

$$d = \frac{\text{mass}}{\text{volume}}$$



Practice rearranging this equation to solve for density, mass, or volume ☺

Density Calculation Example

- Calculate the density of a piece of graphite with a mass of 50.0 grams and a volume of 22.4 cm^3. Be sure to include the units in your answer! ☺

Density Calculation Solution

- **Calculate the density of a piece of graphite with a mass of 50.0 grams and a volume of 22.4 cm^3. Be sure to include the units in your answer! ☺**

- Solution:
  - First, identify what information you are given in the problem.

$$d = \frac{\text{mass}}{\text{volume}}$$

Density Calculation Solution

- **Calculate the density of a piece of graphite with a mass of 50.0 grams and a volume of 22.4 cm^3. Be sure to include the units in your answer! ☺**

- Solution:
  - First, identify what information you are given in the problem.
  - Then, plug in the given values into the density equation and solve.

$$d = \frac{\text{mass}}{\text{volume}} = \frac{50.0\ \text{g}}{22.4\ \text{cm}^3} = 2.23\ {}^{\text{g}}/_{\text{cm}^3}$$

Density Calculation Example 2

- Isopropyl alcohol has a density of 0.785 g/mL at 25°C. How much mass is contained in a 150 mL sample of this alcohol? Be sure to include the units in your answer! ☺

Density Calculation Solution

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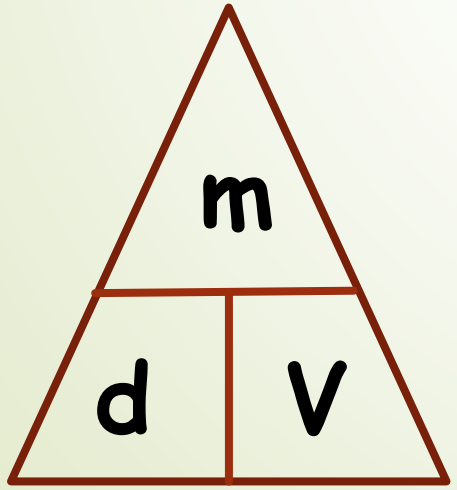
Density Calculation Solution

- **Isopropyl alcohol has a density of 0.785 g/mL at 25°C. How much mass is contained in a 150 mL sample of this alcohol? Be sure to include the units in your answer! ☺**

- Solution:
  - First, identify what information you are given in the problem.
  - Next, rearrange the density equation to solve for mass (m). (Use the triangle)



$$d = \frac{\text{mass}}{\text{volume}}$$

$$\text{m} = \text{density} \times \text{volume}$$

Density Calculation Solution

- **Isopropyl alcohol has a density of 0.785 g/mL at 25°C. How much mass is contained in a 150 mL sample of this alcohol? Be sure to include the units in your answer! ☺**

- Solution:
  - First, identify what information you are given in the problem.
  - Next, rearrange the density equation to solve for mass (m).
  - **Then, plug in the given values into the rearranged density equation and solve.**

$$\mathrm{m} = \text{density} \times \text{volume} = \left(0.785\ {}^{\mathrm{g}}/_{\mathrm{mL}}\right) \times 150\ \mathrm{mL}$$

$$\mathrm{m} = \left(0.785\ {}^{\mathrm{g}}/_{\mathrm{mL}}\right) \times 150\ \mathrm{mL} = 117.75\ \mathrm{g}$$

Sig figs! m = 120 g

Density Calculation Mini Quiz

- A tablet of aspirin has a density of 1.40 g/cm^3 at 25°C. What is the volume of a 3.90 g aspirin tablet? Be sure to include the units in your answer! ☺

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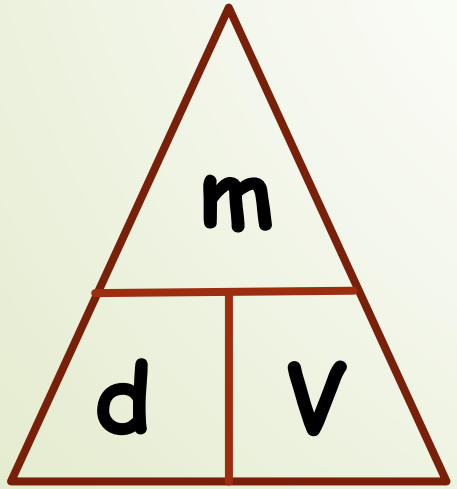
- Solution:
  - First, identify what information you are given in the problem.
  - Next, rearrange the density equation to solve for volume (V). (Use the triangle)



$$d = \frac{\text{mass}}{\text{volume}}$$

$$\text{volume} = \frac{\text{mass}}{d}$$

Density Calculation Mini Quiz Solution

- **A tablet of aspirin has a density of 1.40 g/cm^3 at 25°C. What is the volume of a 3.90 g aspirin tablet? Be sure to include the units in your answer! ☺**

- Solution:
  - First, identify what information you are given in the problem.
  - Next, rearrange the density equation to solve for mass (m).
  - **Then, plug in the given values into the rearranged density equation and solve.**

$$\text{volume} = \frac{\text{mass}}{d} = \frac{3.90\ \text{g}}{1.40\ {}^{\text{g}}/_{\text{cm}^3}} = 2.7857\ \text{cm}^3$$

Sig figs! V = 2.79 cm^3