Perhaps someone has tried to trick you with this question: “Which is heavier, a pound of lead or a pound of feathers?” Many people would instinctively answer “lead.” When they give this incorrect answer, these people are really thinking of density. If a piece of lead and a feather of the same volume are weighed, the lead would have a greater mass than the feather. It would take a much larger volume of feathers to equal the mass of a given volume of lead.

Density is the relationship of the mass of an object to its volume. Density is usually reported in units of grams per cubic centimeter (g/cm³). For example, water has a density of 1.00 g/cm³. Since a cubic centimeter contains the same volume as a milliliter, in some cases you may see density expressed as g/mL.

\[
\text{Density} = \frac{\text{mass}}{\text{volume}} \quad \text{or} \quad D = \frac{M}{V}
\]

To solve density problems, list the known and unknown values, then use one of the following.

- When a problem requires you to calculate density, use the density equation, \( D = \frac{M}{V} \).
- You can solve for mass by multiplying both sides of the density equation by volume.
  \[
  D \times V = \frac{M}{V} \times V \quad \text{or} \quad M = D \times V
  \]
- You can solve for volume by dividing both sides of the equation above by density.
  \[
  \frac{M}{D} = \frac{D \times V}{D} \quad \text{or} \quad V = \frac{M}{D}
  \]

Example: What is the mass of an object that has a density of 8 g/cm³ and a volume of 64 cm³?

Known: \( D = 8 \text{ g/cm}^3 \)

\( V = 64 \text{ cm}^3 \)

Unknown: \( M = ? \)

Equation to use: \( M = D \times V \)

“Plug and chug”: \( M = (8 \text{ g/cm}^3) \times (64 \text{ cm}^3) = 512 \text{ g} \)

PROBLEMS  List the known and unknown values; try to derive the equation without looking above.

1. A piece of tin has a mass of 16.52 g and a volume of 2.26 cm³. What is the density of tin?
   Known:
   Unknown:

2. A man has a 50.0 cm³ bottle completely filled with 163 g of a slimy green liquid. What is the density of the liquid?
   Known:
   Unknown:
3. A sealed 2500 cm$^3$ flask is full to capacity with 0.36 g of a substance. Determine the density of the substance. Guess if the substance is a gas, a liquid, or a solid.

Known:
Unknown:

4. Different kinds of wood have different densities. The density of oak wood is generally 0.7 g/cm$^3$. If a 35 cm$^3$ piece of wood has a mass of 25 g, is the wood likely to be oak?

Known:
Unknown:

5. The density of pine is generally about 0.5 g/cm$^3$. What is the mass of a 800 cm$^3$ piece of pine?

Known:
Unknown:

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

Known:
Unknown:

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

Known:
Unknown:

8. What mass of water in grams will fill a tank 100 cm long, 50 cm wide, and 30 cm high?

Known:
Unknown:

9. A graduated cylinder is filled with water to a level of 40.0 mL. When a piece of copper is lowered into the cylinder, the water level rises to 63.4 mL. Find the volume of the copper sample. If the density of the copper is 8.9 g/cm$^3$, what is its mass?

Known:
Unknown: