

Key Concept Summaries

Measuring Matter

What Units Are Used to Express Mass and Volume?

Weight is a measure of the force of gravity on an object. Weight varies with location in the solar system. A more massive object will exert a greater gravitational force, so the weight of an object on that more massive planet or moon will be greater. Weight is measured with a scale.

Mass is the amount of matter in an object. It does not change with location. Mass is constant. For this reason, scientists prefer to describe matter in terms of mass rather than weight.

To measure the properties of matter, scientists use the **International System of Units, or SI. The SI**

unit of mass is the kilogram (kg). If a smaller unit of mass is needed, the gram (g) is used. There are 1,000 grams in a kilogram or 0.001 kilogram in a gram. Another measurable property of matter is **volume**, or the amount of space matter occupies. **The SI unit of volume is the cubic meter (m³).**

Other common SI units of volume are the cubic centimeter (cm³), the liter (L), and the milliliter (mL). There are 1,000 milliliters in a liter or 0.001 liter in a milliliter. One milliliter is the same volume as 1 cm³. The volume of a rectangular solid is calculated according to the following formula.

$$\text{Volume} = \text{Length} \times \text{Width} \times \text{Height}$$

How Is Density Determined?

Density is a measure of the mass of a material in a given volume. Density is expressed as the number of grams in one cubic centimeter, or g/cm³. Because one milliliter is the same volume as one cm³, density can also be expressed as g/mL. **You can determine the density of a sample of matter by dividing its mass by its volume.**

The density of water is 1 g/mL, or 1 g/cm³. Objects with greater densities will sink. Objects with lesser densities will float. Density is a physical property of a substance. It can be used to identify an unknown substance.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

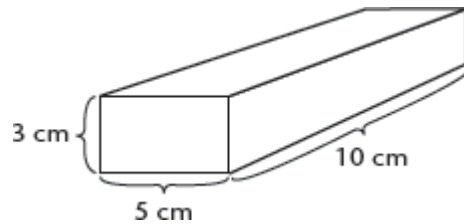
On a separate sheet of paper, describe what mass and volume are, in what units they are measured, how they determine density, and why density is important.

Review and Reinforce

Measuring Matter

Understanding Main Ideas

Use the figure to answer the following questions on a separate sheet of paper.



1. What is the volume of the solid in the figure? Show your work. Be sure to use correct units of measurement.
2. The solid has a mass of 180 g. What is the density of the solid? Show your work. Be sure to use correct units of measurement.
3. Would the solid have a mass of 180 g on the moon? Would it have the same weight on Earth as on the moon? Explain your answers.
4. The solid sinks to the bottom when placed in a container of water. What does this tell you about its density?
5. Will every solid with the same dimensions have the same density? Explain your answer.

Building Vocabulary

Write a definition for each of these terms on a separate piece of paper.

6. International System of Units
7. mass
8. volume
9. density
10. weight

Lesson Quiz

Measuring Matter

Write the letter of the correct answer on the line at the left.

1. ____ A balloon filled with air does not rise as high as a balloon filled with helium. What does this tell you about the density of helium?
A Helium is more dense than air.
B Helium is less dense than air.
C The two gases have the same density.
D When heated, helium becomes more dense.
2. ____ The amount of matter in an object is a measure of its
A volume
B density
C weight
D mass
3. ____ The formula for calculating density is
A Mass \times Volume
B Mass \times Weight
C $\frac{\text{Mass}}{\text{Volume}}$
D $\frac{\text{Volume}}{\text{Mass}}$
4. ____ Which of the following statements about the mass of an object is correct?
A Mass changes with location.
B Mass remains constant.
C Mass changes with altitude.
D Mass changes with gravity.

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

5. _____ The SI unit of mass is the cubic meter.
6. _____ One liter is equal to 100 milliliters.
7. _____ An object's weight is less on the moon than on Earth. On the moon, the object's mass decreases.
8. _____ An object that floats in water has a density less than 1 g/mL.
9. _____ Four measurable properties of matter are mass, weight, volume, and pressure.
10. _____ The SI unit of volume is the kilogram.

Lesson Quiz