

## 9.5 Reading Scientific Notation

**Essential Question** How can you read numbers that are written in scientific notation?

### 1 ACTIVITY: Very Large Numbers

**Work with a partner.**

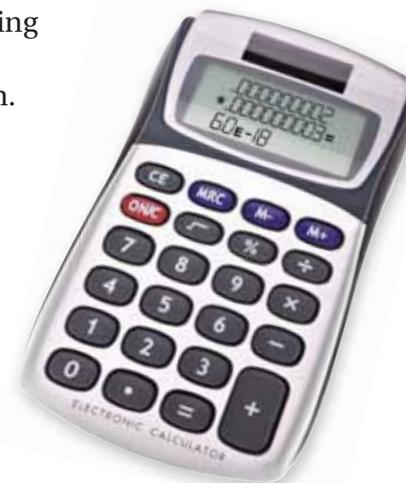
- Use a calculator. Experiment with multiplying large numbers until your calculator gives an answer that is *not* in standard form.
- When the calculator at the right was used to multiply 2 billion by 3 billion, it listed the result as  
 $6.0E+18$ .
- Multiply 2 billion by 3 billion by hand. Use the result to explain what  $6.0E+18$  means.
- Check your explanation using products of other large numbers.
- Why didn't the calculator show the answer in standard form?
- Experiment to find the maximum number of digits your calculator displays. For instance, if you multiply 1000 by 1000 and your calculator shows 1,000,000, then it can display 7 digits.



### 2 ACTIVITY: Very Small Numbers

**Work with a partner.**

- Use a calculator. Experiment with multiplying very small numbers until your calculator gives an answer that is *not* in standard form.
- When the calculator at the right was used to multiply 2 billionths by 3 billionths, it listed the result as  
 $6.0E-18$ .
- Multiply 2 billionths by 3 billionths by hand. Use the result to explain what  $6.0E-18$  means.
- Check your explanation using products of other very small numbers.



### 3 ACTIVITY: Reading Scientific Notation

Work with a partner.

Each description gives an example of a number written in **scientific notation**. Answer the question in the description. Write your answer in standard form.

- a. Nearly  $1.0 \times 10^5$  dust mites can live in 1 square yard of carpet.  
How many dust mites can live in 100 square yards of carpet?



- b. A micron is about  $4.0 \times 10^{-5}$  inch. The length of a dust mite is 250 microns.  
How long is a dust mite in inches?

- c. About  $1.0 \times 10^{15}$  bacteria live in a human body.  
How many bacteria are living in the humans in your classroom?



- d. A micron is about  $4.0 \times 10^{-5}$  inch. The length of a bacterium is about 0.5 micron.  
How many bacteria could lie end-to-end on your finger?

- e. Earth has only about  $1.5 \times 10^8$  kilograms of gold. Earth has a mass of  $6.0 \times 10^{24}$  kilograms.  
What percent of Earth's mass is gold?



- f. A gram is about 0.035 ounce. An atom of gold weighs about  $3.3 \times 10^{-22}$  gram.  
How many atoms are in an ounce of gold?

## What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you read numbers that are written in scientific notation? Why do you think this type of notation is called “scientific notation?” Why is scientific notation important?

### Practice

Use what you learned about reading scientific notation to complete Exercises 3–5 on page 380.

**Key Vocabulary**

scientific notation,  
p. 378

**Study Tip**

Scientific notation is used to write very small and very large numbers.

**Key Idea****Scientific Notation**

A number is written in **scientific notation** when it is represented as the product of a factor and a power of 10. The factor must be at least 1 and less than 10.

The factor is at least 1 and less than 10.

$$8.3 \times 10^{-7}$$

The power of 10 has an integer exponent.

**EXAMPLE 1** Identifying Numbers Written in Scientific Notation

Tell whether the number is written in scientific notation. Explain.

a.  $5.9 \times 10^{-6}$

- The factor is at least 1 and less than 10. The power of 10 has an integer exponent. So, the number is written in scientific notation.

b.  $0.9 \times 10^8$

- The factor is less than 1. So, the number is not written in scientific notation.

**Key Idea****Writing Numbers in Standard Form**

When writing a number from scientific notation to standard form, the absolute value of the exponent tells you how many places to move the decimal point.

- If the exponent is **negative**, move the decimal point to the **left**.
- If the exponent is **positive**, move the decimal point to the **right**.

**EXAMPLE 2** Writing Numbers in Standard Form

a. Write  $3.22 \times 10^{-4}$  in standard form.

$$3.22 \times 10^{-4} = 0.000322$$

4

Move decimal point  $|-4| = 4$  places to the left.

b. Write  $7.9 \times 10^5$  in standard form.

$$7.9 \times 10^5 = 790,000$$

5

Move decimal point  $|5| = 5$  places to the right.

## On Your Own

Now You're Ready  
Exercises 6–23

1. Is  $12 \times 10^4$  written in scientific notation? Explain.

Write the number in standard form.

2.  $6 \times 10^7$

3.  $9.9 \times 10^{-5}$

4.  $1.285 \times 10^4$

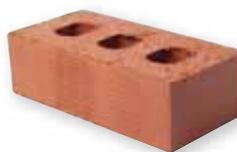
## EXAMPLE 3 Comparing Numbers in Scientific Notation

An object with a lesser density than water will float. An object with a greater density than water will sink. Use each given density (in kilograms per cubic meter) to explain what happens when you place a brick and an apple in water.

Water:  $1.0 \times 10^3$

Brick:  $1.84 \times 10^3$

Apple:  $6.41 \times 10^2$



Write each density in standard form.

Water

$$1.0 \times 10^3 = 1000$$

Brick

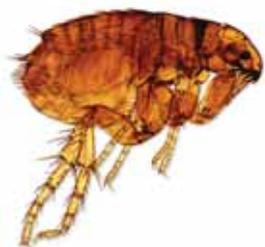
$$1.84 \times 10^3 = 1840$$

Apple

$$6.41 \times 10^2 = 641$$

- ∴ The apple is less dense than water, so it will float. The brick is denser than water, so it will sink.

## EXAMPLE 4 Real-Life Application



A female flea consumes about  $1.4 \times 10^{-5}$  liter of blood per day.

A dog has 100 female fleas. How many milliliters of blood do the fleas consume per day?

$$\begin{aligned} 1.4 \times 10^{-5} \cdot 100 &= 0.000014 \cdot 100 \\ &= 0.0014 \end{aligned}$$

Write in standard form.

Multiply.

- ∴ The fleas consume about 0.0014 liter, or 1.4 milliliters of blood per day.

## On Your Own

5. **WHAT IF?** In Example 3, the density of lead is  $1.14 \times 10^4$  kilograms per cubic meter. What happens when lead is placed in water?
6. **WHAT IF?** In Example 4, a dog has 75 female fleas. How many milliliters of blood do the fleas consume per day?

Now You're Ready  
Exercise 27



## Vocabulary and Concept Check

- WRITING** Describe the difference between scientific notation and standard form.
- WHICH ONE DOESN'T BELONG?** Which number does *not* belong with the other three? Explain.

$$2.8 \times 10^{15}$$

$$4.3 \times 10^{-30}$$

$$1.05 \times 10^{28}$$

$$10 \times 9.2^{-13}$$



## Practice and Problem Solving

Write your answer in standard form.

- A micrometer is  $1.0 \times 10^{-6}$  meter. How long is 150 micrometers in meters?
- An acre is about  $4.05 \times 10^7$  square centimeters. How many square centimeters are in 4 acres?
- A cubic millimeter is about  $6.1 \times 10^{-5}$  cubic inches. How many cubic millimeters are in 1.22 cubic inches?

Tell whether the number is written in scientific notation. Explain.

- |                             |                            |                            |
|-----------------------------|----------------------------|----------------------------|
| 1 6. $1.8 \times 10^9$      | 7. $3.45 \times 10^{14}$   | 8. $0.26 \times 10^{-25}$  |
| 9. $10.5 \times 10^{12}$    | 10. $46 \times 10^{-17}$   | 11. $5 \times 10^{-19}$    |
| 12. $7.814 \times 10^{-36}$ | 13. $0.999 \times 10^{42}$ | 14. $6.022 \times 10^{23}$ |

Write the number in standard form.

- |                          |                           |                         |
|--------------------------|---------------------------|-------------------------|
| 2 15. $7 \times 10^7$    | 16. $8 \times 10^{-3}$    | 17. $5 \times 10^2$     |
| 18. $2.7 \times 10^{-4}$ | 19. $4.4 \times 10^{-5}$  | 20. $2.1 \times 10^3$   |
| 21. $1.66 \times 10^9$   | 22. $3.85 \times 10^{-8}$ | 23. $9.725 \times 10^6$ |

24. **ERROR ANALYSIS** Describe and correct the error in writing the number in standard form.



$$4.1 \times 10^{-6} = 4100000$$



$2.7 \times 10^8$  platelets per milliliter

25. **PLATELETS** Platelets are cell-like particles in the blood that help form blood clots.
- How many platelets are in 3 milliliters of blood? Write your answer in standard form.
  - An adult body contains about 5 liters of blood. How many platelets are in an adult body?

26. **REASONING** A googol is  $1.0 \times 10^{100}$ . How many zeros are in a googol?

27. **STARS** The table shows the surface temperatures of five stars.

- Which star has the highest surface temperature?
- Which star has the lowest surface temperature?

Star	Betelgeuse	Bellatrix	Sun	Aldebaran	Rigel
Surface Temperature (°F)	$6.2 \times 10^3$	$3.8 \times 10^4$	$1.1 \times 10^4$	$7.2 \times 10^3$	$2.2 \times 10^4$



28. **CORAL REEF** The area of the Florida Keys National Marine Sanctuary is about  $9.6 \times 10^3$  square kilometers. The area of the Florida Reef Tract is about 16.2% of the area of the sanctuary. What is the area of the Florida Reef Tract in square kilometers?

29. **REASONING** A gigameter is  $1.0 \times 10^6$  kilometers. How many square kilometers are in 5 square gigameters?

30. **WATER** There are about  $1.4 \times 10^9$  cubic kilometers of water on Earth. About 2.5% of the water is fresh water. How much fresh water is on Earth?

31. **Critical Thinking** The table shows the speed of light through five media.

- In which medium does light travel the fastest?
- In which medium does light travel the slowest?

Medium	Speed
Air	$6.7 \times 10^8$ mi/h
Glass	$6.6 \times 10^8$ ft/sec
Ice	$2.3 \times 10^5$ km/sec
Vacuum	$3.0 \times 10^8$ m/sec
Water	$2.3 \times 10^{10}$ cm/sec



## Fair Game Review What you learned in previous grades & lessons

Simplify. Write the expression using only positive exponents.

32.  $6^3 \cdot 6^5$

33.  $10^2 \cdot 10^5$

34.  $8^{-1} \cdot 8^{-11}$

35.  $10^{-6} \cdot 10^{-10}$

36. **MULTIPLE CHOICE** What is the length of the hypotenuse of the right triangle?

(A)  $\sqrt{18}$  in.

(B)  $\sqrt{41}$  in.

(C) 18 in.

(D) 41 in.

