

# Scientific Notation

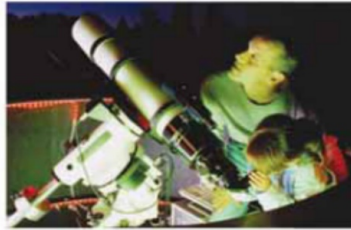
## What You'll Learn

To write numbers in both scientific notation and standard form

■ **New Vocabulary** scientific notation

## Why Learn This?

Some numbers are so large that they are difficult to write. You can use scientific notation to express large numbers, such as distances and speeds in space. Scientists use scientific notation to calculate with large numbers.



### Powers of 10

Exponential Form	$10^1$	$10^2$	$10^3$	$10^4$	$10^5$	$10^6$
Number of Zeros in Standard Form	1	2	3	4	5	6
Standard Form	10	100	1,000	10,000	100,000	1,000,000

When you multiply a factor by a power of 10, you can find the product by moving the decimal point in the factor to the right. The exponent tells you how many places to move the decimal point. When you divide by a power of 10, you move the decimal point to the left.

**Copy this in your notes**

### Multiplying and Dividing by Powers of 10

Standard Form	$3.5 \div 100$	$3.5 \div 10$	$3.5 \times 10$	$3.5 \times 100$	$3.5 \times 1,000$
Exponential Form	$3.5 \div 10^2$	$3.5 \div 10^1$	$3.5 \times 10^1$	$3.5 \times 10^2$	$3.5 \times 10^3$
Number	0.035	0.35	35	350	3,500

*Scientific notation* is a shorter way to write numbers using powers of 10.

### KEY CONCEPTS Scientific Notation

A number in **scientific notation** is written as the product of two factors, one greater than or equal to 1 and less than 10, and the other a power of 10.

$$7,500,000,000,000 = 7.5 \times 10^{12}$$

### EXAMPLE Writing in Scientific Notation

- 1 Science** The moon orbits Earth at a distance of 384,000 km. Write this number in scientific notation.

3.84000. ← Move the decimal point to get a factor greater than 1 but less than 10.

384,000 =  $3.84 \times 100,000$  ← Write as a product of 2 factors.

=  $3.84 \times 10^5$  ← Write 100,000 as a power of 10.



The moon orbits Earth at a distance of  $3.84 \times 10^5$  km.

**1 EXAMPLE** The mean distance from Mars to the sun is about 141,750,000 mi. Write this number in scientific notation.

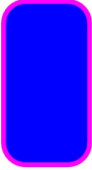
1. 41,750,000. ← Move the decimal point to get a factor greater than 1 but less than 10.

141,750,000 = 1.4175 × 100,000,000 ← Write as a product of 2 factors.

= 1.4175 × 10<sup>8</sup> ← Write 100,000,000 as a power of 10.

The mean distance from Mars to the sun is about 1.4175 × 10<sup>8</sup> mi.

### *Table talk about this question*

- 
1. NASA's Hubble Telescope took pictures of a supernova that is 169,000 light years away. Write this number in scientific notation.
    - A.  $1.69 \times 10^5$
    - B.  $16.9 \times 10^4$
    - C.  $.169 \times 10^5$
    - D.  $169 \times 10^3$

You can change expressions from scientific notation to standard form by simplifying the product of the two factors.

### **EXAMPLE** Writing in Standard Form


**2 Science** The mean distance from the sun to Mars is approximately  $2.3 \times 10^8$  km. Write this number in standard form.

#### **Method 1**

$$\begin{aligned} 2.3 \times 10^8 &= 2.3 \times 100,000,000 && \leftarrow \text{Write as a product of 2 factors.} \\ &= 230,000,000 && \leftarrow \text{Multiply the factors.} \end{aligned}$$

#### **Method 2**

$$\begin{aligned} 2.3 \times 10^8 &= 2.3\underbrace{0000000} && \leftarrow \text{The exponent is 8. Move the decimal} \\ & && \text{8 places to the right.} \\ &= 230,000,000 \end{aligned}$$

 The mean distance is approximately 230,000,000 km.

**2 EXAMPLE** Light from the sun reaches Earth in about  $4.99012 \times 10^2$  s. Write this time in standard form.

#### **Method 1**

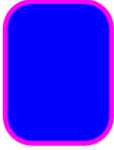
$$\begin{aligned} 4.99012 \times 10^2 &= 4.99012 \times 100 && \leftarrow \text{Write as a product of 2 factors.} \\ &= 499.012 && \leftarrow \text{Multiply the factors.} \end{aligned}$$

#### **Method 2**

$$\begin{aligned} 4.99012 \times 10^2 &= 4.\underline{99}012 && \leftarrow \text{The exponent is 2. Move the} \\ & && \text{decimal 2 places to the right.} \\ &= 499.012 \end{aligned}$$

The time is about 499.012 s.

*Table talk about this question.*



1. A large telescope gathers about  $6.4 \times 10^5$  times the amount of light your eye receives. Write this number in standard form.
  - A. 6,400,000
  - B. 640
  - C. 640,000
  - D. 0.000064

*Grab a clicker now and log in. The last 5 questions will be taken for a grade.*

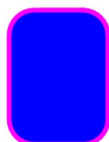


1. A number written in scientific notation is written as a product of two factors, one less than or equal to one and one less than 10.
  - A. True
  - B. False



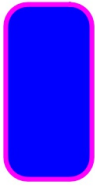
2. Is  $107 \times 10^4$  written in scientific notation?
- A. No; 107 is not less than 10.
  - B. Yes; 107 is a power of 10.
  - C. No; 107 is not less than 1
  - D. Yes;  $10^4$  is a power of 10.

**Match the equivalent numbers.**



5.  $3.96 \times 10^6$
- A. 39,600,000
  - B. 0.00000396
  - C. 396,000
  - D. 3,960,000

**Match the equivalent numbers.**



6.  $3.96 \times 10^7$
- A. 3,960,000
  - B. 396,000
  - C. 39,600,000
  - D. 0.000000396

**Match the equivalent numbers.**



7.  $3.96 \times 10^5$
- A. 39,600,000
  - B. 396,000
  - C. 3,960,000
  - D. 0.0000396

# Power down your clickers and begin work on your assignment worksheet.

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

## Reteaching 2-8

### Scientific Notation

**Scientific notation** is an efficient way to write very large numbers. A number is written as the product of a number between 1 and 10 and a power of 10.

Write 4,000,000,000 in scientific notation.

- ① Count the number of places that you need to move the decimal point to the left to get a factor between 1 and 10.

$$\begin{array}{c} 4,000,000,000 \rightarrow 4,000,000,000 \\ \text{9 places} \end{array}$$

- ② Use the number of places as the exponent of 10.

$$4,000,000,000 = 4 \times 10^9$$

To change a number from scientific notation to standard form, undo the steps at the left.

Write  $3.5 \times 10^8$  in standard form.

- ① Note the exponent of 10. (Here it is 8.)  
 ② Move the decimal point to the right the number of places that is equal to the exponent.

$$\begin{array}{c} 3.5 \times 10^8 \rightarrow 350,000,000 \\ \text{8 places} \end{array}$$

$$3.5 \times 10^8 = 350,000,000$$

### Write in scientific notation.

1. 3,500

Move the decimal point \_\_\_\_\_ places to the \_\_\_\_\_.

$$3,500 = \underline{\quad} \times \underline{\quad}$$

3. 93,000,000 \_\_\_\_\_

5. 17,000 \_\_\_\_\_

7. 560,000,000,000 \_\_\_\_\_

2. 1,400,000

Move the decimal point \_\_\_\_\_ places to the \_\_\_\_\_.

$$1,400,000 = \underline{\quad} \times \underline{\quad}$$

4. 1,200,000 \_\_\_\_\_

6. 750,000 \_\_\_\_\_

8. 34,800,000 \_\_\_\_\_

### Write in standard form.

9.  $2.58 \times 10^3$  \_\_\_\_\_

11.  $4.816 \times 10^5$  \_\_\_\_\_

13.  $8.003 \times 10^1$  \_\_\_\_\_

15.  $4.23 \times 10^2$  \_\_\_\_\_

10.  $8 \times 10^6$  \_\_\_\_\_

12.  $8.11 \times 10^2$  \_\_\_\_\_

14.  $5.66 \times 10^9$  \_\_\_\_\_

16.  $9.992 \times 10^{10}$  \_\_\_\_\_

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