

## 6-5

# Dividing with Scientific Notation

## Check Skills You'll Need

1. A number in *scientific notation* has the first factor greater than or equal to \_\_\_ and less than \_\_\_, and the second factor a power of 10.

Write each expression in scientific notation.

- 14,500,000
- 0.034
- 511
- 0.0004

**GO for Help**  
Lesson 6-1

## What You'll Learn

To divide and compare numbers written in scientific notation.

## Why Learn This?

Earth's mass is almost  $6 \times 10^{24}$  kg, and the mass of Jupiter is almost  $2 \times 10^{27}$  kg. You can divide the mass of Jupiter by the mass of Earth to find how many times greater Jupiter's mass is than Earth's. The rule for dividing powers with the same base applies to dividing numbers in scientific notation.



## EXAMPLE Dividing Numbers in Scientific Notation

- 1 Simplify  $(6.5 \times 10^6) \div (7.3 \times 10^2)$ . Write the quotient in scientific notation.

$$(6.5 \times 10^6) \div (7.3 \times 10^2) = \frac{6.5 \times 10^6}{7.3 \times 10^2}$$

← Write a fraction.

$$= \frac{6.5}{7.3} \times \frac{10^6}{10^2}$$

← Separate the coefficients and the powers of ten.

$$\approx 0.89 \times \frac{10^6}{10^2}$$

← Divide the coefficients.

$$= 0.89 \times 10^4$$

← Subtract the exponents.

$$= 8.9 \times 10^{-1} \times 10^4$$

← Write 0.89 in scientific notation.

$$= 8.9 \times 10^3$$

← Add the exponents.

## Quick Check

1. Simplify. Write each quotient in scientific notation.

a.  $\frac{7.9 \times 10^5}{2.3 \times 10^3}$

b.  $\frac{4.8 \times 10^4}{2.95 \times 10^6}$

c.  $\frac{3.7 \times 10^7}{5.2 \times 10^2}$

**CONTENT STANDARDS**  
8.EE.3, 8.EE.4

**GO for Help**

For help with scientific notation, go to Lesson 6-1, Example 1.

## EXAMPLE Application: Astronomy

- 2 **Gridded Response** The distance between the sun and a comet is about  $2.79 \times 10^8$  miles. Light travels about  $1.1 \times 10^7$  miles per minute. Use the formula  $\text{time} = \frac{\text{distance}}{\text{speed}}$  to estimate how many minutes sunlight takes to reach the comet. Write your answer in standard form and round to the nearest tenth.

$$\begin{aligned} \text{time} &= \frac{\text{distance}}{\text{speed}} && \leftarrow \text{Use the formula for time.} \\ &= \frac{2.79}{1.1} \times \frac{10^8}{10^7} && \leftarrow \text{Substitute. Write as a product of quotients.} \\ &= \frac{2.79}{1.1} \times 10^1 && \leftarrow \text{Subtract exponents.} \\ &\approx 2.54 \times 10^1 && \leftarrow \text{Divide.} \end{aligned}$$

2	5	.	4
.	.	.	.
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Sunlight takes about  $2.54 \times 10^1$  minutes, or 25.4 minutes, to reach the comet.

### Quick Check

2. **Astronomy** The distance between the sun and Earth is about  $9.3 \times 10^7$  miles. Light travels about  $1.1 \times 10^7$  miles per minute. Estimate how long sunlight takes to reach Earth. Write your answer in standard form and round to the nearest tenth.

The rule for dividing numbers in scientific notation applies when one of the numbers is in standard form.

## EXAMPLE Dividing by Numbers in Standard Form

- 3 Divide. Write each quotient in scientific notation.

a.  $(-7.1 \times 10^3) \div 6.3 = \frac{-7.1 \times 10^3}{6.3} \leftarrow \text{Write as a fraction.}$

$$= \frac{-7.1}{6.3} \times 10^3 \leftarrow \text{Write as a product of quotients and a power of 10.}$$

$$\approx -1.1 \times 10^3 \leftarrow \text{Divide.}$$

b.  $4.2 \div (5.5 \times 10^9) = \frac{4.2}{5.5 \times 10^9} \leftarrow \text{Write as a fraction.}$

$$= \frac{4.2}{5.5} \times 10^{-9} \leftarrow \text{Write as a product of quotients and a power of 10.}$$

$$\approx 0.76 \times 10^{-9} \leftarrow \text{Divide.}$$

$$= 7.6 \times 10^{-1} \times 10^{-9} \leftarrow \text{Write 0.76 in scientific notation.}$$

$$= 7.6 \times 10^{-10} \leftarrow \text{Add the exponents.}$$

### Quick Check

3. Divide. Write each quotient in scientific notation.

a.  $\frac{6.2 \times 10^6}{4.1}$

b.  $\frac{-3.5 \times 10^3}{5}$

c.  $\frac{17}{1.4 \times 10^8}$

**EXAMPLE****Ordering Numbers****Vocabulary Tip**

Remember that *ordering* can mean placing values in order from least to greatest or from greatest to least. Be sure to read the question carefully to determine which you need to do.

- 4 Order  $6.2 \times 10^{-4}$ ,  $6.2 \times 10^4$ ,  $7.5 \times 10^4$  and  $6.5 \times 10^3$  from least to greatest.

$$6.2 \times 10^{-4}, 6.5 \times 10^3, 7.5 \times 10^4, 6.2 \times 10^4 \leftarrow \text{Order the numbers from least to greatest power of 10.}$$

$$6.2 \times 10^{-4}, 6.5 \times 10^3, 6.2 \times 10^4, 7.5 \times 10^4 \leftarrow \text{Order the numbers with the same power of 10 from least to greatest using the first factor.}$$

**Quick Check**

4. Order the numbers from least to greatest.

a.  $3 \times 10^6$ ,  $3.11 \times 10^5$ ,  $3 \times 10^{-6}$ ,  $3.8 \times 10^{-5}$

b.  $1.8 \times 10^{-2}$ ,  $1.5 \times 10^3$ ,  $1.5 \times 10^4$ ,  $1.7 \times 10^{-2}$

You can use division to find how many times greater one number is than another. Write a fraction with the greater number as the numerator and the lesser number as the denominator. Then divide and simplify.

**EXAMPLE****Comparing Numbers in Scientific Notation**

- 5 Estimate how many times greater  $4 \times 10^9$  is than  $9 \times 10^7$ .

Write a fraction with the greater number as the numerator. Then divide.

$$\frac{4 \times 10^9}{9 \times 10^7} = \frac{4}{9} \times \frac{10^9}{10^7} \leftarrow \text{Write as a product of quotients.}$$

$$\approx 0.44 \times 10^2 \leftarrow \text{Divide the coefficients, and divide the powers of ten.}$$

$$= 4.4 \times 10^{-1} \times 10^2 \leftarrow \text{Write 0.44 in scientific notation.}$$

$$= 4.4 \times 10^1 \leftarrow \text{Add exponents.}$$

$$= 44 \leftarrow \text{Simplify.}$$

So  $4 \times 10^9$  is about 44 times greater than  $9 \times 10^7$ .

**Quick Check**

5. Estimate how many times greater  $5.5 \times 10^{18}$  is than  $8 \times 10^{17}$ . Round to the nearest tenth.

## Check Your Understanding

Fill in the blank.

1.  $\frac{9 \times 10^5}{\square \times 10^5} = 3$

2.  $\frac{8 \times 10^{-3}}{4 \times 10^{\square}} = 2$

3.  $\frac{2.5 \times 10^{\square}}{2.5 \times 10^5} = 100$

Which number is greater?

4.  $9 \times 10^3$  or  $9.01 \times 10^4$     5.  $8 \times 10^7$  or  $6 \times 10^8$     6.  $2.1 \times 10^{-3}$  or  $1.2 \times 10^{-4}$

7. **Reasoning** If you divide a number in scientific notation by 3, why do you only divide the first factor by 3?

8. **Mental Math** How many times greater is  $8 \times 10^3$  than 4?

## Homework Exercises

For more exercises, see Extra Skills and Word Problems.

### GO for Help

For Exercises	See Examples
9-12	1-3
13-15	4
16-17	5

Divide. Write each quotient in scientific notation.

9.  $\frac{2.1 \times 10^3}{0.5 \times 10^2}$

10.  $\frac{8.5 \times 10^3}{6.1 \times 10^5}$

11.  $\frac{3.9 \times 10^{-3}}{3}$

12.  $\frac{4}{2 \times 10^9}$

Which number in each pair is greater?

13.  $2 \times 10^4$  or  $2.1 \times 10^3$     14.  $8 \times 10^{-3}$  or  $4 \times 10^2$     15.  $6.2 \times 10^7$  or  $5.8 \times 10^7$

Estimate how many times greater the first number is than the second number.

16.  $8 \times 10^{12}$ ,  $4 \times 10^{10}$

17.  $2 \times 10^6$ ,  $4 \times 10^3$

### GPS

18. **Guided Problem Solving** China has about  $1.3 \times 10^9$  people. One of the world's smallest nations, the Marshall Islands, has a population of just  $5.9 \times 10^4$  people. How many times greater is China's population than the Marshall Islands' population?

- **Make a Plan** Write a ratio comparing China's population to the Marshall Islands' population.
- **Carry Out the Plan** Divide and write the quotient in scientific notation. Simplify.

19. The sun's diameter is  $1.39 \times 10^6$  kilometers. Earth's diameter is  $1.28 \times 10^4$  kilometers. How many times greater is the sun's diameter than Earth's diameter?

Divide. Write each quotient in scientific notation.

20.  $\frac{1.9 \times 10^{-1}}{9.8 \times 10^7}$

21.  $\frac{4.4 \times 10^{11}}{9 \times 10^2}$

22.  $\frac{7 \times 10^3}{5.1 \times 10^{-4}}$



Estimate how many times the first number is than the second number. Round to the nearest integer.

23.  $-1.8 \times 10^5, -3.5 \times 10^3$

24.  $8 \times 10^{-6}, 9 \times 10^{-8}$

25. **Speed of Sound** At sea level, the speed of sound is about 761 miles per hour, or  $\frac{4.02 \times 10^6 \text{ feet}}{3.6 \times 10^3 \text{ seconds}}$ . What is this speed in feet per second? Write your answer in scientific notation.

**Writing in Math** Is each statement *true* or *false*? Explain your reasoning.

26.  $1.3 \times 10^{-5} > 1.3 \times 10^{-3}$

27.  $2.8 \times 10^5 > 1.6 \times 10^4$

28. **Space Travel** The space probe *Pioneer 10* was  $12.1 \times 10^9$  km from Earth in 2002. Its radio signal traveled at  $3.0 \times 10^5$  km/s. How many hours did its signal take to reach Earth?

29. **Challenge** According to the U.S. Treasury, the United States had a federal debt of  $1.58 \times 10^{13}$  dollars in 2012. This is approximately \$50,450 of debt per U.S. citizen. Based on this information, approximately how many U.S. citizens were there in the year 2012? Write your answer in scientific notation.

**Careers** Test pilots often fly airplanes faster than the speed of sound. When they fly near the speed of sound, a cloud of condensation may form because of a rapid drop in air pressure and temperature.



## Test Prep and Mixed Review

Practice

### Multiple Choice

30. The distance from the sun to Saturn is about  $8.88 \times 10^8$  miles. The speed of light is about  $1.1 \times 10^7$  miles per minute. Which is the best estimate for the number of seconds it takes for sunlight to reach Saturn. Use the formula  $\text{time} = \frac{\text{distance}}{\text{speed}}$ .

(A)  $8.07 \times 10^3$    (B)  $8.07 \times 10$    (C)  $4.84 \times 10^3$    (D)  $4.84 \times 10^2$

31. According to the graph, which system of equations has no solution?

(F)  $y = 3x + 4$

$y = x + 1$

(G)  $y = x + 1$

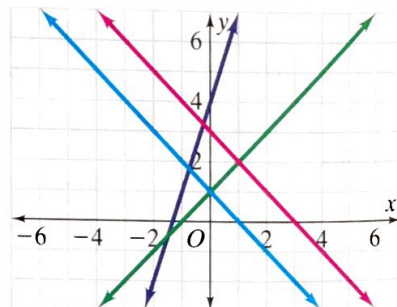
$y = -x + 3$

(H)  $y = -x + 1$

$y = -x + 3$

(J)  $y = -x + 1$

$y = x + 1$



Write each decimal as a mixed number or fraction in simplest form.

32. 1.5

33. 1.125

34. 0.004

35. -6.14

### GO for Help

For Exercises

See Lesson

32-35

1-1