



Lesson 4-5

Compute with Scientific Notation



Interactive Study Guide

See page 83–84 for:

- Getting Started
- Vocabulary Start-up
- Real-World Link



Essential Question

Why is it useful to write numbers in different ways?



Common Core State Standards

Content Standards
8.EE.1, 8.EE.3, 8.EE.4

Mathematical Practices
1, 3, 4, 5, 7

What You'll Learn

- Multiply and divide numbers in scientific notation.
- Add and subtract numbers in scientific notation.



Real-World Link

Aircraft The SR-71 Blackbird is one of the world's fastest airplanes. It is capable of traveling at a cruising speed of Mach 3, or three times the speed of sound. The speed of sound is approximately 760 miles per hour.



Multiplication and Division with Scientific Notation

You can apply the Product of Powers and Quotient of Powers properties to multiply and divide numbers written in scientific notation.



Example 1



STEM Scientists estimate that there are over 3.5×10^6 ants per acre in the Amazon rain forest. If the Amazon rain forest covers approximately 1 billion acres, find the total number of ants. Write in scientific notation.

Step 1 Write the number of acres in scientific notation.

$$1 \text{ billion} = 1 \times 10^9$$

Step 2 Multiply the number of ants per acre by the number of acres to find the total number of ants.

$$\begin{aligned} (3.5 \times 10^6) \times (1 \times 10^9) &= (3.5 \times 1) \times (10^6 \times 10^9) \\ &= (3.5) \times (10^6 \times 10^9) \\ &= 3.5 \times 10^{6+9} \\ &= 3.5 \times 10^{15} \end{aligned}$$

Commutative and Associative Properties

Multiply 3.5 by 1

Product of Powers

Add the exponents.

(a.) $4.62 \times 8.15 \times 10^5 \times 10^9$
 37.653×10^{14}
 3.7653×10^{15}

$7.53 \times 2.93 \times 10^{-8} \times 10^{-3}$
 22.0629×10^{-11}

So, there are about 3.5×10^{15} ants in the Amazon rain forest.

0.00000000220629
 2.20629×10^{-10}

Got It? Do these problems to find out.

Evaluate each expression. Express the result in scientific notation.

1a. $(4.62 \times 10^5)(8.15 \times 10^9)$

1b. $(7.53 \times 10^{-8})(2.93 \times 10^{-3})$

1c. $(1.2 \times 10^7)(1500)$

1d. $(6.4 \times 10^{-5})(12,000)$

1c. $(1.2 \times 10^7)(1500)$
 $(1.2 \times 10^7)(1.5 \times 10^3)$
 1.8×10^{10}

1d. $(6.4 \times 10^{-5})(12,000)$
 $(6.4 \times 10^{-5})(1.2 \times 10^4)$
 7.68×10^{-1}



Example 2

Evaluate $\frac{7.56 \times 10^8}{3.15 \times 10^3}$. Express the result in scientific notation.

$$\begin{aligned} \frac{7.56 \times 10^8}{3.15 \times 10^3} &= \left(\frac{7.56}{3.15}\right)\left(\frac{10^8}{10^3}\right) \\ &= 2.4 \left(\frac{10^8}{10^3}\right) \\ &= 2.4 \times 10^{8-3} \\ &= 2.4 \times 10^5 \end{aligned}$$

Associative Property

Divide 7.56 by 3.15.

Quotient of Powers

Subtract the exponents.

$$\begin{aligned} \frac{2^5}{2^3} &= \frac{\boxed{2} \cdot \boxed{2} \cdot \boxed{2} \cdot 2 \cdot 2}{\boxed{2} \cdot \boxed{2} \cdot \boxed{2}} = 2^2 \\ 2^{5-3} &= 2^2 \end{aligned}$$

2a. $\frac{4.62 \times 10^5}{1.4 \times 10^{-9}}$

$$\frac{4.62}{1.4} \times \frac{10^5}{10^{-9}}$$

$$3.3 \times 10^{5-(-9)}$$

$$3.3 \times 10^{14}$$

$$4.62 \times 10^5 < 3.3 \times 10^{14}$$

\$462000

$$2 \div 4 = 0.5$$

$$2 \div 2 = 1$$

$$2 \div 0.5 = 4$$

$$2 \div 0.25 = 8$$

$$2 \div 0.125 = 16$$

Decimal Point

Since 0.4×10^1 is not written in scientific notation, move the decimal point 1 place to the right and subtract one from the exponent.

Got It? Do these problems to find out.

Evaluate each expression. Express the result in scientific notation.

2a. $\frac{4.62 \times 10^5}{1.4 \times 10^{-9}}$

2b. $\frac{2.5627 \times 10^{-9}}{5.23 \times 10^{-3}}$

330,000,000,000,000



Example 3

In 2010, the population of China was about 1.3×10^9 . According to census data, the population of the United States was 308,745,538. About how many times greater was the population of China than the population of the United States in 2010?

Estimate the population of the United States and write in scientific notation.

$$308,745,538 \approx 300,000,000 \text{ or } 3 \times 10^8$$

Find $\frac{1.3 \times 10^9}{3 \times 10^8}$.

$$\frac{1.3 \times 10^9}{3 \times 10^8} = \left(\frac{1.3}{3}\right)\left(\frac{10^9}{10^8}\right)$$

Associative Property

$$\approx 0.4 \times \left(\frac{10^9}{10^8}\right)$$

Divide 1.3 by 3. Round to the nearest tenth.

$$\approx 0.4 \times 10^{9-8}$$

Quotient of Powers

$$\approx 0.4 \times 10^1$$

Subtract the exponents.

$$\approx 4 \times 10^0$$

Write in scientific notation.

So, the population of China was about 4 times greater than the population of the United States in 2010.



Got It? Do this problem to find out.

- Until 2008, the world's largest working cattle ranch was located in Australia. It was about 6×10^6 acres. The largest ranch in the United States is 825,000 acres. About how many times larger was the ranch in Australia than the largest ranch in the United States?



Addition and Subtraction with Scientific Notation

When adding or subtracting decimals in standard form, you line up the place values. When adding or subtracting in scientific notation, the place value is represented by the exponent. Each exponent must have the same value in order to add or subtract.



Example 4

Evaluate each expression. Express the result in scientific notation.

a. $(5.45 \times 10^3) + (3.12 \times 10^4)$

$$(5.45 \times 10^3) + (3.12 \times 10^4)$$

$$= (5.45 \times 10^3) + (31.2 \times 10^3)$$

$$= (5.45 + 31.2) \times 10^3$$

$$= 36.65 \times 10^3$$

$$= 3.665 \times 10^4$$

Write 3.12×10^4 as 31.2×10^3 .

Distributive Property

Add 5.45 and 31.2.

Write 36.65×10^3 in scientific notation.

b. $(2.78 \times 10^5) - (46,500)$

$$(2.78 \times 10^5) - (46,500)$$

$$= (2.78 \times 10^5) - (4.65 \times 10^4)$$

$$= (27.8 \times 10^4) - (4.65 \times 10^4)$$

$$= (27.8 - 4.65) \times 10^4$$

$$= 23.15 \times 10^4$$

$$= 2.315 \times 10^5$$

Write 46,500 in scientific notation.

Write 2.78×10^5 as 27.8×10^4 .

Distributive Property

Subtract 4.65 from 27.8.

Write 23.15×10^4 in scientific notation.

Got It? Do these problems to find out.

4a. $(1.7 \times 10^7) + (6.25 \times 10^5)$

4b. $0.00864 + (5.67 \times 10^{-4})$

4c. $(2.84 \times 10^{11}) - (5.4 \times 10^9)$

4d. $0.0000321 - (4.9 \times 10^{-7})$



Guided Practice



1. About 1×10^6 fruit flies weigh 1.3×10^2 pounds. How much does one fruit fly weigh? Write in scientific notation. (Example 1)

Evaluate each expression. Express the result in scientific notation. (Examples 2 and 4)

2. $(1.217 \times 10^5) - (5.25 \times 10^4)$

3. $(2.003 \times 10^4) + (7.98 \times 10^7)$

4. $\frac{8.25 \times 10^{10}}{2.75 \times 10^4}$

5. $(3.45 \times 10^7) - (24,650,000)$

6. $523 + (6.2 \times 10^3)$

7. $\frac{9.02 \times 10^3}{4.1 \times 10^5}$



8. The equatorial circumference of Earth is about 4×10^4 kilometers. The equatorial circumference of Jupiter is about 439,263.8 kilometers. About how many times greater is Jupiter's circumference than Earth's? (Example 3)