1-4 Applying Exponents

Warm Up

Problem of the Day

Lesson Presentation

Warm Up

Find each value.

1. 9^2 81

2. 12^2 144

3. 15^2 225

4. 10^2 100

5. 10^3 1,000

6. 10^4 10,000

Problem of the Day

Each day, Lowell runs one more lap than he did the day before. After seven days he has run a total of 77 laps. How many laps did he run on the first day? 8

1-4 Applying Exponents

Learn to express large numbers in scientific notation.

Vocabulary

scientific notation

1-4 Applying Exponents

The distance from Venus to the Sun is over 100,000,000 kilometers. You can write this number as a power of ten by using a base of ten and an exponent.

$$10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 = 10^8$$

Power of ten

The table shows several powers of ten.

Power of 10	Meaning	Value
10^1	10	10
10^2	10 · 10	100
10^3	10 · 10 · 10	1,000
10^4	10 · 10 · 10 · 10	10,000

Additional Example 1A: Multiplying by Powers of Ten

Multiply $14 \cdot 10^3$.

Method 1: Evaluate the power.

$14 \cdot 10^3 = 14 \cdot (10 \cdot 10 \cdot 10)$ *Multiply 10 by itself 3 times.*

$= 14 \cdot 1{,}000$ *Multiply.*

$= 14{,}000$

Additional Example 1B: Multiplying by Powers of Ten

Multiply $14 \cdot 10^3$.

Method 2: Use mental math.

$14 \cdot 10^3 = 14.\mathbf{000}$

3 places

$= 14{,}000$

Move the decimal point 3 places.
(You will need to add 3 zeros.)

Check It Out: Example 1A

Multiply $12 \cdot 10^2$.

Method 1: Evaluate the power.

$12 \cdot 10^2 = 12 \cdot (10 \cdot 10)$ *Multiply 10 by itself 2 times.*

$= 12 \cdot 100$ *Multiply.*

$= 1{,}200$

Check It Out: Example 1B

Multiply $12 \cdot 10^2$.

Method 2: Use mental math.

$12 \cdot 10^2 = 12.\mathbf{00}$

2 places

$= 1{,}200$

Move the decimal point 2 places.
(You will need to add 2 zeros.)

Scientific notation is a kind of shorthand that can be used to write large numbers. Numbers expressed in scientific notation are written as the product of *two factors*. In scientific notation, 17,900,000 is written as

$$1.79 \times 10^{7}$$

A number greater than or equal to 1 but less than 10

A power of 10

Writing Math

In scientific notation, it is customary to use a multiplication cross (×) instead of a dot.

Additional Example 2: Writing Numbers in Scientific Notation

Write the number 4,340,000 in scientific notation.

6 places

$4{,}340{,}000 = 4{,}340{,}000$

Move the decimal point to get a number that is greater than or equal to 1 and less than 10.

$= 4.34 \times 10^6$

The exponent is equal to the number of places the decimal point is moved.

Check It Out: Example 2

Write the number 8,421,000 in scientific notation.

6 places

$8{,}421{,}000 = 8{,}421{,}000$

Move the decimal point to get a number that is greater than or equal to 1 and less than 10.

$= 8.421 \times 10^6$

The exponent is equal to the number of places the decimal point is moved.

Additional Example 3: Writing Numbers in Standard Form

The population of China in the year 2000 was estimated to be about 1.262×10^9. Write this number in standard form.

$$1.262 \times 10^9 = 1.262000000$$

Since the exponent is 9, move the decimal point 9 places to the right.

$$= 1{,}262{,}000{,}000$$

The population of China was about 1,262,000,000 people.

Check It Out: Example 3

The distance from the Earth to the Sun is calculated to be 1.5×10^8 kilometers. Write this distance in standard form.

$1.5 \times 10^8 = 1.50000000$

Since the exponent is 8, move the decimal point 8 places to the right.

$= 150{,}000{,}000$

The distance from the Earth to the Sun is about 150,000,000 kilometers.

Additional Example 4: Comparing Numbers in Scientific Notation

In 2005, the population of Mexico was 1.06×10^8 and the population of Brazil was 1.86×10^8. In which country do more people live?

To compare numbers written in scientific notation, first compare the exponents. If the exponents are equal, then compare the decimal portion of the numbers.

Mexico: 1.06×10^8 Brazil: 1.86×10^8

Notice that $1.06 < 1.86$. So $1.06 \times 10^8 < 1.86 \times 10^8$

Brazil has more people living there.

Check It Out: Additional Example 4

The number of coins in Ty's jar was 0.76×10^4 and number of coins in Laurel's jar was 0.93×10^3. In which jar are there more coins?

To compare numbers written in scientific notation, first compare the exponents. If the exponents are equal, then compare the decimal portion of the numbers.

Ty's jar: 0.76×10^4 Laurel's jar: $.93 \times 10^3$

Notice that $4 > 3$. So $.76 \times 10^4 > .93 \times 10^3$

Ty's jar has more coins in it.

Lesson Quiz: Part I

Multiply.

1. 25×10^2 2,500

2. 18×10^4 180,000

3. 110×10^2 11,000

4. 3.742×10^3 3,742

Lesson Quiz: Part II

Write each number in scientific notation.

5. 7,400,000 7.4×10^6

6. 45,000 4.5×10^4

7. Earth is about 9.292×10^7 miles from the Sun. Write this number in standard form.

92,920,000