Scientific Notation

Standards

MCC8.EE.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions.

MCC8.EE.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities. Interpret scientific notation that has been generated by technology.

Essential Questions

How can the properties of exponents and knowledge of working with scientific notation help me interpret information?

How can I represent very small and large numbers using integer exponents and scientific notation?

Warm Up

Evaluate each expression.

- **1.** $123 \times 1{,}000$
- **2.** $123 \div 1{,}000$
- **3.** 0.003×100
- **4.** $0.003 \div 100$
- **5.** 10^{4}
- **6.** 10^{-4}
- **7.** 23^{0}

Making the Exponent Connection to Scientific Notation

Exponent Form	Expanded Form	Numerical Equivalent
10^3	10 * 10 * 10	1000
10^2	10 * 10	100
10^1	10	10
10^0	1	1
10^{-1}	$\frac{1}{10^1} = \frac{1}{10}$	.1
10^{-2}	$\frac{1}{10^2} = \frac{1}{10 * 10} = \frac{1}{100}$	.01
10^{-3}	$\frac{1}{10^3} = \frac{1}{10 * 10 * 10} = \frac{1}{1000}$	.001

Scientific Notation

... is a way to express very small or very large numbers.

... is most often used in "scientific" calculations where the analysis must be very precise.

... consists of two parts:*

(1) a number between 1 and 10

$$1 \leq n < 10$$

and

(2) a power of 10.

*a large or small number may be written as any power of 10; however, CORRECT scientific notation must satisfy the above criteria.

3.2×10^{13} is correct scientific notation

23.6×10^{-8} is not correct scientific notation

Remember that the first number MUST BE greater than or equal to one and less than 10.

To Change from Standard Form to Scientific Notation:

1 Place decimal point such that there is one non-zero digit to the left of the decimal point.

2 Count number of decimal places the decimal has "moved" from the original number. This will be the exponent of the 10.

3 If the original number was less than 1, the exponent is negative; if the original number was greater than 1, the exponent is positive.

Examples:

Given: 4,750,000

use: 4.75 (moved 6 decimal places)

answer: **4.75×10^{6}**

The original number was greater than 1 so the exponent is positive.

Given: 0.000789

use: 7.89 (moved 4 decimal places)

answer: **7.89×10^{-4}**

The original number was less than 1 so the exponent is negative.

Part 1:
Express in correct scientific notation:

1. 61,500
2. 0.0000568
3. 321
4. 64,960,000
5. 0.07085

To Change from Scientific Notation to Standard Form:

1. Move decimal point to right for positive exponent of 10.

2. Move decimal point to left for negative exponent of 10.

Examples:

Given: 1.015×10^{-8}

answer: 0.00000001015
(8 places to left)

Given: 5.024×10^{3}

answer: 5,024
(3 places to right)

Positive exponent move decimal to the right.

Part 2:
Express in standard form:

1. 1.09×10^{3}
2. 4.22715×10^{8}
3. 3.078×10^{-4}
4. 9.004×10^{-2}
5. 5.1874×10^{2}

To Multiply and/or Divide using Scientific Notation:

1. Multiply/divide decimal numbers with each other.
2. Use exponent rules to "combine" powers of 10.
3. If not "correct" scientific notation, change accordingly.

Examples:

Given:

$$\frac{(5.29x10^{6})(1.17x10^{-4})}{2.35x10^{-2}}$$

Method:

$$\frac{(5.29)(1.17)}{2.35} = 2.63$$

$$\frac{10^{6} \cdot 10^{-4}}{10^{-2}} = 10^{6-4--2} = 10^{4}$$

Answer:

$$2.63\,x10^{4}$$

Given:

$$\frac{(6.98x10^{-5})(8.21x10^{17})}{1.06x10^{3}}$$

Method:

$$\frac{(6.98)(8.21)}{1.06} = 54.06$$

$$\frac{10^{-5} \cdot 10^{17}}{10^{3}} = 10^{-5+17-3} = 10^{9}$$

Answer:

$$54.06x10^{9}$$

Correct Scientific Notation

$$5.406x10^{10}$$

Part 3:
Multiply or divide as indicated and express in correct scientific notation:

1. $(2.85x10^{7})(3.16x10^{-3})$

2. $\dfrac{8.09x10^{-5}}{3.46x10^{6}}$

3. $\dfrac{(1.16x10^{3})(5.09x10^{-7})}{2.45x10^{2}}$

4. $\dfrac{(4.06x10^{-5})(7.19x10^{3})}{6.57x10^{-4}}$

5. $\dfrac{(9.25x10^{-11})(4.98x10^{26})}{7.58x10^{-15}}$