Operating With Scientific Notation

Warm Up

Write each number in scientific notation.

1. 13000 1.3×10^{4}

2. 2,091,000 2.091×10^{6}

3. 0.001080090 1.08009×10^{-3}

Operating With Scientific Notation

Essential Question:
How do you add, subtract, multiply, and divide using scientific notation?

Standard:
MCC8.EE.4: Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used…Interpret scientific notation that has been generated by technology

MCC8.EE.3: Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.

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Masses of objects in space are so great that astronomers often need to use scientific notation to describe them. The approximate masses of planets in the solar system are given in the table.

Mass of Planets in the Solar System	
Planet	**Approximate Mass**
Mercury	3.30×10^{23} kg
Venus	4.87×10^{24} kg
Earth	5.97×10^{24} kg
Mars	6.42×10^{23} kg
Jupiter	1.89×10^{27} kg
Saturn	5.69×10^{26} kg
Uranus	8.68×10^{25} kg
Neptune	1.02×10^{26} kg

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Helpful Hint

You can use the properties of exponents to multiply and divide numbers expressed in scientific notation.

Dividing SN

Steps

1. Divide the coefficients (number out front)
2. Use rules of dividing exponents to divide the powers of 10.

$$\frac{5.97 \times 10^{24}}{1.3 \times 10^{22}}$$

Step 1) $5.97 \div 1.3 = 4.59$

Step 2) $10^{24} \div 10^{22} = 10^{24-22} = 10^{2}$

Put it all together 4.59×10^{2}

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Additional Example 1: Division With Scientific Notation

Video

Check It Out: Example 1

About how many times greater is the mass of Saturn than the mass of Earth? Write your answer in scientific notation.

Write a unit ratio, or divide, to find how many times.

$$\frac{5.69 \times 10^{26}}{5.97 \times 10^{24}}$$ *Write the ratio of Saturn's mass to Earth's mass.*

$$= \frac{5.69}{5.97} \times \frac{10^{26}}{10^{24}}$$ *Divide the coefficients and divide the powers. Subtract exponents.*

$$\approx 0.9531 \times 10^{2}$$

$$\approx 9.53 \times 10^{1}$$ *Write the result in scientific notation.*

Saturn's mass is about 9.531×10^{1} times the mass of Earth.

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Additional Example 2: Multiplication with Scientific Notation

Video

The mass of Venus is about 66 times the mass of the moon. What is the mass of the moon? Write your answer in scientific notation.

$$\frac{4.87 \times 10^{24}\ \text{kg}}{\text{mass of moon}} = 66$$

Solve for the mass of the moon..

$$\text{mass of moon} = \frac{4.87 \times 10^{24}\ \text{kg}}{66}$$

$$\approx 0.0738 \times 10^{24}\ \text{kg}$$

$$\approx 7.4 \times 10^{22}\ \text{kg}$$

The mass of the moon is about 7.4×10^{22} kg.

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Check It Out: Example 2

The average mass of a grain of sand on a beach is about 1.5×10^{-5} g. There are about 6.1×10^{12} grains of sand in a beach volleyball court. What is the mass of the grains of sand in the beach volleyball court?

Mass of grains of sands in court

$$= (1.5 \times 10^{-5}\ \text{g})(6.1 \times 10^{12})$$

$$= 9.15 \times 10^{7}\ \text{g}$$

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Remember!

A number written in scientific notation has one factor greater than or equal to 1 and less than 10 and the other factor a power of 10.

In normal speak:
It has a number between 1 and 10 multiplied by a power of 10.

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Additional Example 3: Addition and Subtraction with Scientific Notation

The water in Mono Lake, CA, was used for residents of LA. As a result, the lake's volume, in acre-feet, dropped from 4.3×10^7 to 2.1×10^7 from 1941 to 1982. After becoming protected, the lake increased in volume by 5.0×10^6 acre-feet in the next 20 years. What was its volume in 2002?

$2.1 \times 10^7 \rightarrow 21 \times 10^6$

$+5.0 \times 10^6 \rightarrow +5.0 \times 10^6$

$26. \times 10^6$

Rewrite so that the powers are the same; then add.

2.6×10^7

Write the result in scientific notation.

The volume was about 2.6×107 acre-feet.

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Check It Out: Example 3

How much greater is the mass of Neptune than the mass of Earth? Write your answer in scientific notation. Write your answer in scientific notation.

$$\begin{array}{rcl} 1.02 \times 10^{26}\ \text{kg} & \rightarrow & 102 \times 10^{24}\ \text{kg} \\ -5.97 \times 10^{24}\ \text{kg} & \rightarrow & -5.97 \times 10^{24}\ \text{kg} \\ \hline & & 96.03 \times 10^{24}\ \text{kg} \\ & & \\ & & 9.603 \times 10^{25}\ \text{kg} \end{array}$$

Neptune's is about 9.603×10^{25} kg greater in mass than Earth.

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Write your answer in scientific notation.

1. The GDP of China in 2009 was about $\$8.7 \times 10^{12}$. The GDP of Togo in 2009 was about $\$5.5 \times 10^{9}$. How many times greater was China's GDP than Togo's GDP in 2009?

1.58×10^{3} times greater

2. A web site averages 4.5×10^{4} hits per day. How many hits will it get in 3.6×10^{2} days?

1.62×10^{7} hits

Operating With Scientific Notation

3. Two companies merged to form a new company. One company was worth $\$3.5 \times 10^7$. The other was worth $\$7.8 \times 10^8$. What is the combined value of the new company?

$\$8.15 \times 10^8$