

2.4 Operations with Scientific Notation

8.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

Adding and Subtracting with Scientific Notation

Numbers written in scientific notation can be added and subtracted either directly or by rewriting them in standard notation

EXAMPLE 1COMMON
CORE

8.EE.4

The table below shows the population of the three largest countries in North America in 2011. Find the total population of these countries.

Country	United States	Canada	Mexico
Population	3.1×10^8	3.38×10^7	1.1×10^8

338000000
338000000

Method 1:

STEP 1

*Write each number
with the same power
of 10*

$$\begin{array}{r} 3.1 \times 10^8 \\ 1.1 \times 10^8 \\ .338 \times 10^8 \end{array}$$

STEP 2

*Add the
multipliers*

$$\begin{array}{r} 3.100 \\ + 1.100 \\ + 0.338 \\ \hline 4.538 \end{array}$$

STEP 3

*Write in
Scientific
notation*

$$4.538 \times 10^8$$

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The table below shows the population of the three largest countries in North America in 2011. Find the total population of these countries.

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Method 2:

STEP 1

Write in
Standard notation

STEP 2

Find the
sum

$$\begin{array}{r}
 310000000 \\
 + 33800000 \\
 110000000 \\
 \hline
 453800000
 \end{array}$$

STEP 3

Write in
Scientific notation

$$4.538 \times 10^8$$

ADDITIONAL EXAMPLE 1

Use the population table in Example 1 on the student page. How many more people live in the United States than in Canada?

Country	United States	Canada	Mexico
Population	3.1×10^8	3.38×10^7	1.1×10^8

$$3.38 \times 10^7$$

$$3,100,000,000 = 31,000,000,000$$

$$31 \times 10^7$$

$$\begin{array}{r} 2 \ 10 \ 9 \ 10 \\ 31.00 \\ - 3.38 \\ \hline \end{array}$$

$$27.62 \times 10^7$$

$$\hline 27.62$$

$$2.762 \times 10^8$$

$$3.1 \times 10^8 = 310,000,000$$

$$3.38 \times 10^7 = 33,800,000$$

$$\begin{array}{r} 2 \ 10 \ 9 \ 10 \\ 310,000,000 \\ - 33,800,000 \\ \hline 276,200,000 \end{array}$$

$$2.762 \times 10^8$$

YOUR TURN

Country	United States	Canada	Mexico
Population	3.1×10^8	3.38×10^7	1.1×10^8

1. Using the population table above, how many more people live in Mexico than in Canada? Write your answer in scientific notation.
-

$$\begin{array}{l}
 3.38 \times 10^7 \\
 33800000 \\
 \bullet 338 \times 10^8 \quad C \\
 1.1 \times 10^8 \quad M
 \end{array}$$

$$\begin{array}{r}
 \circ 10910 \\
 \cancel{+ + 00} \\
 - \quad .338 \\
 \hline
 .762
 \end{array}$$

$$\begin{array}{l}
 \bullet 762 \times 10^8 \\
 762000000 \\
 \hline
 7.62 \times 10^7
 \end{array}$$

Add

4.2×10^6

$2.25 \times 10^5 = 2.25000 = 225000$

2.8×10^6

225×10^6

$$\begin{array}{r} 1 \\ 4.200 \\ + 0.225 \\ \hline \end{array}$$

$$+ \frac{2.800}{\hline}$$

7.225

7.225×10^6

Add

1.25×10^2

0.5×10^2

3.25×10^2

1 1

1.25

.50

3.25

$$\frac{ + }{\hline} 5.00$$

5×10^2

* No need to
move decimals
because exponent
is same

Subtract

$$8.5 \times 10^3$$

$$5.3 \times 10^3$$

$$1.0 \times 10^2 = 100 = \overset{\cdot}{100}$$

$$\overset{\cdot}{1} \times 10^3$$

$$\begin{array}{r} 8.5 \\ - 5.3 \\ \hline 3.2 \\ - \overset{\cdot}{1} \\ \hline 3.1 \end{array}$$

$$3.1 \times 10^3$$

Subtract

$$6.2 \times 10^5$$

$$2.6 \times 10^4 = 2.6000 = \overset{\cdot}{26000}$$

$$1.9 \times 10^2 = 1.90 = \overset{\cdot}{190}$$

$$\checkmark \overset{\cdot}{26} \times 10^5$$

$$\checkmark \overset{\cdot}{0019} \times 10^5$$

$$\begin{array}{r} 5'' \\ 6.210 \\ - \overset{\cdot}{26} \\ \hline 5.9381 \end{array}$$

$$\begin{array}{r} 5.9381 \\ - \overset{\cdot}{0019} \\ \hline 5.9381 \end{array}$$

$$5.9381 \times 10^5$$

Multiplying and Dividing with Scientific Notation

Numbers in scientific notation can be multiplied and divided directly by using properties of exponents

EXAMPLE 2**Problem Solving**COMMON
CORE

8.EE.4

When the Sun makes an orbit around the center of the Milky Way, it travels 2.025×10^{14} kilometers. The orbit takes 225 million years. At what rate does the Sun travel? Write your answer in scientific notation.

Km = distance
years = time

Analyze Information

- What's being asked
- What factors
- What operation

Formulate a Plan

Set up operation $\text{Rate} = \frac{\text{Distance}}{\text{Time}}$

EXAMPLE 2**Problem Solving**COMMON
CORE

8.EE.4

When the Sun makes an orbit around the center of the Milky Way, it travels 2.025×10^{14} kilometers. The orbit takes 225 million years. At what rate does the Sun travel? Write your answer in scientific notation.

**Solve****STEP 1**

$$\text{Rate} = \frac{2.025 \times 10^{14}}{225,000,000}$$

STEP 2

$$\frac{2.025 \times 10^{14}}{2.25 \times 10^8}$$

STEP 3

- ① Divide the multipliers
② Use exponents rules

$$\textcircled{1} 2.025 \div 2.25 = .9$$

$$\textcircled{2} \frac{10^{14}}{10^8} = 10^6$$

STEP 4

$$.9 \times 10^6 = 9 \times 10^5$$

ADDITIONAL EXAMPLE 2

When Neptune makes an orbit around the Sun, it travels about 2.82×10^{10} km. Neptune travels at a rate of about 470,000 km/day. How many days does one orbit of Neptune take? Write your answer in scientific notation.

$$\text{Rate} = \frac{\text{Distance}}{\text{Time}}$$

$$\frac{2.82 \times 10^{10}}{4.7 \times 10^5}$$

60000
60000

$$2.82 \div 4.7 = .6$$

$$\frac{10^{10}}{10^5} = 10^5$$

$$.6 \times 10^5 = \boxed{6 \times 10^4 \text{ days}}$$

YOUR TURN

2. Light travels at a speed of 1.86×10^5 miles per second. It takes light from the Sun about 4.8×10^3 seconds to reach Saturn. Find the approximate distance from the Sun to Saturn. Write your answer

in scientific notation. 8.928×10^8 miles

$$\begin{array}{r} 1.86 \\ \times 4.8 \\ \hline \end{array}$$

$$10^5 \times 10^3 = 10^{5+3} = 10^8$$

YOUR TURN

3. Light travels at the speed of 1.17×10^7 miles per minute. Pluto's average distance from the Sun is 3,670,000,000 miles. On average, how long does it take sunlight to reach Pluto? Write your answer in scientific notation. 3.14×10^2 min.

$$\frac{3.67 \times 10^9}{1.17 \times 10^7} = \frac{3.67 \div 1.17 \approx 3.14}{\frac{10^9}{10^7}} = 10^2$$

Scientific Notation on a Calculator

On scientific calculators, you can use functions such as "E", "ee", or 10^{\square} to solve scientific notation questions

EXAMPLE 3COMMON
CORE

8.EE.4

The table shows the approximate areas for three continents given in square meters. What is the total area of these three continents? Write the answer in scientific notation using more appropriate units.

Continent	Asia	Africa	Europe
Area (m ²)	4.4×10^{13}	3.02×10^{13}	1.04×10^{13}

$$4.4E13 + 3.02E13 + 1.04E13$$
$$= 8.46E13$$

ADDITIONAL EXAMPLE 3

Use the table in Example 3 on the student page. What is the difference between Asia's area and Europe's area? Use your calculator to find the answer.

Continent	Asia	Africa	Europe
Area (m ²)	4.4×10^{13}	3.02×10^{13}	1.04×10^{13}

$$\begin{array}{r} 4.4 \times 10^{13} \\ - 1.04 \times 10^{13} \\ \hline 3.36 \times 10^{13} \end{array}$$

YOUR TURN 

Write each number using calculator notation.

4. 7.5×10^5

7.5E5

5. 3×10^{-7}

3E-7

6. 2.7×10^{13}

2.7E13

Write each number using scientific notation.

7. $4.5E-1$

4.5×10^{-1}

8. $5.6E12$

5.6×10^{12}

9. $6.98E-8$

6.98×10^{-8}

HW