Warm Up

Order each set of numbers from least to greatest.

1. $10^4, 10^{-2}, 10^0, 10^{-1}$

$10^{-2}, 10^{-1}, 10^0, 10^4$

2. $8^2, 8^{-2}, 8^3, 8^0$

$8^{-2}, 8^0, 8^2, 8^3$

3. $2^3, 2^{-6}, 2^{-4}, 2^1$

$2^{-6}, 2^{-4}, 2^1, 2^3$

4. $5.2^2, 5.2^9, 5.2^{-1}, 5.2^{-2}$

$5.2^{-2}, 5.2^{-1}, 5.2^2, 5.2^9$

Scientific Notation

Essential Question:

How can you use properties of exponents to simplify expressions?

Standards:

MGSE8.EE.1
Know and apply the properties of integer exponents to generate equivalent numerical expressions.

Vocabulary

scientific notation

Scientific Notation

An ordinary quarter contains about 97,700,000,000,000,000,000,000 atoms. The average size of an atom is about 0.00000003 centimeter across.

The length of these numbers in standard notation makes them awkward to work with.

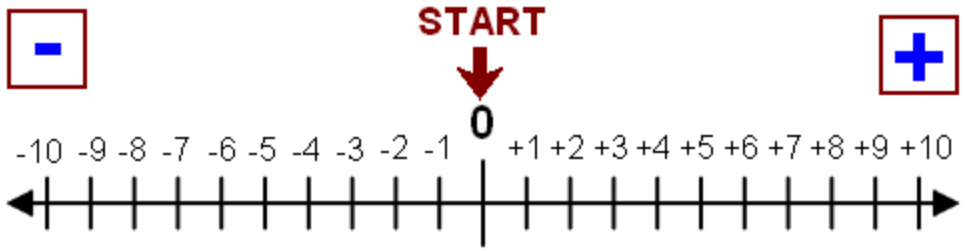
Scientific notation is a shorthand way of writing such numbers. Other Power Point

Song

Scientific Notation

Numbers written in **scientific notation** are written as two factors. One factor is a number greater than or equal to 1 and less than 10. The other factor is a power of 10.

Think of a number line as a reference tool.
Positive exponents mean move right.
Negative exponents mean move left.



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Topic 2- Scientific Notation

Scientific notation: a shorthand method to express very large or very small numbers.

Ex: $3\ 400\ 000\ 000 = 3.4 \times 10^{9}$

$0.0000000576 = 5.76 \times 10^{-8}$

General Structure:

(decimal number between 1 and 10) × (power of 10)

$\_\_.\_\_\_\_ \times 10$

3.56×10^{7}

To convert a number from **standard form** to **scientific notation**:

1. Move the decimal point as much as needed to obtain a decimal number between 1 and 10.
   Eg. 3562 = 3562.0 → 3.562
2. The amount of places the decimal was moved becomes the exponent on the 10
   Eg. Moved the decimal 3 places → 10^{3}
3. $3562 = 3.562 \times 10^{3}$ in scientific notation.

**NOTE*:
If the decimal point moves left, the exponent on the 10 is **positive**; if it moves right the exponent is **negative**.

Example: Convert 250 883 to scientific notation.

1. 250 883 → 2.50883
2. Moved decimal 5 times to left → 10^{5}
3. So $2.50883 = 2.50883 \times 10^{5}$

Practice: Write the following numbers in scientific notation.

1. Move the decimal point as much as needed to obtain a decimal number between 1 and 10.
   Eg. $3562 = 3562.0 \rightarrow 3.562$
2. The amount of places the decimal was moved becomes the exponent on the 10
   Eg. Moved the decimal 3 places $\rightarrow 10^3$
3. $3562 = 3.562 \times 10^3$ in scientific notation.

**NOTE*:
If the decimal point moves left, the exponent on the 10 is **positive**; if it moves right the exponent is **negative**.

Example: Convert 250 883 to scientific notation.

1. $250\,883 \rightarrow 2.50883$
2. Moved decimal 5 times to left $\rightarrow 10^5$
3. So $2.50883 = 2.50883 \times 10^5$

Practice: Write the following numbers in scientific notation.

1. 8546 __._____ × 10
2. 23 000 __._____ × 10
3. 572.9 __._____ × 10
4. 2 990 000 __._____ × 10
5. 3418.06 __._____ × 10
6. 0.0003 __._____ × 10

Scientific Notation

7. 0.65743 ___._____ × 10

8. 0.0224 ___._____ × 10

To convert a number from **scientific notation** to **standard form**

1. CONVERSELY,
   positive exponent → move the decimal point to the *right*,
   negative exponent → move the decimal point to the *left*.

2. Move the decimal from its current place, the *amount* and *direction* specified by the exponent on the 10.
   Eg. $2.31 \times 10^{-3} \rightarrow 0.00231$

Practice: Convert these numbers to standard form.

7. 0.65743 __._____ × 10

8. 0.0224 __._____ × 10

To convert a number from **scientific notation** to **standard form**

1. CONVERSELY,
   positive exponent → move the decimal point to the *right*,
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2. Move the decimal from its current place, the *amount* and *direction* specified by the exponent on the 10.
   Eg. $2.31 \times 10^{-3} \rightarrow 0.00231$

Practice: Convert these numbers to standard form.

1) $2 \times 10^{3} =$ _____

2) $2.331 \times 10^{5} =$ _____

3) $5 \times 10^{-3} =$ _____

4) $7.627 \times 10^{-5} =$ _____

5) $3.004 \times 10^{3} =$ _____

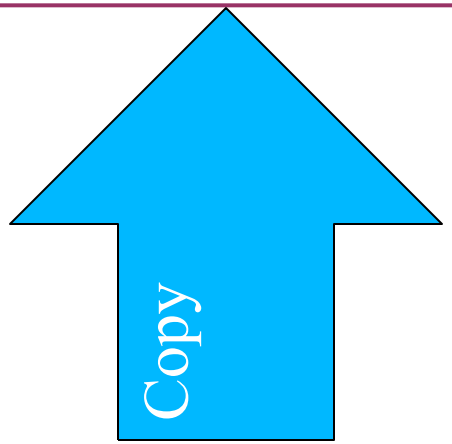
6) $5.23 \times 10^{4} =$ _____

7) $5.062 \times 10^{2} =$ _____

Scientific Notation

Writing Math

To write scientific notation for numbers already between 1 and 10, use a 0 exponent. $5.63 = 5.63 \times 10^0$.



Scientific Notation

- Workbook Pg. 73

Scientific Notation

Additional Example 1A: Translating Scientific Notation to Standard Notation

Write the number in standard notation.

1.35×10^5

1.35×10^5 *$10^5 = 100{,}000$*

$1.35 \times 100{,}000$

$135{,}000$ *Think: Move the decimal right 5 places.*

Helpful Hint

A positive exponent means move the decimal to the right, and a negative exponent means move the decimal to the left.

Additional Example 1B: Translating Scientific Notation to Standard Notation Continued

Write the number in standard notation.

2.7×10^{-3}

2.7×10^{-3}

$10^{-3} = \frac{1}{1000}$

$2.7 \times \frac{1}{1000}$

$2.7 \div 1000$ *Divide by the reciprocal.*

0.0027 *Think: Move the decimal left 3 places.*

Additional Example 1C: Translating Scientific Notation to Standard Notation Continued

Write the number in standard notation.

2.01×10^4

2.01×10^4

$2.01 \times 10{,}000$

$20{,}100$

$10^4 = 10{,}000$

Think: Move the decimal right 4 places.

Check It Out: Example 1A

Write the number in standard notation.

2.87×10^9

2.87×10^9 *$10^9 = 1{,}000{,}000{,}000$*

$2.87 \times 1{,}000{,}000{,}000$

$2{,}870{,}000{,}000$

Think: Move the decimal right 9 places.

Check It Out: Example 1B

Write the number in standard notation.

$\mathbf{1.9 \times 10^{-5}}$

1.9×10^{-5}

$10^{-5} = \frac{1}{100,000}$

$1.9 \times \frac{1}{100,000}$

$1.9 \div 100,000$ *Divide by the reciprocal.*

0.000019 *Think: Move the decimal left 5 places.*

Check It Out: Example 1C

Write the number in standard notation.

5.09×10^8

5.09×10^8 *$10^8 = 100{,}000{,}000$*

$5.09 \times 100{,}000{,}000$

$509{,}000{,}000$

Think: Move the decimal right 8 places.

Scientific Notation

Cut out from workbook pg. 70 and glue into notebook.

WRITING NUMBERS IN SCIENTIFIC NOTATION	
For numbers greater than or equal to 10, use a positive exponent.	For numbers less than 1, use a negative exponent.
$15{,}237 = 1.5237 \times 10^{4}$ *The decimal moves 4 places.*	$0.00396 = 3.96 \times 10^{-3}$ *The decimal moves 3 places.*

Additional Example 2: Translating Standard Notation to Scientific Notation

Write 0.00709 in scientific notation.

0.00709

Think: The decimal needs to move 3 places to get a number between 1 and 10.

7.09

$7.09 \times 10^{\square}$ *Set up scientific notation.*

Think: The decimal needs to move left to change 7.09 to 0.00709, so the exponent will be negative.

So 0.00709 written in scientific notation is 7.09×10^{-3}.

Check $7.09 \times 10^{-3} = 7.09 \times 0.001 = 0.00709$

Check It Out: Example 2

Write 0.000811 in scientific notation.

0.000811

Think: The decimal needs to move 4 places to get a number between 1 and 10.

8.11

$8.11 \times 10^{\square}$ *Set up scientific notation.*

Think: The decimal needs to move left to change 8.11 to 0.000811, so the exponent will be negative.

So 0.000811 written in scientific notation is 8.11×10^{-4}.

Check $8.11 \times 10^{-4} = 8.11 \times 0.0001 = 0.000811$

Additional Example 3: *Application*

A pencil is 18.7 cm long. If you were to lay 10,000 pencils end-to-end, how many millimeters long would they be? Write the answer in scientific notation.

1 centimeter = 10 millimeters

18.7 centimeters = 187 millimeters *Multiply by 10.*

187 mm × 10,000 *Find the total length.*

1,870,000 mm *Multiply.*

Additional Example 3 Continued

$1.87 \times 10^{\square}$

Set up scientific notation.

Think: The decimal needs to move right to change 1.87 to 1,870,000, so the exponent will be positive.

Think: The decimal needs to move 6 places.

In scientific notation the 10,000 pencils would be 1.87×10^6 mm long, laid end-to-end.

Check It Out: Example 3

An oil rig can hoist 2,400,000 pounds with its main derrick. It distributes the weight evenly between 8 wire cables. What is the weight that each wire cable can hold? Write the answer in scientific notation.

Find the weight each cable is expected to hold by dividing the total weight by the number of cables.

2,400,000 pounds ÷ 8 cables =
300,000 pounds per cable

Each cable can hold 300,000 pounds.

Now write 300,000 pounds in scientific notation.

Check It Out: Example 3 Continued

$3.0 \times 10^{\square}$

Set up scientific notation.

Think: The decimal needs to move right to change 3.0 to 300,000, so the exponent will be positive.

Think: The decimal needs to move 5 places.

In scientific notation, each cable can hold 3.0×10^5 pounds.

Additional Example 4: Life Science *Application*

A certain cell has a diameter of approximately 4.11×10^{-5} meters. A second cell has a diameter of 1.5×10^{-5} meters. Which cell has a greater diameter?

4.11×10^{-5} $\quad$ 1.5×10^{-5}

$10^{-5} = 10^{-5}$ $\quad$ *Compare powers of 10.*

$4.11 > 1.5$ $\quad$ *Compare the values between 1 and 10.*

$4.11 \times 10^{-5} > 1.5 \times 10^{-5}$

The first cell has a greater diameter.

Check It Out: Example 4

A certain cell has a diameter of approximately 5×10^{-3} meters. A second cell has a diameter of 5.11×10^{-3} meters. Which cell has a greater diameter?

5×10^{-3} 5.11×10^{-3}

$10^{-3} = 10^{-3}$ *Compare powers of 10.*

$5 < 5.11$ *Compare the values between 1 and 10.*

$5 \times 10^{-3} < 5.11 \times 10^{-3}$

The second cell has a greater diameter.