Name: _____ Date: _____

Scientific Notation

Warm-up: Complete the table. Answer the questions below.

Multiplication Expression	Multiplication Expression with Powers	Product
5.678×10	5.678×10^{1}	56.78
5.678×100	5.678×10^{2}	567.8
$5.678 \times 1{,}000$	5.678×10^{3}	5678
$5.678 \times 10{,}000$	5.678×10^{4}	56,780
$5.678 \times \frac{1}{10} = 5.678 \times 0.1$	$5.678 \times \frac{1}{10^{1}} = 5.678 \times 10^{-1}$	0.5678
$5.678 \times \frac{1}{100} = 5.678 \times 0.01$	$5.678 \times \frac{1}{10^{2}} = 5.678 \times 10^{-2}$	0.05678
$5.678 \times \frac{1}{1000} = 5.678 \times 0.001$	$5.678 \times \frac{1}{10^{3}} = 5.678 \times 10^{-3}$	0.005678
$5.678 \times \frac{1}{10{,}000} = 5.678 \times 0.0001$	$5.678 \times \frac{1}{10^{4}} = 5.678 \times 10^{-4}$	0.0005678

1) When 5.678 is multiplied by a positive power of 10, what relationship exists between the decimal point's new position and the exponent?

The exponent value is the amount of times you move the decimal point to the right.

2) When 5.678 is multiplied by a negative power of 10, what relationship exists between the decimal point's new position and the exponent?

The exponent value is the amount of times you move the decimal point to the left.

Key Concept

Scientific Notation

Words Scientific notation is when a number is written as the product of a factor and an integer power of 10. When the number is positive the factor must be greater than or equal to 1 and less than 10.

Symbols $a \times 10^n$, where $1 \leq a < 10$ and n is an integer

Example $425{,}000{,}000 = 4.25 \times 10^8$

Use these rules to express a number in scientific notation.

- If the number is greater than or equal to 1, the power of ten is positive.
- If the number is between 0 and 1, the power of ten is negative.

Work Zone

Powers of Ten
Multiplying a factor by a positive power of 10 moves the decimal point right. Multiplying a factor by a negative power of 10 moves the decimal point left.

a. _____ Show your work.

Examples

Tutor

Write each number in standard form.

1. 5.34×10^4

$5.34 \times 10^4 = 53{,}400.$

2. 3.27×10^{-3}

$3.27 \times 10^{-3} = 0.00327$

Got It? Do these problems to find out.

a. 7.42×10^5 **b.** 6.1×10^{-2} **c.** 3.714×10^2

742,000 0.061 371.4

Examples

Write each number in scientific notation.

3. 3,725,000

3.725×10^6

3.725000

4. 0.000316

3.16×10^{-4}

Got It? Do these problems to find out.

d. 14,140,000 **e.** 0.00876 **f.** 0.114

Copy the chart. Complete it without using your calculator.

Description	Number in Standard Form (approximate)	Number in Scientific Notation
Time since dinosaurs began roaming Earth (years)	225,000,000	
Projected World population in 2010		6.8×10^{9}
Distance from Earth to Andromeda galaxy (miles)		1.5×10^{19}
Mass of the sun (kg)	2,000,000,000,000,000,000,000,000,000,000	

Description	Number in Standard Form (approximate)	Number in Scientific Notation
Average mass of a hydrogen atom (grams)	0.00000000000000000000000016735	
Diameter of the body of a Purkinje cell (meters)		8×10^{-5}
Diameter of some fats in the body (meters)		5×10^{-10}
Average mass of an oxygen atom (grams)	0.00000000000000000000000026566	

For each pair of numbers, indicate which is greater.

18. 2.34×10^5 or 1.35×10^6

19. 3.83312×10^{31} or 8.1×10^{32}

21. 2.34×10^{-5} or 1.35×10^{-6}

22. 1.92×10^{-3} or 0.21×10^{-2}

23. 6.391×10^{-9} or 7.814×10^{-10}

24. 5.1×10^{-19} or 6.92×10^{-20}

25. 9.384×10^{-23} or 7.6×10^{-24}

26. 3.83312×10^{-31} or 8.1×10^{-32}

Example

Watch Tutor

5. **Refer to the table at the right. Order the countries according to the amount of money visitors spent in the United States from greatest to least.**

Dollars Spent by International Visitors in the U.S	
Country	**Dollars Spent**
Canada	1.03×10^7
India	1.83×10^6
Mexico	7.15×10^6
United Kingdom	1.06×10^7

Canada and United Kingdom — Mexico and India

Step 1 $\begin{Bmatrix} 1.06 \times 10^7 \\ 1.03 \times 10^7 \end{Bmatrix} > \begin{Bmatrix} 7.15 \times 10^6 \\ 1.83 \times 10^6 \end{Bmatrix}$ ← Group the numbers by their power of 10.

Step 2 $1.06 > 1.03$ $\quad 7.15 > 1.83$ ← Order the decimals.

United Kingdom Canada Mexico India

Got It? Do this problem to find out.

g. Some of the top U.S. cities visited by overseas travelers are shown in the table. Order the cities according to the number of visitors from least to greates

U.S. City	Number of Visitors
Boston	7.21×10^5
Las Vegas	1.3×10^6
Los Angeles	2.2×10^6
Metro D.C. area	9.01×10^5

Boston, Metro DC, Las Vegas, Los Angeles

Example

6. STEM **If you could walk at a rate of 2 meters per second, it would take you 1.92×10^8 seconds to walk to the moon. Is it more appropriate to report this time as 1.92×10^8 seconds or 6.09 years? Explain your reasoning.**

The measure 6.09 years is more appropriate. The number 1.92×10^8 seconds is very large so choosing a larger unit of measure is more meaningful.

Got It? Do this problem to find out.

h. STEM In an ocean, the sea floor moved 475 kilometers over 65 million years. Is it more appropriate to report this rate as 7.31×10^{-5} kilometer per year or 7.31 centimeters per year? Explain your reasoning.

7.31 cm -

Guided Practice

Write each number in standard form. (Examples 1 and 2)

1. $9.931 \times 10^5 =$ **993,100**

2. $6.02 \times 10^{-4} =$ **0.000602**

Show your work.

Write each number in scientific notation. (Examples 3 and 4)

3. $8{,}785{,}000{,}000 =$ **8.785×10^9**

4. $0.524 =$ **5.24×10^{-1}**

5. The table lists the total value of music shipments for four years. List the years from least to greatest dollar amount. (Example 5)

year 4, year 3, year 2, year 1

Year	Misic Shipments($)
1	1.22×10^{10}
2	1.12×10^{10}
3	7.15×10^6
4	1.06×10^7

6. STEM A plant cell has a diameter of 1.3×10^{-8} kilometer. Is it more appropriate to report the diameter of a plant cell as 1.3×10^{-8} kilometer or 1.3×10^{-2} millimeter? Explain your reasoning. (Example 6)

1.3×10^{-2} millimeter; the number is very small so choosing a smaller unit of measure is more meaningful.

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Computing with Scientific Notation

Warm-up:

1) $9 \cdot 10^{9}(-2 \cdot 10^{-3})$

$9(-2) = -18$

$10^{9} \cdot 10^{-3} = 10^{6}$

$-18 \cdot 10^{6}$

Not Scientific Notation just yet... → -1.8×10^{7}

Let's see...

$4x^{2}y^{3}(5xy^{6}) = 20x^{3}y^{9}$

$4 \cdot 5 = 20$

$x^{2} \cdot x = x^{2+1} = x^{3}$

$y^{3} \cdot y^{6} = y^{3+6} = y^{9}$

Multiplying & Dividing with SN

Ex 1: $(7.2 \times 10^{3})(1.6 \times 10^{4})$

Let's use Laws of Exponents! Yay! :)

$7.2(1.6) = 11.52$

$10^{3} \times 10^{4} = 10^{3+4} = 10^{7}$

11.52×10^{7}

1.152×10^{8}

Ex 2: $(2.63 \times 10^{4})(1.2 \times 10^{-3})$

$2.63(1.2) = 3.156$

$10^{4} \cdot 10^{-3} = 10^{4+(-3)} = 10^{1}$

$\boxed{3.156 \times 10^{1}}$

Ex 3: $\dfrac{8.37 \times 10^{8}}{2.7 \times 10^{3}}$

$8.37 \div 2.7 = 3.1$

$\dfrac{10^{8}}{10^{3}} = 10^{8-3} = 10^{5}$

$\boxed{3.1 \times 10^{5}}$

Ex 4: $\dfrac{3.24 \times 10^{-7}}{8.1 \times 10^{-4}}$

$3.24 \div 8.1 = 0.4$

$10^{-7-(-4)} = 10^{-7+4} = 10^{-3}$

$0.4 \times 10^{-3} = 0.0004$

4×10^{-4}

Addition & Subtraction

Ex 5: $(6.89 \times 10^4) + (9.24 \times 10^5)$

$(6.89 \times 10^4) + (92.4 \times 10^4)$

Remember: $(3 \times 6) + (4 \times 6) = (3+4)6$

$(6.89 + 92.4) \times 10^4$

$= 99.29 \times 10^4$

$= 9.929 \times 10^5$

Ex 6: $(7.83 \times 10^8) - 11{,}610{,}000$

$(7.83 \times 10^8) - (1.161 \times 10^7)$

$(78.3 \times 10^7) - (1.161 \times 10^7)$

$(78.3 - 1.161) \times 10^7$

77.139×10^7

7.7139×10^8