

7-4 Study Guide and Intervention

Scientific Notation

Scientific Notation Very large and very small numbers are often best represented using a method known as **scientific notation**. Numbers written in scientific notation take the form $a \times 10^n$, where $1 \leq a < 10$ and n is an integer. Any number can be written in scientific notation.

Example 1 Express 34,020,000,000 in scientific notation.

Step 1 Move the decimal point until it is to the right of the first nonzero digit. The result is a real number a . Here, $a = 3.402$.

Step 2 Note the number of places n and the direction that you moved the decimal point. The decimal point moved 10 places to the left, so $n = 10$.

Step 3 Because the decimal moved to the left, write the number as $a \times 10^n$.

$$34,020,000,000 = 3.4020000000 \times 10^{10}$$

Step 4 Remove the extra zeros. 3.402×10^{10}

Example 2 Express 4.11×10^{-6} in standard notation.

Step 1 The exponent is -6 , so $n = -6$.

Step 2 Because $n < 0$, move the decimal point 6 places to the left.

$$4.11 \times 10^{-6} \Rightarrow .00000411$$

Step 3 $4.11 \times 10^{-6} \Rightarrow 0.00000411$

Rewrite; insert a 0 before the decimal point.

Exercises

Express each number in scientific notation.

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|-----------------------|-------------------|--------------------|
| 1. 5,100,000 | 2. 80,300,000,000 | 3. 14,250,000 |
| 4. 68,070,000,000,000 | 5. 14,000 | 6. 901,050,000,000 |
| 7. 0.0049 | 8. 0.000301 | 9. 0.0000000519 |
| 10. 0.000000185 | 11. 0.002002 | 12. 0.00000771 |

Express each number in standard form.

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|----------------------------|------------------------------|--------------------------|
| 13. 4.91×10^4 | 14. 3.2×10^{-5} | 15. 6.03×10^8 |
| 16. 2.001×10^{-6} | 17. 1.00024×10^{10} | 18. 5×10^5 |
| 19. 9.09×10^{-5} | 20. 3.5×10^{-2} | 21. 1.7087×10^7 |

7-4 Study Guide and Intervention *(continued)*

Scientific Notation

Products and Quotients in Scientific Notation You can use scientific notation to simplify multiplying and dividing very large and very small numbers.

Example 1 Evaluate $(9.2 \times 10^{-3}) \times (4 \times 10^8)$. Express the result in both scientific notation and standard form.

$(9.2 \times 10^{-3})(4 \times 10^8)$	Original expression
$= (9.2 \times 4)(10^{-3} \times 10^8)$	Commutative and Associative Properties
$= 36.8 \times 10^5$	Product of Powers
$= (3.68 \times 10^1) \times 10^5$	$36.8 = 3.68 \times 10$
$= 3.68 \times 10^6$	Product of Powers
$= 3,680,000$	Standard Form

Example 2 Evaluate $\frac{(2.76 \times 10^7)}{(6.9 \times 10^5)}$. Express the result in both scientific notation and standard form.

$\frac{(2.76 \times 10^7)}{(6.9 \times 10^5)}$	$= \left(\frac{2.76}{6.9}\right)\left(\frac{10^7}{10^5}\right)$	Product rule for fractions
	$= 0.4 \times 10^2$	Quotient of Powers
	$= 4.0 \times 10^{-1} \times 10^2$	$0.4 = 4.0 \times 10^{-1}$
	$= 4.0 \times 10^1$	Product of Powers
	$= 40$	Standard form

Exercises

Evaluate each product. Express the results in both scientific notation and standard form.

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| 1. $(3.4 \times 10^3)(5 \times 10^4)$ | 2. $(2.8 \times 10^{-4})(1.9 \times 10^7)$ |
| 3. $(6.7 \times 10^{-7})(3 \times 10^3)$ | 4. $(8.1 \times 10^5)(2.3 \times 10^{-8})$ |
| 5. $(1.2 \times 10^{-4})^2$ | 6. $(5.9 \times 10^5)^2$ |

Evaluate each quotient. Express the results in both scientific notation and standard form.

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| 7. $\frac{(4.9 \times 10^{-3})}{(2.5 \times 10^{-4})}$ | 8. $\frac{5.8 \times 10^4}{5 \times 10^{-2}}$ |
| 9. $\frac{(1.6 \times 10^5)}{(4 \times 10^{-4})}$ | 10. $\frac{8.6 \times 10^6}{1.6 \times 10^{-3}}$ |
| 11. $\frac{(4.2 \times 10^{-2})}{(6 \times 10^{-7})}$ | 12. $\frac{8.1 \times 10^5}{2.7 \times 10^4}$ |