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 $1 \le a < 10$ 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.

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

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.

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.

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

Lesson 7-4

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

$\dfrac{(2.76 \times 10^7)}{(6.9 \times 10^5)} = \left(\dfrac{2.76}{6.9}\right)\left(\dfrac{10^7}{10^5}\right)$	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.

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. $(8.1 \times 10^5)(2.3 \times 10^{-3})$

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.

7. $\dfrac{(4.9 \times 10^{-3})}{(2.5 \times 10^{-4})}$

8. $\dfrac{5.8 \times 10^4}{5 \times 10^{-2}}$

9. $\dfrac{(1.6 \times 10^5)}{(4 \times 10^{-4})}$

10. $\dfrac{8.6 \times 10^6}{1.6 \times 10^{-3}}$

11. $\dfrac{(4.2 \times 10^{-2})}{(6 \times 10^{-7})}$

12. $\dfrac{8.1 \times 10^5}{2.7 \times 10^4}$