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About the Author

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PRECALCULUS

Chapter P - Preliminary Concepts

P9: Scientific Notation

Concept of writing any positive real number in the form of scientific notation was developed to help calculations of very large or very small quantities, frequently encountered in Physics, Chemistry, Biology, Statistics, Microbiology, etc. This notation states the number in the form $k \times 10^m$, where $1 \leq k < 10$ and m is an integer.

EXAMPLE 1:

$$65,000,000 = 6.5 \times 10^7$$

EXAMPLE 2:

$$0.00000000096 = 9.6 \times 10^{-10}$$

For very large numbers, place the decimal after the first digit from the left. Then, count the number of remaining digits in the number. This number becomes the positive exponent of 10.

For very small numbers, place the decimal after the first non-zero digit. Then, count the number of digits preceding the decimal point that you have placed, until the original decimal point. This number becomes the negative exponent of 10.

EXAMPLE 3:

Write the number $387,000,000,000,000$ in scientific notation.

Solution: $387,000,000,000,000 = 3.87 \times 10^{14}$

EXAMPLE 4:

Write 0.000000000000000163

Solution: $0.000000000000000163 = 1.63 \times 10^{-16}$

To convert a number from scientific notation, just multiply.

EXAMPLE 5:

$5.138 \times 10^{11} = 513,800,000,000$

EXAMPLE 6:

$2.93 \times 10^{-9} = 0.00000000298$

Multiplication and division problems of very large or very small number can be done with ease, using scientific notation.

EXAMPLE 7:

Simplify: $(45,000,000)(0.000000238)$

Solution: We first write the numbers in scientific notation.Then, multiply the numbers, and add the exponents using laws of exponents. Finally, convert the result into scientific notation or write it in decimal form as required.

$$
\begin{aligned}
(45,000,000)(0.0000000238) &= (4.5 \times 10^7)(2.38 \times 10^8) \\
&= (4.5 \times 2.38)(10^7 \times 10^8) \\
&= 10.71 \times 10^{15} \\
&= 1.071 \times 10^{16}
\end{aligned}
$$

EXAMPLE 8:

Simplify: $\dfrac{(35,000,000)(0.000000000021)}{14,100,000000}$

Solution:

$$\frac{(35,000,000)(0.000000000021)}{14,100,000000} = \frac{(3.5 \times 10^7)(2.1 \times 10^{-11})}{1.41 \times 10^{10}}$$

$$= \frac{(3.5)(2.1)}{1.41} \times 10^{7-11-10}$$

$$= 5.21 \times 10^{-14}$$

If there are more than 4 non-zero digits in the number, then, approximate it to three significant digits. This means, one integral part and two decimal digits.

Practice Problems

(1) Convert $552,000,000$ into scientific notation.

(2) Convert 0.000076 into scientific notation.

(3) Convert 3.33×10^{-6} into decimal form.

(4) Convert 7.845×10^9 into decimal form.

(5) Write $36,750,338$ in scientific notation.

(6) Write 1.23×10^{-8} in decimal form.

(7) The following table gives revenues for the Department of Education in the school-year 2007-2008:

Source	Amount(in dollars)
Federal	3.95×10^{15}
State	2.34×10^{10}
Local	3.39×10^{5}

Write the amount of dollars obtained from each source in decimal form.

(8) The radius of a certain atom is 0.000000000023.Write this in scientific notation.

(9) The mean distance of two planets is $4,467,500,000$ mils.Write this in scientific notation.

(10) The mass a a neutron is 1.655×10^{-21} mg. Write this in decimal form.

(11) The distance light travels in a year is 6.73×10^{12} miles.Write this in decimal form.

(12) Simplify:

$$\frac{(3.23 \times 10^{-6})(1.42 \times 10^{9})}{2.5 \times 10^{5}}$$

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