



Math Application

Scientific Notation

In science one encounters very large and very small numbers. After all, the universe is a very big place, and it is composed of very small particles. Therefore scientists use scientific notation to represent these numbers with greater ease. Scientific notation incorporates the concept of significant figures. Only significant digits are represented in scientific notation.

Rules for Stating a Value in Scientific Notation

1. In Scientific Notation a number is expressed in the form $m \times 10^n$.
2. m is a value greater than or equal to 1 and less than 10 and n is an integer.
3. All digits of m must be significant.
4. The exponent n represents the number of places the decimal moved to the left (+) or right (-).

Here are some numbers expressed in standard and scientific notation.

$$\begin{array}{lll} 1\ 000\ 000\ 000 = 1 \times 10^9 & 0.0000000040 = 4.0 \times 10^{-9} & 107\ 500 = 1.075 \times 10^5 \\ 12\ 500 = 1.25 \times 10^4 & 0.023 = 2.3 \times 10^{-2} & 0.000000976 = 9.76 \times 10^{-7} \end{array}$$

Addition and Subtraction: Only numbers with the same value of n may be added and subtracted. All other numbers must be expanded first.

$$\begin{array}{ll} 1.25 \times 10^4 + 2.30 \times 10^4 = 3.55 \times 10^4 & 1.25 \times 10^4 + 5.00 \times 10^2 \neq 6.25 \times 10^4 \\ (12\ 500 + 23\ 000 = 35\ 500) & (12\ 500 + 500 \neq 62\ 500) \end{array}$$

Multiplication and Division: When multiplying two numbers, multiply m_1 by m_2 then add n_1 to n_2 to get a result. Adjust m if it becomes a value greater than or equal to 10. When dividing two numbers, divide m_1 by m_2 then subtract n_2 from n_1 to get a result. Adjust m if it becomes a value less than one.

$$\begin{array}{l} (9.76 \times 10^{-7}) \times (1 \times 10^9) = (9.76 \times 10^2) \\ m_1 \times m_2 = (9.76 \times 1); n_1 + n_2 = (-7 + 9) \end{array}$$

$$\begin{array}{l} (2.3 \times 10^{-2}) \div (4.0 \times 10^{-9}) = (5.8 \times 10^6)^* \\ m_1 \div m_2 = (2.3 \div 4.0); n_1 - n_2 = (-2 - (-9)) \\ \text{*Because this would make the answer } 0.575 \times 10^7, \text{ we must adjust the decimal one} \\ \text{place to the right: } 5.75 \times 10^6. \text{ Also, because} \\ \text{our answer can contain no more significant} \\ \text{figures than our least precise starting value,} \\ \text{we must round the answer to: } 5.8 \times 10^6. \end{array}$$