Review of Scientific Notation

What is Scientific Notation?

We sometimes need to deal with numbers that have many leading or trailing zeros. This can be time consuming and error prone. An elegant solution is Scientific Notation (SN), which takes advantage of the power of exponents. To avoid possible confusion, the constant term is always shown with exactly one digit to the left of the decimal point. For example, the number 23,000 is written as 2.3×10^4 rather than 23×10^3, and the number 4,602,000,000,000 is written as 4.602×10^{12}.

1. Move the decimal point until there is only one significant (non-zero) digit to the left of the point. This digit must be ($1 \leq \mathrm{M} < 10$).
2. Multiply this new term to the power of 10 that is equal to the number of digits the decimal point was moved.

$$100 = 1 \times 10^2 \qquad \textit{Decimal point moves 2 places to the left.}$$
$$2,000 = 2 \times 10^3 \qquad \textit{Decimal point moves 3 places to the left.}$$
$$4,000,000,000 = 4 \times 10^9 \qquad \textit{Decimal point moves 9 places to the left.}$$

Very small values are shown using negative exponents.

$$.0002 = 2 \times 10^{-4} \qquad \textit{Decimal point moves 4 places to the right.}$$
$$.00054 = 5.4 \times 10^{-4} \qquad \textit{Decimal point moves 4 places to the right.}$$

Adding and Subtracting (with Like Exponents)

If the numbers have the same exponent, use the Distributive Property of Algebra.

1. Add or subtract the constant terms.
2. Keep the value of the exponent.

$$\begin{aligned} (4 \times 10^8) + (3 \times 10^8) &= (4+3) \times 10^8 &&= 7 \times 10^8 \\ (6.2 \times 10^{-3}) - (2.8 \times 10^{-3}) &= (6.2 - 2.8) \times 10^{-3} &&= 3.4 \times 10^{-3} \end{aligned}$$

Adding and Subtracting (with Unlike Exponents)

If the exponents are not the same, they must be made the same before the values can be added or subtracted. Move the decimal points and adjust the exponents until all exponents are the same.

$$\begin{aligned} (4 \times 10^6) + (3 \times 10^5) &= (4 \times 10^6) + (0.3 \times 10^6) \\ &= (4 + 0.3) \times 10^6 \\ &= 4.3 \times 10^6 \end{aligned}$$

Multiplying and Dividing

Values in Scientific Notation can be multiplied and divided whether or not the exponents are the same. We simply add the exponents to multiply, or subtract the exponents to divide.

Multiplying

1. Multiply the constant terms.

2. Add the exponents.

$$
\begin{aligned}
(3 \times 10^6) \times (2 \times 10^3) &= (3 \times 2) \times 10^9 \\
(3 \times 10^6 m) \times (2 \times 10^3 m) &= (3 \times 2) \times 10^9 m^2 \quad \textit{With units in meters.}
\end{aligned}
$$

Dividing

1. Divide the constant terms
2. Subtract the exponent of the divisor (denominator) from the exponent of the dividend (numerator).

$$\frac{(6 \times 10^8)}{(2 \times 10^5)} = \left(\frac{6}{2}\right) \times 10^{(8-5)} = (3 \times 10^3)$$

Warning: Watch for the Karat! Sometimes we use the karat symbol ^ (Shift-6 on a computer keyboard) to indicate an exponent. For example: 2^4 $= 2^4 = 2 \times 2 \times 2 \times 2 = 16$.