Scientific Notation

Very large and very small numbers can be expressed more conveniently using scientific notation.

Scientific notation follows the general format of $N \times 10^m$

N is a decimal with a single-digit whole part (so it is between 1 and 10), and m is the exponent that expresses how many decimal places the point must be moved to show the magnitude of the number.

For example,

$82,673.78 = 8.267378 \times 10^4$

You can interpret the statement by noting that:

$10^4 = 10 \times 10 \times 10 \times 10 = 10,000$

$8.267378 \times 10,000 = 82,673.78$

Multiplying by a multiple of 10 is as easy as moving a decimal place. 10^4 can translate into moving the decimal place in scientific notation 4 places to the right to get the original number:

8.267378×10^4

$=82.67378 \times 10^3$

$=826.7378 \times 10^2$

$=8,267.378 \times 10^1$

$=82,673.78$

The decimal moved 4 places to get back to the original value of 82,673.78

The same rules apply in the opposite direction:

$0.000756 = 7.56 \times 10^{-4}$

The -4 just means you move the decimal in the opposite direction:

7.56×10^{-4}

$=0.756 \times 10^{-3}$

$=0.0756 \times 10^{-2}$

$=0.00756 \times 10^{-1}$

$=0.000756$

Addition and Subtraction

To add or subtract numbers written in scientific notation, you need to first ensure the exponents are the same. Then you simply evaluate the numbers and carry the exponent through.

For example:

a. $(7.4 \times 10^3) + (2.1 \times 10^3) = 9.5 \times 10^3$

b. $(4.31 \times 10^4) + (3.9 \times 10^3)$
$= (4.31 \times 10^4) + (0.39 \times 10^4)$
$= 4.70 \times 10^4$

Multiplication and Division

To multiply numbers with scientific notation, we multiply the numbers but then add the exponents. For division, we divide the numbers but then subtract the exponents. Both rules are just applications of the normal mathematical rules for powers.

For example:

a. $(8.0 \times 10^4) \times (5.0 \times 10^2)$
$= (8.0 \times 5.0) \times (10^{4+2})$
$= 40 \times 10^6$
$= 4.0 \times 10^7$

b. $\frac{6.9 \times 10^7}{3.0 \times 10^{-5}}$
$= \frac{6.9}{3.0} \times \left(10^{7-(-5)}\right)$
$= 2.3 \times 10^{12}$