Exponential Notation

Very large and very small numbers — such as 4,650,000,000 and 0.00000032 — are cumbersome to write. It is more convenient to express such numbers in exponential, or scientific, notation; that is, to express numbers as a power of 10

Exponential, or scientific, notation

4,650,000,000 can also be written as 4.65×10^9

Coefficient: Always a number between 1 and 9

Exponent: May be positive or negative

Steps:

1. Determine the coefficient by moving the decimal point so there is only one nonzero digit to the left of it.

$$0.00000032$$

In this example, we can see the coefficient is 3.2.

2. Determine the exponent by counting the number of places that the decimal point was moved. If it was moved to the left, the exponent is positive. If it was moved to the right, the exponent is negative.

$$0.00000032 = 3.2 \times 10^{-7}$$

In this example, the decimal point was moved 7 places to the right, so the exponent is -7.

Let's do another example, where we are working with a large number instead of a very small one. The same rules apply, but our exponent value will be positive, rather than negative

$$870,000,000 = 8.7 \times 10^8$$

To multiply numbers written in exponential notation, multiply the coefficients and add the exponents. For example:

$$(3 \times 10^4) \times (2 \times 10^3) = 6 \times 10^7$$

To divide numbers written in exponential notation, divide the coefficients and subtract the exponents. For example:

$$(3 \times 10^5) / (2 \times 10^3) = 1.5 \times 10^2$$

Microbiologists use exponential notation in many situations. For instance, exponential notation is used to describe the number of microorganisms in a population. Such numbers are often very large. Another application of exponential notation is to express concentrations of chemicals in a solution. Such numbers are often very small. Converting from one unit of measurement frequently requires the use of exponents, e.g. There are 1 X 10_6 μL in one L.

Additional practice:

1. Write each of the following numbers in exponential notation:

780,000,000,000

0.00987

1/100

1/19,000

2. Work the following problems:

$(1 \times 10^{-2}) \times (1 \times 10^{-2}) \times (1 \times 10^{-1})$

$(4.8 \times 10^{-2}) \times (1 \times 10^{-4}) \times (2.5 \times 10^{-1})$

$(2.45 \times 10^{-6}) / (1.5 \times 10^{-3})$

$(5.30 \times 10^{-4}) / (1.03 \times 10^{-6})$

3. If there are 1×10^{6} μL in one L, and if there is 1×10^{3} L in 1 mL, how many μL are in 1 mL?

4. If a microorganism is 2.5 μm long, how long is this organism in m? Express your answer in scientific notation.