SCIENTIFIC NOTATION AND GREEK PREFIXES FOR POWERS OF TEN

For those students and adults interested in STEM topics (science, technology, engineering, and mathematics) one of the first things they must become familiar with is Scientific Notation and the Greek prefixes for various powers of ten. These topics are usually acquired in high school and early college. Our purpose here is to quickly summarize them.

SCIENTIFIC NOTATION:

The idea here is that any number can be represented as a fraction times a power of ten. Thus, for example,-

567343=5.67343 x 10^5 and 0.00173382=1.73382 x 10^-3

We call the power of ten representation its scientific notation. It is particularly handy for expressing very large and very small numbers when only a few digits are known from a scientific experiment. To get to the original number one simply moves the decimal point of the fraction by the indicated power of ten. Let us carry out in scientific notation the time it takes for light to travel from the sun to the earth. We know the distance to the sun is D=1.496 x 10^8 km and the speed of light is c=2.99792 x 10^5 km/sec. So we have in scientific notation-

T=D/c=(1.496/2.99792) x 10^3=4.9901 x 10^2 sec

This elapsed time is a little over eight minutes.

Complicated expressions involving both multiplication and division are handled by adding together the exponents of ten and multiplying things
by the quotient of the fractions. Consider the following-

N=3.56x10^4*1.89x10^6/3.97x10^5=(3.56*1.89/3.97)x10^5=1.694x10^5

GREEK PREFIXES FOR POWERS OF TEN:

The unit of length and time in the SI system are the meter(m) and the second (s), respectively. Often in scientific measurements m and s are far removed from unity. This makes the scientific notation extremely useful since we can describe expressions such as a 10^-9 m as a nanometer and 10^-6 sec as a microsecond. The use of such Greek prefixes to describe measurements as powers of 10 extends from 10^24 down to 10^-24. Here is the prefix list-

10^24 yotta	10^21 zetta	10^18 exa	10^15 peta	10^12 tera
10^9 giga	10^6 mega	10^3 kilo	10^1 deca	10^-1 deci

10^-2 centi 10^-3 milli 10^-6 micro 10^-9 nano 10^-12 pico

10^-15 fempto 10^-18 atto 10^-21 zepto 10^-24 yocto

As another example of the use of scientific notation including
Greek prefixes consider find the length in kilometers of a light year. By definition one light year(ly)equals the distance light will travel in one year . That is-

1 ly=one year * speed of light=(365.25*24*3600)s*299792.458 km/s
=9.46073 x 10^12km=9.46 terameters

The nearest star to earth is Alpha Centauri. It is 4.367 light years away. Measured in km the distance is 9.46073x10^12*4.367=4.13 x 10^13 km. It would take some 43 years for a space ship moving at one tenth the speed of light to get there.

The diameter of the hydrogen atom is about 1.06x10^-10 meters. Here 10^-10=1Angstrom=0.1nanometer. The original definition of one meter was made in 1793 and is defined as one ten millionth of the distance from the north pole to the earth's equator. That is, the earth's radius is close to-

$$R=4x10^7/(2\pi)=6366 \text{ km}$$

We note that the meter represents an anthropomorphic measure since it is close to the average western European male height of 1.77 m.

U.H.Kurzweg
January 23, 2021
Gainesville,Florida